Public Works and Government Services Canada

Requisition Number: EZ108-162126/A

MERX I.D. Number: _____

SPECIFICATIONS for:

Esquimalt Graving Dock
South Substation Switchgear Replacement (SSSR)

Issued For Tender

January 28, 2016

Project No: R.062548.002

APPROVED BY:

Regional Manager, AES — Date: FEB. 2/2016

Construction Safety Coordinator — Date: 2016-02-02

TENDER:

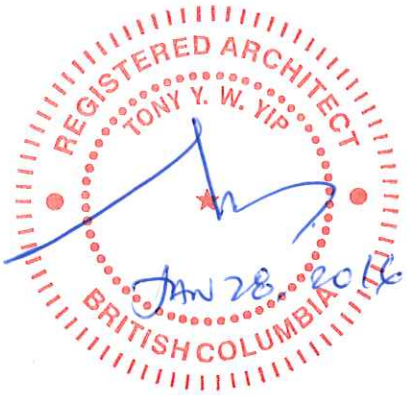
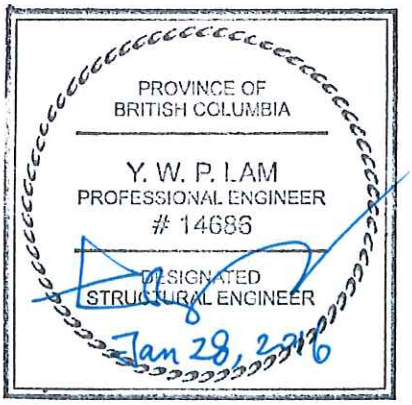
Project Manager — Date: 2016-01-29

TITLE DRAWING

5000 SERIES - SOUTH SIDE SUBSTATION REPLACEMENT PROJECT (SSSR)

ELECTRICAL

CONSULTANTS – SEAL & SIGNATURE

Discipline	**Seal/Signature/Date**
Architectural (Prime) Chernoff Thompson Architects	
Structural CWMM Consulting Engineers Ltd.	
Mechanical JM Bean & Company	

Electrical
Applied Engineering Solutions Ltd.

JAN 2 8 2016

Civil
Westbrook Consulting Ltd.

END OF SECTION 00 01 07

1.0 GENERAL

1.1 RELATED SECTIONS

.1 General Instructions Section 01 11 55

1.2 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this contract comprises of the construction of the new South Side Substation reconfiguration of the existing South Side Substation, electrical ductbank and cabling, and the associated civil work at Esquimalt Graving Dock, 825 Admirals Road, Victoria, B.C. Work is comprised of tasks listed in Section 01 11 55 item 1.2.1.

1.3 CONTRACT METHOD

1 Construct work under lump sum contract.

1.4 WORK BY OTHERS

.1 Co-operate with other Contractors on site in carrying out their respective works and carry out instructions from the Departmental Representative.

.2 Coordinate work with that of other Contractors. If any part of the work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Departmental Representative, in writing, any defects which may interfere with proper execution of work.

1.5 WORK SEQUENCE

.1 Construct work in stages to accommodate continued use of premises in immediate surrounding areas.

.2 Do not close public usage of facilities such as roadways, walkways and building access until alternate usage has been provided.

.3 Closing of Road during weekday is not permitted. Work that requires closing of road may be permitted during weekend subject to coordination with EGD.

.4 Maintain fire access/control as shown in Appendix L of the specifications.

.5 Existing adjacent storage shed at EGD will be removed by EGD prior to handover of the project worksite to the contractor.

.6 Work to follow electrical and construction sequencing such that construction will not affect the continual operation of the existing south side substation until switch over of services.

.7 New Substation must be completed, commissioned, and operational before removal of existing switchgear within the existing substation.

1.6 CONTRACTOR USE OF PREMISES

.1 Co-ordinate use of premises under direction of Departmental Representative.

.2 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Departmental Representative.

.3 At completion of operations the condition of existing work which is specified to remain must be equal to or better than that which existed before new work started.

.4 Obtain and pay for use of additional storage or work areas needed for work under this contract.

.5 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.

1.7 OWNER OCCUPANCY

.1 During the entire construction period, the owner will have access to adjacent areas including the emergency generator building, compressor room and the existing south side substation within the project work site for execution of normal operations.

.2 Co-operate with Departmental Representative in scheduling operations to minimize conflict and to facilitate Owner usage of adjacent areas including those mentioned in 1.7.1. In the event of a conflict the contractor will accommodate changes to their operations to minimize interference with owner operations.

1.8 OWNER AND CONTRACTOR RESPONSIBILITIES

.1 Owner Responsibilities:

.1 Arrange for delivery of up-to-date utility location information, safety requirements, and any site specific work policies that may have changed or were not available at the time of specification and drawing preparation.

.2 Contractor Responsibilities:

.1 Designate Submittals and delivery date for major building components and equipment in progress schedule.

.2 Review all submittals and contract requirements. As soon as it becomes apparent, submit to Departmental Representative written and verbal notification of observed discrepancies or problems anticipated due to non-conformance with Contract Documents.

.3 Provide any installation inspections required by public safety authorities and authority having jurisdiction.

.4 Receive and unload products and equipment at site.

.5 Review deliveries jointly with Departmental Representative, record shortages, and damaged or defective items.

.6 Handle product at site, including uncrating and storage.

.7 Protect product from damage.

.8 Repair or replace items damaged by Contractor or subcontractor on site (under their control).

1.9 EXISTING SERVICES

.1 Notify Departmental Representative of intended interruption of services and obtain required permission. Where work involves breaking into or connecting to existing services, contractor shall submit a request to the Departmental Representative a minimum of 4 weeks prior to the event. The contractor will not proceed until approval has been granted. The Departmental Representative will make all reasonable efforts to accommodate the request; however the Departmental Representative will not accept delay charges should the request not be accepted.

.2 Minimize duration of interruptions, and where required, provide temporary services to maintain critical systems.

.3 Provide alternative routes for personnel and vehicular traffic.

.4 Establish location and extent of service lines in area of work before starting work. Notify Departmental Representative of findings.

.5 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including mechanical, plumbing, power and communication services. Adhere to approved schedule and provide notice to affected parties.

.6 Provide temporary services, when directed by Departmental Representative to maintain critical systems.

.7 Provide adequate bridging over trenches which cross roads or walkways to permit normal traffic.

.8 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing

.9 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in a manner approved by authorities having jurisdiction.

.10 Record locations of maintained, re-routed and abandoned service lines.

.11 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures. Maintain construction barriers as delineated in the drawings during the full duration of the contract.

END OF SECTION 01 11 00

1.0 GENERAL

1.1 CODES, BYLAWS, STANDARDS

.1 Perform work in accordance with the National Building Code of Canada (NBCC) 2010, and other indicated Codes, Construction Standards and/or any other Code or Bylaw of local application.

.2 Comply with applicable local bylaws, rules and regulations enforced at the location concerned.

.3 Meet or exceed requirements of Contract documents, specified standards, codes and referenced documents.

.4 In any case of conflict or discrepancy, the most stringent requirements shall apply.

1.2 DESCRIPTION OF WORK

.1 Work under this Contract comprises, but is not limited to, the provision of all labour, materials, services and equipment necessary for the construction of the new South side and interior reconfiguration of existing South Side substation, electrical duct bank and cabling, and associated on-site and off-site civil work as fully described in the Tender Documents.

1.3 CONTRACT DOCUMENTS

.1 The Contract documents, drawings and specifications are intended to complement each other.

.2 Drawings are, in general, diagrammatic and are intended to indicate the scope and general arrangement of the work.

1.4 TIME OF COMPLETION

.1 Commence work immediately upon official notification of acceptance of offer and complete the project within fourty-eight (48) weeks after contract award.

1.5 HOURS OF WORK

.1 All work shall be executed during the normal operating hours of Esquimalt Graving Dock: Monday through Friday – 07:00 to 20:00 hours, excluding statutory holidays.

.2 Notify Departmental Representative of all after hours work, including weekends and holidays.

.3 All work conducted during and outside of normal operating hours will be subject to restrictions outlined in sections 01 14 00 and 01 51 00, including security arrangements and within the local township of Esquimalt Noise Bylaw.

1.6 WORK SCHEDULE

.1 Carry out work as follows:

.1 Within 10 working days after Contract award, submit Bar (GANTT) chart as per specification sections 01 32 16.07 Construction Progress Schedule Bar (GANTT) chart. Indicate the following:

.1 Submission of shop drawings, product data, MSDS sheets and samples.

.2 Commencement and completion of work of each section of the specifications or trades for each phase as outlined.

.3 Final completion date within the time period required by the Contract documents.

.2 Do not change approved Schedule without notifying Departmental Representative.

.3 Interim reviews of work progress based on work schedule will be conducted monthly by Departmental Representative and schedule updated by Contractor in conjunction with and to approval of Departmental Representative. A copy of the updated schedule will be provided with the monthly progress payment.

1.7 DIVISION OF SPECIFICATIONS

.1 The specifications are subdivided in accordance with the current 6-digit National Master Specifications System.

.2 A division may consist of the work of more than 1 subcontractor. Responsibility for determining which subcontractor provides the labour, material, equipment and services required to complete the work rests solely with the Contractor.

.3 In the event of discrepancies or conflicts when interpreting the drawings and specifications, the specifications govern.

1.8 INVESTIGATION OF HIDDEN SERVICES

.1 Contractor to provide ground penetrating radar (GPR) scan prior to coring or cutting of existing concrete slab or wall and prior to excavation work, to verify existing hidden or underground services or structural reinforcement.

1.9 DOCUMENTS REQUIRED

.1 Maintain one copy each of the following at the job site:

.1 Contract drawings.
.2 Contract specifications.
.3 Addenda to Contract documents.
.4 Copy of work schedule.
.5 Reviewed shop drawings.
.6 Change orders.
.7 Other modifications to Contract.
.8 Field test reports.
.9 Reviewed samples.
.10 Manufacturer’s installation and application instructions.
.11 One set of record drawings and specifications for “as-built” purposes.
.12 National Building Code of Canada 2010.
.13 Current construction standards of workmanship listed in technical Sections.
.14 Building Safety Plan.
.15 Building Permit
.16 Request for Information (RFI)
.17 Contemplated Change Notices
.18 WHMIS Documents
.19 Site Instructions
.20 Contractor’s Health and Safety Plan, including map to nearest hospital.

1.10 REGULATORY REQUIREMENTS

.1 Building Permit

.1 Obtain and pay for Building Permit, Occupancy Permit, Certificates, Licenses and other permits required by City of Victoria, provincial or federal authorities to complete the work.

.2 Provide inspection authorities with plans and information required for issue of acceptance certificates.

.3 Furnish inspection certificates in evidence that the work installed conforms with the requirements of the authority having jurisdiction.

.4 Comply with conditions as stated in Standard Acquisition Clauses and Conditions (SACC) Manual.

1.11 CONTRACTOR'S USE OF SITE

.1 Use of site:

.1 Exclusive and complete for execution of work.

.2 Assume responsibility for assigned premises for performance of this work.

.3 Be responsible for coordination of all work activities on site, including the work of other contractors engaged by the Departmental Representative.

.4 Provide security of Contractor's work site and all Contractors and Subcontractor's equipment and material. Secure Contractor's work site at the end of each work day.

.5 Perform work in accordance with the Contract documents. Ensure work is carried out in accordance with indicated phasing.

.6 Do not unreasonably encumber site with material or equipment

.7 Any area of the Esquimault Graving Dock property to which access is restricted by sign is a secured or restricted area and shall not be entered.

.8 Do not obstruct access to other areas outside of the Contractor's work site. Maintain overhead clearances, keep roadways and walkways clear,and maintain routes for emergency response vehicles.

.2 Perform work in accordance with Contract documents. Ensure work is carried out in accordance with approved schedules.

.3 Do not unreasonably encumber site with material or equipment.

.4 Coordinate work in particular crossover of underground duct banks entering and under the building.

1.12 EXAMINATION

.1 Examine site and be familiar and conversant with existing conditions likely to affect work.

1.13 EXISTING SERVICES

.1 Where Work involves breaking into or connecting to existing services, carry out work as directed in Section 01 14 00 – Work Restrictions.

.2 Record locations of maintained, re-routed and abandoned service lines.

.3 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.14 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space, and in accordance with manufacturer's recommendations for safety, access and maintenance.

.3 Inform Departmental Representative at least 48 hours prior to impending installation and obtain approval for actual location.

.4 Submit field drawings or shop drawings to indicate the relative position of various services and equipment when required by the Departmental Representative and/or as specified.

1.15 CUTTING AND PATCHING

.1 Cut existing surfaces as required to accommodate new work.

.2 Remove items so shown or specified.

.3 Do not cut, bore, or sleeve load-bearing members.

.4 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.

.5 Fit work airtight to pipes, sleeves, ducts and conduits.

.6 Conceal pipes, ducts and wiring in raised floors (if any), wall and ceiling construction of finished areas except where indicated otherwise.

.7 Patch and make good surfaces cut, damaged or disturbed, to Departmental Representative's approval. Match existing material, colour, finish and texture.

.8 Making good is defined as matching construction and finishing materials and the adjacent surfaces such that there is no visible difference between existing and new surfaces when viewed from 1.5 metres in ambient light, and includes painting the whole surface to the next change in plane.

1.16 SETTING OUT OF WORK

1 Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.

.2 Provide devices needed to lay out and construct work.

.3 Supply such devices as templates required to facilitate Departmental Representative's inspection of work.

1.17 ACCEPTANCE OF SUBTRADES

1 Each trade shall examine surfaces prepared by others and job conditions which may affect his work, and shall report defects to the General Contractor. Commencement of work shall imply acceptance of prepared work or substrate surfaces.

1.18 QUALITY OF WORK

.1 Ensure that quality workmanship is performed through use of skilled tradesmen, under supervision of qualified journeyman.

.2 The workmanship, erection methods and procedures to meet minimum standards set out in the National Building Code of Canada 2010 and Construction Standards as specified herein.

.3 In cases of dispute, decisions as to standard or quality of work rest solely with the Departmental Representative, whose decision is final.

1.19 WORKS COORDINATION

.1 Coordinate work of sub-trades:
- .1 Designate one person to be responsible for review of contract documents and shop drawings and managing coordination of Work.

.2 Convene meetings between subcontractors whose work interfaces and ensure awareness of areas and extent of interface required.
- .1 Provide each subcontractor with complete plans and specifications for Contract, to assist them in planning and carrying out their respective work.
- .2 Develop coordination drawings when required, illustrating potential interference between work of various trades and distribute to affected parties.
  - .1 Pay particularly close attention to overhead work above ceilings and within or near to building structural elements.
  - .2 Identify on coordination drawings, building elements, services lines, rough-in points and indicate location services entrance to site.
  - .3 Facilitate meeting and review coordination drawings. Ensure subcontractors agree and sign off on drawings.
  - .4 Publish minutes of each meeting.
  - .5 Plan and coordinate work in such a way to minimize quantity of service line offsets.
  - .6 Submit copy of coordination drawings and meeting minutes to Departmental Representative for information purposes.

.3 Submit shop drawings and order of prefabricated equipment or rebuilt components only after coordination meeting for such items has taken place.

.4 Work cooperation:
- .1 Ensure cooperation between trades in order to facilitate general progress of Work and avoid situations of spatial interference.
- .2 Ensure that each trade provides all other trades reasonable opportunity for completion of Work and in such a way as to prevent unnecessary delays, cutting, patching and removal or replacement of completed work.
- .3 Ensure disputes between subcontractors are resolved.
- .4 Departmental Representative is not responsible for, or accountable for extra costs incurred as a result of Contractor's failure to coordinate Work.
- .5 Maintain efficient and continuous supervision.

1.20 APPROVAL OF SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

.1 In accordance with Section 01 33 00, submit the requested shop drawings, product data, MSDS sheets and samples indicated in each of the technical Sections.

.2 Allow sufficient time for the following:

.1 Review of product data.
.2 Approval of shop drawings.
.3 Review of re-submission.
.4 Ordering of approved material and/or products. Refer to individual technical sections of specifications.

1.21 PROJECT MEETINGS

.1 Contractor shall arrange project meetings and assume responsibility for setting times and distributing minutes. Meeting frequency should be at a minimum of once every 2 weeks throughout the contract period.

.2 The contractor shall record the meeting minutes and distribute meeting agenda 5 days prior to the meeting to Departmental Representative and all other parties as directed by Departmental Representative for review.

.3 Meeting room will be provided by EGD in one of their facilities on site.

1.22 TESTING AND INSPECTION

.1 Particular requirements for inspection and testing to be carried out by testing service or laboratory approved by the Departmental Representative are specified in Sections 01 45 00.

.2 The Contractor will appoint and pay for the services of testing agency or testing laboratory as specified, and where required for the following:
.1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
.2 Inspection and testing performed exclusively for Contractor's convenience.
.3 Testing, adjustment and balancing of mechanical and electrical equipment and systems.
.1 Mill tests and certificates of compliance.
.2 Tests specified in the contract documents to be carried out by Contractor which may be under the Departmental Representative's supervision.

.3 Within 15 working days after Contract award provide a list of proposed testing services or testing laboratories for Departmental Representative’s approval.

.4 The Departmental Representative may require, and pay for, additional inspection and testing services not included in paragraph 1.22.2.

.5 Where tests or inspections by designated testing laboratory reveal work is not in accordance with the Contract requirements, Contractor shall pay costs for additional tests or inspections as the Departmental Representative may require to verify acceptability of corrected work.

.6 Contractor shall furnish labour and facilities to carry out specified testing and notify Departmental Representative in advance of planned testing.

.7 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.

.8 Pay costs for uncovering and making good work that is covered before required inspection or testing is completed and approved by Departmental Representative.

.9 Provide Departmental Representative with digital copy of testing laboratory reports as soon as they are available.

1.23 RELICS & ANTIQUITIES

.1 Relics and antiquities and items of historical or scientific interest shall remain property of Department. Protect such articles and request directives from Departmental Representative.

.2 Give immediate notice to Departmental Representative if evidence of archaeological discoveries are encountered during excavation/construction, and await Departmental Representative's written instructions before proceeding with work in this area.

1.24 SECURITY CLEARANCES

.1 Personnel employed on this project will be subject to security check. Obtain requisite clearances, as instructed, for each individual required to enter the premises.

.2 Personnel will need to obtain security clearance at start of project and be provided with a pass which must be worn at all times.

.3 Contractor shall be fully responsible for securing the premises and its contents throughout construction period.

1.25 SURVEYING

.1 All construction layout and final accurate construction records shall be the responsibility of the contractor and shall be set by a licensed land surveyor in the Province of British Columbia..

.2 Contractor to submit name of licensed land surveyor to Departmental Representative during first project meeting (startup meeting).

.3 Contractor to provide survey data in accordance with EGD Standards for Survey (See Appendix F).

1.26 AS-BUILT DOCUMENTS

.1 The Departmental Representative will provide 5 sets of drawings and 5 sets of specifications, including 1 set of drawings and specification for "as-built" purposes.

.2 Keep one set of current white prints of all contract drawings and all addenda, revisions, clarifications, change orders, and reviewed shop drawings in the site office; and have them available at all times for inspection by the Consultant.

.3 As the Work progresses, maintain accurate records to show all deviations from the Contract documents. Note on as-built specifications, drawings and shop drawings as changes occur.

.4 Provide accurate as-built drawings by a qualified professional surveyor identifying the various elements shown on the drawings in the requested format.

.5 At completion of the Work, transfer all deviations, including those called up by addenda, revisions, clarifications, shop drawings and change order, to a set of Issued for Construction drawings. Submit the 'red-marked' as-built set to the Departmental

Representative in hard copy with contractor's review stamp and date confirming that the set submitted are a true record of "as-built" information.

.6 Refer to Section 01 78 00 – Close-out Submittals.

1.27 CLEANING

.1 Refer to Section 01 74 11 - Cleaning.

1.28 DUST CONTROL

.1 Provide temporary dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of work and public.

.2 Protect furnishings and equipment within work area with 0.102 mm thick polyethylene film during construction. Remove film during non- construction hours and leave premises in clean, unencumbered and safe manner for normal daytime function.

.3 Maintain and relocate protection until such work is complete.

1.29 ENVIRONMENTAL PROTECTION

.1 Prevent extraneous materials from contaminating air beyond construction area, by providing temporary enclosures during work.

.2 Do not dispose of waste or volatile materials into water courses, storm or sanitary sewers.

.3 Ensure proper disposal procedures in accordance with all applicable territorial regulations.

.4 Refer to other sections and Appendix H for site specific environmental requirements and risk management procedures.

1.30 MAINTENANCE MATERIALS, SPECIAL TOOLS AND SPARE PARTS

.1 Specific requirements for maintenance materials, tools and spare parts are specified in individual technical sections of specifications.

1.31 ADDITIONAL DRAWINGS

.1 The Departmental Representative may furnish additional drawings for clarification. These additional drawings have the same meaning and intent as if they were included with drawings referred to in the Contract Documents.

.2 Departmental Representative will furnish up to a maximum of five (5) sets of Contract Documents for use by the Contractor at no additional cost. Should more than five (5) sets of documents be required, the Departmental Representative can provide them at additional cost.

1.32 BUILDING SMOKING ENVIRONMENT

.1 Smoking within the building and within 7.5m of all air intakes is not permitted.

.2 A 'No Smoking' sign to be put up by Contactor at the project area.

.3 Smoking is only allowed in designated locations within EGD. "Designated Smoking Areas" are at the discretions of the Director of EGD and Departmental Representative.

1.33 SYSTEM OF MEASUREMENT

.1 The metric system of measurement (SI) will be employed on this Contract.

1.34 FAMILIARIZATION WITH SITE

.1 Before submitting tender, visit site as indicated in tender documents and become familiar with all conditions likely to affect the cost of the work.

1.35 SUBMISSION OF TENDER

.1 Submission of a tender is deemed to be confirmation of the fact that the Tenderer has analyzed the Contract documents and inspected the site, and is fully conversant with all conditions.

1.36 COST BREAKDOWN

.1 Before submitting the first progress claim, submit a breakdown of the Contract price in detail as directed by the Departmental Representative and aggregating Contract price. After approval, the cost breakdown will form the basis of progress payments.

.2 Within 10 days after award of contract, provide a monthly cash flow projection for the whole contract period in detail as directed by Departmental Representative. Contractor should provide a monthly update of the cash flow projection according to the actual work schedule and progress payment submitted.

1.37 SUBSTANTIAL COMPLETION

.1 Substantial completion includes commissioning and functional use of the project in addition to the requirements under other terms and conditions of the contract listed in the Standard Acquisition Conditions and Clauses.

END OF SECTION 01 11 55

1.0 GENERAL

1.1 FACILITY OPERATIONS AND SECURITY PROCEDURES

.1 All construction staff shall become thoroughly familiar with and abide by all provisions and requirements of Esquimalt Graving Dock's Operations, Safety and Security Procedures and Restrictions.

- .1 The parking area(s) to be used by construction employees will be designated by the Director of EGD. Parking in other locations will be prohibited and vehicles may be subject to removal.
- .2 Speed limits are posted on site. Failure to abide by site speed limits may result in removal of employee and vehicle from site.
- .3 EGD is under surveillance at all times on closed circuit TV. All activities are monitored internally for security purposes. All construction staff should be advised that they are being recorded.
- .4 Director of EGD may require photographs to be taken for construction identification badges used to access the site.
- .5 EGD enforces a zero tolerance policy for the following misbehavior:
  - .1 Appear to be under the influence of alcohol, drugs or narcotics.
  - .2 Behave in an unusual or disorderly manner.
  - .3 In possession of contraband.

.2 Cooperate with and coordinate construction/demolition activities with Esquimalt Graving Dock.

1.2 ACCESS AND EGRESS

.1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant Federal, municipal, provincial and other regulations.

.2 Provide hoarding, and scaffolding plan for Departmental Representative to review 5 business days prior to installation.

.3 Refer to Appendix K of this specification for designated Site Access, Site Office and Laydown Area.

.4 Refer to Appendix L of this specification for emergency access route to be maintained.

1.3 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.

.2 Maintain existing services to building and provide for personnel and vehicle access.

.3 Where security is reduced by work, provide temporary means to maintain security as per Departmental Representatives direction.

.4 Closures: protect work temporarily until permanent enclosures are completed.

.5 The whole dockyard will be occupied by the public, government staff and other PWGSC construction contractors and other dock lease operations during entire construction period.

.6 Coordinate with Departmental Representative in scheduling operations to minimize conflict and to facilitate use of space.

1.4 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

.1 Execute work with least possible interference or disturbance to Esquimalt Graving Dock's operations, occupants, and normal use of existing South Substation, Compressor and Standby Generator Buildings. Arrange with Departmental Representative to facilitate execution of work.

1.5 EXISTING SERVICES SHUT DOWNS

.1 Notify Departmental Representative and utility companies of any intended interruption of services. Obtain applicable permission as required.

.2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 4 weeks of notice for necessary interruption of civil, mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.

.1 Optimize and plan shut-downs so that services are restored in time for normal facility operation hours. Coordinate all shut-downs with utility providers and facility users.

.1 EGD will expect complete South Side wide electrical shut downs (2 or more) and shorter partial South Side electrical shutdowns (possibly 5 to 10 or more).

.2 For shut downs during the migration of loads that will affect air services and the dock pumping and other dock lease operations, contractor to transfer one load at a time to mitigate interruptions.

.3 The Contractor shall give priority to the installation, testing, and commissioning of the new plant in such a way as to minimize or eliminate site-wide shutdowns during this project.

.4 Shut down will be required for Domestic Water System for new piping tie-ins.

.5 Shut down will be required for new tie-in for 100 u/g Sanitary Sewer.

.6 Shut down will be required for new tie-in for 150 u/g Storm Sewer.

.7 Shut down of existing exhaust fan in the adjacent existing sub-station when installing new sheet metal work for re-ducting existing exhaust discharge up to roof

.8 Limit the down time for each mechanical and plumbing system shut down item 4 to 7 above to a few hours and maximum one day.

.9 Review the foregoing shutdown requirements; submit within the Project Schedule suggested time and duration for any planned outages. The Departmental Representative will review the proposed schedule and may stipulate changes. Any such changes, modifications, or revisions shall not be the basis for any extra claim.

.10 After review of draft schedule, contractor to submit firm time and duration for each outage required. Include all input from the Departmental Representative as described above.

.11 Shutdowns or disruptions to standby power on the South Side are expected. These shutdowns are to be closely coordinated with the Departmental Representative to ensure that appropriate backup measures are taken in the event of a utility failure.

.2 Contractor shall be held responsible for damages to facility equipment as the result of service shut-downs.

.3 Contractor shall be held responsible for any and all unscheduled shut-downs of building utilities and services.

.4 Contractor will not be allowed to connect to Departmental Representative's existing data and communication services.

.5 Submit a "Fire Alarm Bypass" request to Departmental Representative 3 working days in advance for approval.

.6 Obtain permission from Departmental Representative for access to restricted areas outside the construction zones 5 working days in advance.

.3 Provide for personnel and vehicular traffic (if required) and barricade or walkway delineation for personnel walkways.

.4 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.6 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions. Smoking is not permitted within Esquimalt Graving Dock.

1.7 NOISE CONTROL

.1 Comply with applicable provincial by-law for noise control.

END OF SECTION 01 14 00

1.0 GENERAL

.1 This section includes the following:

.1 Coordination of Work under administration of Departmental Representative.

.2 Scheduled Pre-construction and Site meetings.

.3 Project planning and construction schedule.

.4 Site progress monitoring and control.

1.1 DESCRIPTION

.1 Coordinate and manage construction schedule, submittals, use of site, temporary utilities, construction facilities, quality control program, and construction Work, with progress of Work of subcontractors, other contractors and Departmental Representative.

1.2 PRE-CONSTRUCTION MEETING

.1 Pre-construction Meeting:

.1 Within 10 days after award of Contract, Departmental Representative will arrange pre-construction meeting.

.2 Departmental Representative, Contractor and members of EGD Project Management Office (PMO) will be in attendance.

.3 Departmental Representative will establish time and location of meeting and notify parties concerned.

.4 The Departmental Representative will chair the meeting, record minutes and issue minutes to all attendees.

.1 Agenda of meeting is generally as follows:

.1 Project team introductions including main construction personnel, PWGSC personnel, EGD and consultants.

.2 Communication protocol for submittals.

.3 Start date on site.

.4 EGD security requirements.

.5 Construction Organization and Start-up:

.1 Comply with Departmental Representative's allocation of mobilization areas of site; for access, traffic, and parking facilities.

.2 During construction coordinate use of site and facilities through Departmental Representative's procedures for intra-project communications: Submittals, reports and records, schedules, coordination of drawings, recommendations, and resolution of ambiguities and conflicts.

.3 Comply with instructions of Departmental Representative for use of temporary utilities and construction facilities.

.4 Coordinate layout of construction barrier with Departmental Representative.

1.3 PROJECT PLANNING

.1 Plan construction activities, submittals and field reviews ahead of time for efficient and effective management to ensure timely completion of project.

1.4 SCHEDULES

.1 Submit preliminary construction schedule to Departmental Representative 10 days after contract award and prepare for review during Pre-Construction meeting.

.2 After review, revise and resubmit schedule. Submit final full schedule within 2 weeks after Pre-Construction meeting.

.3 During progress of Work revise and resubmit with the monthly progress payment draw to the Departmental Representative.

1.5 CONSTRUCTION SITE MEETINGS

.1 During course of Work and prior to project completion, Departmental Representative will request Construction Site Meetings as required.

.2 Contractor will record minutes of meetings and circulate to attending parties and affected parties not in attendance.

.3 Agenda to include following:

- .1 Review, approval of minutes of previous meeting.
- .2 Review of Work progress since previous meeting.
- .3 Field observations, problems, conflicts.
- .4 Review of Health and Safety including any incidents, near misses, and WorkSafe BC visits.
- .5 Problems which impede construction schedule.
- .6 Review of off-site fabrication delivery schedules.
- .7 Corrective measures and procedures to regain projected schedule.
- .8 Revision to construction schedule.
- .9 Progress schedule, during succeeding work period.
- .10 Review submittal schedules: expedite as required.
- .11 Update of Red Line As-Built Drawings.
- .12 Maintenance of quality standards.
- .13 Review proposed changes for effect on construction schedule and on completion date.
- .14 Other business.

1.6 WALK THROUGH FIELD REVIEW BY DEPARTMENTAL REPRESENTATIVE

.1 Departmental Representative will carry out the following:

- .1 Walk-through field review of the work with contractor's representatives.
- .2 Preparation and distribution of the Walk-through field review Reports. Reports will be distributed within 5 days of field review.

1.7 SUBMITTALS

.1 Submit requests for interpretation of Contract Documents, and obtain instructions through Departmental Representative utilizing Request for Information (RFI) forms.

.2 Process substitutions through Departmental Representative.

.3 Deliver closeout submittals for review and inspections, for transmittal to Departmental Representative.

1.8 CLOSEOUT PROCEDURES

.1 Notify Departmental Representative when Work is considered Substantially Complete. Contractor to prepare list of defects, deficiencies and incomplete work prior to inspection by Departmental Representative. Follow procedures as outlined in Section 01 78 00 – Closeout Submittals.

.2 Accompany Departmental Representative on preliminary inspection to determine items listed for completion or correction.

.3 Comply with Departmental Representative's instructions for correction of items of Work listed in deficiency list.

.4 Notify Departmental Representative of instructions for completion of items of Work determined in Departmental Representative's final inspection.

END OF SECTION 01 31 00

1.0 GENERAL

1.1 ADMINISTRATIVE

.1 Schedule and administer site meetings throughout the progress of the work on a regular basis or at the call of Departmental Representative.

.2 Prepare and distribute agenda at least three (3) days prior to the meetings.

.3 Distribute written notice of each meeting seven (7) days in advance of meeting date to Departmental Representative.

.4 Meeting space can be held in the meeting room in the EGD administration building or operation trailer. Book meeting room in advance through Departmental Representative.

.5 Preside at meetings.

.6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.

.7 Reproduce and distribute copies of minutes within five (5) days after meetings and transmit to meeting participants and affected parties not in attendance, Departmental Representative and Consultants.

.8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRE – CONSTRUCTION MEETING

.1 Within 15 days after award of Contract: Departmental Representative will request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Attendance will include, but is not limited to, the Departmental Representative, members of the EGD Project Management Office (PMO) and Contractor.

.3 Departmental Representative to establish time and location of preconstruction meeting, Contractor to notify parties concerned a minimum of 4 working days before meeting.

.4 Departmental Representative will chair the meeting, record minutes and issue minutes.

.5 Agenda to include:

- .1 Introduction of official representative of participants in the Work.
- .2 Start date on site.
- .3 Communication Protocol for submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 51 00 - Temporary Utilities.
- .5 EGD Security requirements.
- .6 Site safety in accordance with Section 01 56 00 - Temporary Barriers and Enclosures, Section 01 35 33 – Health and Safety Requirements.
- .7 Communication Protocol for proposed changes, change orders, procedures, approvals required.
- .8 Owner’s Work.

.9 Record drawings in accordance with Section 01 78 00 - Closeout Submittals.
.10 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
.11 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
.12 Monthly progress claims, administrative procedures, photographs, hold backs.
.13 Appointment of inspection and testing agencies or firms being submitted for Review of Surveyor.

1.3 PROGRESS MEETINGS

.1 During course of Work and two weeks prior to Project Completion, schedule progress meetings bi-weekly.

.2 Attendance to include but is not limited to Departmental Representatives, members of the EGD Project management Office (PMO) and Contractor.

.3 Contractor responsible to record minutes of meetings and circulate to attending parties and affected parties not in attendance within five (5) days after meeting.

.4 Record next meeting dates in the meeting minutes or notify parties minimum of seven (7) days in advance for other ad-hoc meetings.

.5 Agenda to include, at a minimum, the following:
.1 Review, approval of minutes of previous meeting.
.2 Review of Health and Safety including any incidents, near misses, and WorkSafe BC visits.
.3 Review of Work progress since previous meeting.
.4 Coordination discussions with EGD..
.5 Construction schedule review.
.6 Review of off-site fabrication delivery schedules.
.7 Corrective measures and procedures to regain projected schedule.
.8 Request for Information (RFI) log review.
.9 Engineering Disciplines Reviews.
.1 Architectural
.2 Structural
.3 Mechanical
.4 Electrical
.5 Civil
.10 Change order log review.
.11 Review submittal schedule.
.12 Review updated as built.
.13 Review and resolve site issues.
.14 New business.

1.0 GENERAL

1.1 DEFINITIONS

.1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.

.2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.

.3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.

.4 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.

.5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.

.6 Master Plan: summary-level schedule that identifies major activities and key milestones.

.7 Milestone: significant event in project, usually completion of major deliverable.

.8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

.9 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

1.2 REQUIREMENTS

.1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.

.2 Plan to complete Work in accordance with prescribed milestones and time frame.

.3 Limit activity durations to maximum of approximately 15 working days, to allow for progress reporting.

.4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

.5 Clearly show sequence and interdependence of construction activities and indicate:
- .1 Start and completion of all items of Work, their major components and interim milestones completion dates.
- .2 Activities for procurement, delivery, installation and completion of each major piece of equipment, materials and other supplies, including:
  - .1 Time for submittals, re-submittal and review.
  - .2 Time for fabrication and delivery of manufactured products for Work.
  - .3 Interdependence of procurement and construction activities.
- .3 Include sufficient detail for project activities to assure adequate planning and execution of work. Activities should generally range in duration from 3 to 15 days each.
- .4 Provide level of detail for project activities such that sequence and interdependency of Contract tasks are demonstrated to allow coordination and control of project activities. Show continuous flow from left to right.
- .5 Ensure activities with no float are calculated and clearly indicated on logical CPM construction network system as being whenever possible, continuous series of activities throughout length of project to form critical path.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit to Departmental Representative within 28 working days after Award of Contract Project schedule in form of Bar (GANTT) Chart for planning, monitoring and reporting of project progress.

1.4 REVIEW OF THE SCHEDULE

.1 Allow 10 working days for Departmental Representative to review proposed schedule. Make necessary changes to proposed schedule within 5 days.

.2 Submit letter ensuring the schedule has been prepared in coordination with major subcontractors and suppliers.

.3 Promptly provide additional information to validate practicability of schedule as required by Departmental Representative.

.4 Submittal of Schedule indicates that it meets Contract Requirements and will be executed generally in sequence.

1.5 COMPLIANCE WITH SCHEDULE

.1 Comply with reviewed schedule.

.2 Proceed with significant changes and deviations from schedule sequence of activities which cause delay only after review by Departmental Representative.

.3 Identify activities that are behind schedule and causing delay. Provide recovery plan and schedule to regain slippage.
- .1 Recovery plan and schedule must include:
  - .1 An increase of personnel on the site for effective activities or work packages.
  - .2 An increase in materials and equipment.
  - .3 Additional work shifts, longer hours.
  - .4 Resource loaded schedule indicating the items noted above.

1.6 PROJECT SCHEDULE

.1 Develop detailed Project Schedule derived from Master Plan.

.2 Ensure detailed Project Schedule that shows milestone and activity types and expand from the following items:
- .1 Award.
- .2 Shop Drawings, Samples and Approvals.
- .3 Permits.
- .4 Mobilization.
- .5 Mock-ups and Approvals.
- .6 Procurement.
- .7 Construction.
- .8 Installation.
- .9 Site Works.
- .10 Training.
- .11 Shutdowns for systems indicated in Section 01 14 00 1.5 Existing Services Shut Downs.
- .12 Commissioning.

1.7 PROJECT SCHEDULE REPORTING

.1 On an ongoing basis, schedule on job site must show “progress to date”. Arrange participation on and off site of subcontractor and suppliers, as and when necessary, for purpose of network planning, scheduling, updating and progress monitoring. Inspect Work with Departmental Representative at least once monthly to establish progress on each current activity shown on applicable networks.

.2 Maintain a daily log of progress of the work:
- .1 Submit daily force report to Departmental Representative daily prior to noon the following day indicating:
  - .1 Total number of personnel on site.
  - .2 Major subcontractors on site listed by trade.
  - .3 Major equipment on site, i.e. excavators, cranes, drills.
  - .4 Concrete volumes.
  - .5 Visitors to site.
  - .6 Weather
  - .7 Documents required from Departmental Representative to Contractor to maintain.

.3 Perform schedule update monthly dated on last working day of the month. Update to reflect activities completed to date, activities in progress, logic and duration changes.

.4 Do not automatically update actual start and finish dates by using default mechanisms found in project management software.

.5 Requirements for monthly progress monitoring and reporting are basis for progress payment request.

.6 Submit monthly schedule updates with the progress payment request.

.7 Submit monthly written reports based on schedule, showing Work to Date performed, comparing work progress planned and presenting current forecasts. Report must

summarize progress, defining problem areas and anticipated delays with respect to Work Schedule, and critical paths. Explain alternatives for possible schedule recovery to mitigate any potential delay. Include in report:

.1 Description of progress made.

.2 Pending items and status of: Permits, shop drawings, samples, mockups, deliveries, change orders, possible time extension.

.3 Status of Contract Completion Date and Milestones.

.4 Current and Anticipated problem areas, potential delays and corrective measures.

.8 Submit weekly 3 week look ahead schedule to Departmental Representative on each Friday of the Week indicating the planned tasks of the next three week period.

1.8 PROJECT MEETINGS

.1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

.2 Weather related delays with their remedial measures will be discussed and negotiated.

END OF SECTION 01 32 16.07

1.0 GENERAL

1.1 ADMINISTRATIVE

.1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are coordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.

.10 Keep one reviewed copy of each submission on site.

.11 Do not proceed with work until relevant submissions are reviewed by Departmental Representative.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 When specified in the Contract document, submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia of Canada.

.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.4 Allow 10 days for Departmental Representative's review of each submission, unless noted otherwise.

.5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.

.6 Make changes in shop drawings as Departmental Representative may require consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.

.7 Accompany submissions with transmittal letter, in duplicate, containing:
- .1 Date.
- .2 Project title and number.
- .3 Contractor's name and address.
- .4 Identification and quantity of each shop drawing, product data and sample.
- .5 Other pertinent data.

.8 Submissions include:
- .1 Date and revision dates.
- .2 Project title and number.
- .3 Name and address of:
  - .1 Subcontractor.
  - .2 Supplier.
  - .3 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
  - .1 Fabrication.
  - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.
  - .7 Operating weight.
  - .8 Wiring diagrams.
  - .9 Single line and schematic diagrams.
  - .10 Relationship to adjacent work.

.9 After Departmental Representative's review, distribute copies.

.10 Submit electronic copy of shop drawings for each requirement requested in specification sections and as Departmental Representative may reasonably request.

.11 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

.12 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
- .2 Testing must have been within 3 years of date of contract award for project.

.13 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
- .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
- .2 Certificates must be dated after award of project contract complete with project name.

.14 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.
- .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

.15 Submit copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.

.16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.17 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.

.18 Delete information not applicable to project.

.19 Supplement standard information to provide details applicable to project.

.20 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, electronic copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.21 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.
- .1 This review shall not mean that Departmental Representative approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of Construction and Contract Documents.
- .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

.22 Shop drawings format larger than 11" x17" (275mm x 430mm) must be submitted with hardcopies together with electronic format. Submit sufficient copies such that Departmental Representative will keep 5 copies plus contractor's distribution and maintenance manual.

.23 Electronic submissions will only be reviewed and returned electronically. No hardcopies will be returned to contractor.

.24 All electronic submissions to be uploaded to Document Control System Collaborative site hosted by PWGSC. Contractor will be responsible for becoming familiar with and utilizing the system.

1.3 SAMPLES

.1 Submit for review samples in duplicate as required in respective specification Sections. Label samples with origin and intended use.

.2 Deliver samples prepaid to Departmental Representative's business address.

.3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.

.4 Where colour, pattern or texture is criterion, submit full range of samples.

.5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.

.6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.

.7 Reviewed and accepted samples will be kept onsite and will become standard of workmanship and material against which installed Work will be verified.

1.4 MOCK-UPS

.1 Erect mock-ups in accordance with 01 45 00 - Quality Control.

1.5 PHOTOGRAPHIC DOCUMENTATION

.1 Submit electronic copy of colour digital photography in jpg format, standard resolution monthly with progress statement and as directed by Departmental Representative.

.2 Project identification: name and number of project and date of exposure indicated.

.3 Viewpoints and their locations as reasonably determined by Departmental Representative.

.4 Provide photographic documentation of adjacent existing conditions prior to commencement of construction for determining and accidental damage as a result of contractor's work.

.5 Frequency of photographic documentation: monthly as directed by Departmental Representative.

.1 Upon completion of: demolition, framing and services before concealment of Work, and as directed by Departmental Representative.

1.6 CERTIFICATES AND TRANSCRIPTS

.1 Submit electronic copies of test results and inspection reports required as noted in each section of specifications.

END OF SECTION 01 33 00

1.0 REFERENCES

.1 Canada Labour Code: Part 11-Occupational Health and Safety

.2 Canada Occupation Health and Safety Regulations

.3 Canadian Environmental Protection Act, S.C.

.4 Controlled Products Regulations

.5 Inter-provincial Movement of Hazardous Waste Regulations

.6 National Fire Code of Canada

.7 Transportation and Dangerous Goods Act

.8 Canadian Council of Ministers of the Environment (CCME) Documentation.

.9 Canadian Council of Ministers of the Environment. Canada-Wide Standards for Petroleum Hydrocarbons (PHCs) in Soil.

.10 Land Development Guidelines for the Protection of Aquatic Habitat. DFO and MOE.

.11 All other federal and provincial acts, regulations, guidelines and standards as applicable to the Work.

1.1 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submittals for Progress Meetings: make submittals at least **24 hours** prior to scheduled progress meetings as follows:

- .1 Updated progress schedule detailing activities. Include review of progress with respect to previously established dates for starting and stopping various stages of Work, major problems and action taken, injury reports, equipment breakdown, and material removal.
- .2 Copies of transport manifests, trip tickets, and disposal receipts for waste materials removed from work area, and for materials brought onto the site.
- .3 Summary (to the date of Progress Meeting) of all waste materials removed from work area, and for materials brought onto the site.

.3 Site Layout: within 5 days after date of Notice to Proceed and prior to mobilization to site, submit site layout drawings showing existing conditions and facilities, construction facilities and temporary controls provided by Contractor including following:

- .1 Equipment and personnel decontamination areas.
- .2 Means of ingress, egress and temporary traffic control facilities. Refer to Section 01 56 00 - Temporary Barriers and Enclosures for traffic control.
- .3 Equipment and material staging areas.
- .4 Soil stockpile areas.
- .5 Exclusion Zones and other zones specified in Contractor's site-specific Health and Safety Plan.

.4 Provide documentation that disposal facilities have the required authorization and approval to accept the classes of material encountered at the site.

1.2 REGULATORY REQUIREMENTS

.1 Provide erosion and sediment control in accordance with Section 01 35 43 – Environmental Procedures.

.2 Comply with federal, provincial, and local anti-pollution laws, ordinances, codes, and regulations when disposing of waste materials, debris, and rubbish.

.3 Provide evidence that disposal facilities have the required authorization and approval to accept the classes of material encountered at the site.

.4 Work to meet or exceed minimum requirements established by federal, provincial, and local laws and regulations which are applicable.

.5 Contractor: responsible for complying with amendments as they become effective.

.6 In event that compliance exceeds scope of work or conflicts with specific requirements of contract notify Departmental Representative immediately.

1.3 SEQUENCING AND SCHEDULING

.1 Do not commence Work involving contact with potentially contaminated materials until decontamination facilities are operational and approved by Departmental Representative.

1.4 EQUIPMENT DECONTAMINATION FACILITY

.1 Prior to commencing work involving equipment contact with potentially contaminated materials, construct equipment decontamination facility.

.2 Provide, operate, and maintain necessary equipment, pumps, and piping required to collect and contain equipment decontamination wastewater and sediment and transfer materials to approved storage facilities.

1.5 SOIL STOCKPILING FACILITIES

.1 Provide, maintain, and operate storage/stockpiling facilities as required. Locate stockpiles to minimize handling. Location to be coordinated with and approved by Departmental Representative.

.2 Install 6-mil polyethylene liner below proposed stockpile locations to prevent contact between stockpile material and ground.

.3 Equip facility with tarps capable of covering all stockpiled material until Departmental Representative advises Contractor to dispose of material off site.

.4 Contractor will ensure that stockpiled material not being actively added to is covered with tarps and these are secured so they do not blow off. Any stockpiles not fully covered by tarps must be fixed immediately.

1.6 DRUMS

.1 Storage of Liquid Waste: 200 L steel drums meeting Transportation and Dangerous Goods Act, closable lids, complete with labels for marking contents and date filled.

1.7 VEHICULAR ACCESS AND PARKING

.1 Maintenance and Use:

.1 Prevent contamination of access roads or other areas of the site not within the work area as defined by the Contractor and Departmental Representative. Immediately scrape up debris or material from access roads if it is suspected to be contaminated as determined by Departmental Representative; transport and place into designated area approved by Departmental Representative. The roads shall be kept free of dust and debris - cost of road cleaning is incidental to the work. Washing down roads to storm drains is not permitted.

.2 Departmental Representative may collect soil samples for chemical analyses from traveling surfaces of constructed and existing access routes prior to, during, and upon completion of Work. Excavate and dispose of clean soil contaminated by Contractor's activities at no additional cost to PWGSC.

1.8 DUST AND PARTICULATE CONTROL

.1 Execute Work by methods that minimize raising dust.

.2 The contractor will provide a formal site specific Dust and Particulate Control Plan to Departmental Representative for review and approval prior to the initiation of work. This plan will include an occupational monitoring program that addresses potential occupational dust & particulate exposures and complies with the applicable regulations.

.3 The contractor will maintain monitoring records on site and available for inspection during the life of the project. These monitoring records will be consolidated and submitted to the Departmental Representative upon completion of the project.

.4 The Contractor, Departmental Representative all have the right to provide stop work notice or require workers in the active work zone to don a half face respirator. Implement and maintain dust and particulate control measures immediately on initiation of work.

.5 Provide positive means to prevent airborne dust from dispersing into atmosphere. Use water for dust and particulate control.

.6 Use chemical means for water misting system for dust and particulate control only with Departmental Representative’s prior written approval.

.7 As minimum, use appropriate covers on trucks hauling fine or dusty material. Use watertight vehicles to haul wet materials.

.8 Prevent dust from spreading to adjacent property sites.

.9 Departmental Representative will stop work at any time when Contractor's control of dusts and particulates is inadequate for wind conditions present at site, or when air quality monitoring indicates that release of fugitive dusts and particulates into atmosphere equals or exceeds specified levels, or when adjacent properties complain of dust.

.10 If Contractor's dust and particulate control is not sufficient for controlling dusts and particulates into atmosphere, stop work. Contractor must discuss procedures that Contractor proposes to resolve problem. Make necessary changes to operations prior to resuming excavation, handling, processing, or other work that may cause release of dusts or particulates.

1.9 POLLUTION CONTROL

.1 Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious toxic substances and pollutants produced by construction operations.

.2 Be prepared to intercept, clean up, and dispose of spills or releases that may occur whether on land or water. Maintain materials and equipment required for cleanup of spills or releases readily accessible on site.

.3 Promptly report spills and releases potentially causing damage to environment to:

.1 Departmental Representative.

.2 Authority having jurisdiction or interest in spill or release including conservation authority, water supply authorities, drainage authority, road authority, and fire department.

.3 Owner of pollutant, if known.

.4 Person having control over pollutant, if known.

.4 Contractor to ascertain hazards involved, precautions required, and measures used in cleanup or mitigating action.

.5 Provide spill response materials including containers, adsorbent materials, shovels, and personal protective equipment. Make spill response materials available at all times in which hazardous materials or wastes are being handled or transported. Spill response materials must be compatible with the types of material being handled.

.6 Take immediate action using available resources to contain and mitigate effects on environment and persons from spill or release.

1.10 EQUIPMENT DECONTAMINATION

.1 The contractor will develop a site specific decontamination plan and submit the plan to the Departmental Representative for review and approval prior to the initiation of work.

.2 Commence work involving equipment contact with potentially contaminated material only after Equipment Decontamination Facility is operational.

.3 Decontaminate equipment after working in potentially contaminated work areas and prior to subsequent work or travel on clean areas.

.4 Perform equipment decontamination on all vehicles and equipment that contact impacted soil.

.5 Collect all washwater for treatment.

.6 All equipment and vehicles must be free of contaminated material and/or soil prior when entering a “clean zone” at the site. The Departmental Representative reserves the right to inspect and request additional cleaning of equipment and vehicles if deemed unacceptable.

.7 Maintain inspection record on site which includes: equipment descriptions with identification numbers; time and date of decontamination; and name of inspector with comment stating that decontamination was performed and completed.

.8 Departmental Representative will have the right to inspect each piece of equipment after decontamination and prior to removal from site and/or travel on clean areas. Departmental Representative will have the right to require additional decontamination to be completed if deemed necessary.

.9 Take appropriate measures necessary to minimize drift of mist and spray during decontamination including provision of wind screens.

.10 Collect decontamination wastewaters and sediments which accumulate on equipment decontamination area. Transfer wastewaters to designated wastewater storage tank.

.11 Furnish and equip personnel engaged in equipment decontamination with protective equipment including suitable disposable clothing, respiratory protection, and face shields.

.12 Have on hand sufficient pumping equipment, of adequate pumping capacity and associated machinery and piping in good working condition for ordinary emergencies, including power outage, and competent workers for operation of pumping equipment. Maintain piping and connections in good condition and leak-free.

1.11 WATER CONTROL

.1 The Contractor will develop a site specific Water Management Plan and submit the plan to the Departmental Representative for review and approval prior to the initiation of work.

.2 Maintain excavations free of water and snow.

.3 Protect site from puddling or running water. Grade site to drain, if required.

.4 Prevent surface water runoff from leaving work areas.

.5 Do not discharge decontaminated water, surface water runoff, or groundwater which may have come in contact with potentially contaminated material. All waste water must be directed to storage tanks.

.6 Prevent precipitation from infiltrating or from directly running off stockpiled materials. Cover stockpiled materials with an impermeable liner during periods of work stoppage including at end of each working day and as directed by Departmental Representative.

.7 Provide, operate, and maintain necessary equipment appropriately sized to keep excavations, staging pads, and other work areas free from water or snow.

.8 Contain water from stockpiled materials. Transfer potentially contaminated surface waters to wastewater storage tanks.

.9 Have on hand sufficient pumping equipment, machinery, and tankage in good working condition for ordinary emergencies, including power outage, and competent workers for operation of pumping equipment.

.10 Contain and collect wastewaters and transfer such collected wastewaters to wastewater storage tanks.

.11 The contractor will be responsible for all sampling and analytical costs associated with the Water Management Plan.

1.12 DEWATERING

.1 Dewater without limitation, excavations and work areas.

.2 Sample/analyze water generated from dewatering activities and treat to meet required discharge or disposal criteria. Sample and analytical procedures are to meet acceptable regulatory standards.

.3 The contractor must obtain written approval from the Departmental Representative prior to discharging any waters generated from dewatering activities. To gain approval, the contractor must provide analytical data (including the sampling analytical and sampling methodology) to support meeting the applicable discharge criteria of the receiving environment.

.4 The contractor will be responsible for all sampling and analytical costs associated with the Dewatering process.

1.13 EROSION AND SEDIMENT CONTROL

.1 Plan and execute construction/remediation by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas, from stockpiles, staging areas, and other work areas. Prevent erosion and sedimentation.

.2 Minimize amount of bare soil exposed at one time. Stabilize disturbed soils as quickly as practical. Strip vegetation, regrade, or otherwise develop to minimize erosion. Remove accumulated sediment resulting from construction activity from adjoining surfaces, drainage systems, and water courses, and repair damage caused by soil erosion and sedimentation as directed by Departmental Representative.

.3 Provide and maintain temporary measures which may include, silt fences, hay or straw bales, ditches, geotextiles, drains, berms, terracing, riprap, temporary drainage piping, sedimentation basins, vegetative cover, dikes, and other construction required to prevent erosion and migration of silt, mud, sediment, and other debris off site or to other areas of site where damage might result, or that might otherwise be required by Laws and Regulations. Make sediment control measures available during construction. Place silt fences and/or hay or straw bales in ditches to prevent sediments from escaping from ditch terminations.

.4 Hay or Straw Bale: wire bound or string tied; securely anchored by at least 2 stakes or rebar’s driven through bale 300 mm to 450 mm into ground; chinked (filled by wedging) with hay or straw to prevent water from escaping between bales; and entrenched minimum of 100 mm into ground.

.5 Silt Fence: assembled, ready to install unit consisting of geotextile attached to driveable posts. Geotextile: uniform in texture and appearance, having no defects, flaws, or tears that would affect its physical properties; and contain sufficient ultraviolet ray inhibitor and stabilizers to provide minimum 2-year service life from outdoor exposure. Installation must be as directed in the document “Land Development Guidelines for the Protection of Aquatic Habitat”.

.6 Net Backing: industrial polypropylene mesh joined to geotextile at both top and bottom with double stitching of heavy-duty cord, with minimum width of 750 mm.

.7 Posts: sharpened wood, approximately 50 mm square, protruding below bottom of geotextile to allow minimum 450 mm embedment; post spacing 2.4 m maximum. Securely fasten each post to geotextile and net backing using suitable staples.

.8 Plan construction procedures to avoid damage to work or equipment encroachment onto water bodies or drainage ditch banks. In event of damage, promptly take action to mitigate effects. Restore affected bank or water body to existing condition.

.9 Installation:

.1 Construct temporary erosion control items as indicated. Actual alignment and/or location of various items as directed by Departmental Representative.

.2 Do not construct bale barriers and silt fence in flowing streams or in swales.

.3 Check erosion and sediment control measures weekly after each rainfall; during prolonged rainfall check daily.

.4 Bales and/or silt fence may be removed at beginning of work day, replace at end of work day.

.5 Whenever sedimentation is caused by stripping vegetation, regrading, or other development, remove it from adjoining surfaces, drainage systems, and watercourses, and repair damage as quickly as possible.

.6 Prior to or during construction, Departmental Representative may require installation or construction of improvements to prevent or correct temporary conditions on site. Improvements may include berms, mulching, sediment traps, detention and retention basins, grading, planting, retaining walls, culverts, pipes, guardrails, temporary roads, and other measures appropriate to specific condition. Temporary improvements must remain in place and in operation as necessary or until otherwise directed by Departmental Representative.

.7 Repair damaged bales, end runs, and undercutting beneath bales.

.8 Unless directed by Departmental Representative, remove temporary erosion and sediment control devices upon completion of Work. Spread accumulated sediments to form a suitable surface for seeding or dispose of, and shape area to permit natural drainage to satisfaction of Departmental Representative. Materials once removed become property of Contractor.

.10 Do not disturb existing embankments or embankment protection, if present.

.11 Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

.12 If soil and debris from site accumulate in low areas, storm sewers, roadways, gutters, ditches, or other areas where in the Departmental Representative's determination it is undesirable, remove accumulation and restore area to original condition. This will include if requested by the Departmental Representative the provision of confirmatory analytical data of the applicable chemical/physical parameters showing the relevant area has not be impacted by the contamination from the soil or debris. The contractor will assume all costs associated with the sampling and analysis associated with this confirmatory sampling.

.13 The contractor will assume all costs for the disposal of all wastes types created during the life of the project.

1.14 PROGRESS CLEANING

.1 Maintain cleanliness of Work and surrounding site to comply with federal, provincial, and local fire and safety laws, ordinances, codes, and regulations.

.2 Co-ordinate cleaning operations with disposal operations to prevent accumulation of dust, dirt, debris, rubbish, and waste materials.

1.15 FINAL DECONTAMINATION

.1 Perform final decontamination of construction facilities, equipment, and materials which may have come in contact with potentially contaminated materials prior to removal from site.

.2 Perform decontamination as specified to satisfaction of Departmental Representative. Departmental Representative will direct Contractor to perform additional decontamination if required. This will include if requested by the Departmental Representative the provision of confirmatory analytical data of the applicable chemical/physical parameters showing the relevant area has not be impacted by the contamination from the soil or debris. The contractor will assume all costs associated with the sampling and analysis associated with this confirmatory sampling.

1.16 REMOVAL AND DISPOSAL

.1 Remove surplus materials and temporary facilities from site.

.2 Dispose of non-contaminated waste materials, litter, debris, and rubbish off site in accordance with Section 01 74 19 Waste Management and Disposal.

.3 Do not burn or bury rubbish and waste materials on site.

.4 Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner on to the property.

.5 Do not discharge wastes into streams or waterways.

.6 Dispose of following materials at appropriate off-site facility identified by Contractor and approved by Departmental Representative:

.1 Debris including excess construction material.
.2 Non-contaminated litter and rubbish.
.3 Disposable PPE worn during final cleaning.
.4 Lumber from decontamination pads, if necessary.

.7 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.

.8 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:

.1 Hazardous wastes recycled in manner constituting disposal;
.2 Hazardous waste burned for energy recovery;
.3 Lead-acid battery recycling.

1.17 RECORD KEEPING

.1 Maintain bills of ladings for a minimum of 365 days from date of shipment or longer period required by applicable law or regulation.

END OF SECTION 01 35 13.43

1.0 GENERAL

1.1 REFERENCES

.1 Government of Canada.
- .1 Canada Labour Code - Part II
- .2 Canada Occupational Health and Safety Regulations.

.2 National Building Code of Canada (NBC 2010):
- .1 Part 8, Safety Measures at Construction and Demolition Sites.

.3 Canadian Standards Association (CSA as amended):
- .1 CSA Z797-2009 Code of Practice for Access Scaffold
- .2 CSA S269.1-1975 (R2003) Falsework for Construction Purposes
- .3 CSA S350-M1980 (R2003) Code of Practice for Safety in Demolition of Structures

.4 Fire Protection Engineering Services, HRSDC:
- .1 FCC No. 301, Standard for Construction Operations.
- .2 FCC No. 302, Standard for Welding and Cutting.

.5 American National Standards Institute (ANSI):
- .1 ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.

.6 Province of British Columbia:
- .1 Workers Compensation Act Part 3-Occupational Health and Safety.
- .2 Occupational Health and Safety Regulation

.7 Current B.C. Electrical Code

.8 EGD Environmental Best Management Practices in Appendix H.

1.2 RELATED SECTIONS

.1	Construction Progress Schedule Bar (GANTT) Chart	Section 01 32 16.7
.2	Submittal Procedures	Section 01 33 00
.3	Temporary Utilities	Section 01 51 00
.4	Temporary Barriers Enclosures	Section 01 56 00
.5	Asbestos abatement Intermediate Precautions	Section 02 82 00.02
.6	Lead Base Paint Abatement Intermediate Precautions	Section 02 83 11

1.3 WORKERS' COMPENSATION BOARD COVERAGE

.1 Comply fully with the Workers' Compensation Act, regulations and orders made pursuant thereto, and any amendments up to the completion of the work.

.2 Maintain Workers' Compensation Board coverage during the term of the Contract, until and including the date that the Certificate of Final Completion is issued.

1.4 COMPLIANCE WITH REGULATIONS

.1 PWGSC may terminate the Contract without liability to PWGSC where the Contractor, in the opinion of PWGSC, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.

.2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations.

1.5 SUBMITTALS

.1 Submit to Departmental Representative submittals listed for review. In accordance with Section 01 33 00

.2 Work effected by submittal shall not proceed until review is complete.

.3 Submit the following:

.1 Health and Safety Plan.

.2 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.

.3 Copies of incident and accident reports.

.4 Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Material Information System (WHMIS) requirements.

.5 Emergency Procedures.

.4 The Departmental Representative will review the Contractor's site-specific project Health and Safety Plan and emergency procedures, and provide comments to the Contractor within 2 days after Receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.

.5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.

.6 Submission of the Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:

.1 Be construed to imply approval by the Departmental Representative.

.2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.

.3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

1.6 RESPONSIBILITY

.1 Assume responsibility as the Prime Contractor for work under this contract.

.2 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

.3 Comply with and enforce compliance by employees with safety requirements of Contract documents, applicable Federal, Provincial, Territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.7 HEALTH AND SAFETY COORDINATOR

.1 The Health and Safety Coordinator must:

.1 Be responsible for completing all health and safety training, and ensuring that personnel that do not successfully complete the required training are not permitted to enter the site to perform work.

.2 Be responsible for implementing, daily enforcing, and monitoring the site-specific Health and Safety Plan.

.3 Be on site during execution of work.

1.8 GENERAL CONDITIONS

.1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.

.2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.

.1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.

.2 Secure site at night time as deemed necessary to protect site against entry.

1.9 PROJECT/SITE CONDITIONS

.1 The Esquimalt Graving Dock is a dry dock and ship repair facility. It is an industrial site wherein industrial, manufacturing, fabrication, heavy construction, and like works are conducted by a variety of contractors and sub-trades for a variety of owners and/or the Departmental Representative.

.2 Work at site will involve a number of hazards known to PWGSC as noted in the Preliminary Job hazard Analysis in Appendix C attached. This site may involve contact with hazardous and/or toxic materials and substances such as bit not limited to:

.1 Waste sandblast grit.
.2 Paint spray, including solvents and mineral spirits.
.3 Waste water.
.4 Contaminated soils and debris
.5 Polychlorinate biphenyl (PCB)
.6 Creosote and creosote materials.
.7 Asbestos.
.8 Lead paints and other paints containing toxic substances such as arsenic and carcinogens.

.3 Other safety hazards or risks which may be encountered include, but are not limited to:

.1 Contact with traveling and mobile cranes, forklifts, manlifts and other motorized vehicles.
.2 Overhead hazards such as that created by material transported by cranes.
.3 Fall hazards.
.4 Drowning hazards.
.5 Confined space hazards.
.6 Electrical hazards.

.7 Contact with operating mechanical, electrical, electronic, pneumatic, thermal, and hydraulic machinery and equipment.

.8 Fire hazards.

1.10 REGULATORY REQUIREMENTS

.1 Comply with specified codes, acts, bylaws, standards and regulations to ensure safe operations at site.

.2 In event of conflict between any provision of the above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Departmental Representative will advise on the course of action to be followed.

1.11 WORK PERMITS

.1 Obtain specialty trade permits related to project before start of work.

1.12 FILING OF NOTICE

.1 The General Contractor is to complete and submit a Notice of Project as required by Provincial authorities.

.2 Provide copies of all notices to the Departmental Representative.

1.13 HEALTH AND SAFETY PLAN

.1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.

.2 Prepare and comply with a site-specific project Health and Safety Plan based on hazard assessment, including, but not limited to, the following:

.1 Primary requirements:

.1 Contractor's safety policy.

.2 Identification of applicable compliance obligations.

.3 Definition of responsibilities for project safety/organization chart for project.

.4 General safety rules for project.

.5 Job-specific safe work, procedures.

.6 Inspection policy and procedures.

.7 Incident reporting and investigation policy and procedures.

.8 Occupational Health and Safety Committee/Representative procedures.

.9 Occupational Health and Safety meetings.

.10 Occupational Health and Safety communications and record keeping procedures.

.2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.

.3 List hazardous materials to be brought on site as required by work.

.4 Indicate Engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.

.5 Identify personal protective equipment (PPE) to be used by workers.

.6 Identify personnel and alternates responsible for site safety and health.

.7 Identify personnel training requirements and training plan, including site orientation for new workers.

.3 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.

.4 Revise and update Health and Safety Plan as required, and re-submit to the Departmental Representative.

.5 Departmental Representative's review: the review of Health and Safety Plan by Public Works and Government Services Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

1.14 EMERGENCY PROCEDURES

.1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:
- .1 Designated personnel from own company.
- .2 Regulatory agencies applicable to work and as per legislated regulations.
- .3 Local emergency resources.
- .4 Departmental Representative and site staff.

.2 Include the following provisions in the emergency procedures:
- .1 Notify workers and the first-aid attendant, of the nature and location of the emergency.
- .2 Evacuate all workers safely.
- .3 Check and confirm the safe evacuation of all workers.
- .4 Notify the fire department or other emergency responders.
- .5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
- .6 Notify Departmental Representative and site staff.

.3 Provide written rescue/evacuation procedures as required for, but not limited to:
- .1 Work at high angles.
- .2 Work in confined spaces or where there is a risk of entrapment.
- .3 Work with hazardous substances.
- .4 Underground work.
- .5 Work on, over, under and adjacent to water.
- .6 Workplaces where there are persons who require physical assistance to be moved.

.4 Design and mark emergency exit routes to provide quick and unimpeded exit.

.5 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.

1.15 HAZARDOUS PRODUCTS

.1 Comply with requirements of Workplace Hazardous Materials Information system (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labeling and provision of material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.

.2 Where use of hazardous and toxic products cannot be avoided:
- .1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS documents as per Section 01 33 00.

.2 In conjunction with Departmental Representative, schedule to carry out work during "off hours" when Esquimalt Graving Dock Staff have left the building.

.3 Prvide adequate means of ventilation in accordance with Section 01 51 00.

1.16 ASBESTOS HAZARD

.1 Carry out work or demolition activities involving asbestos in accordance with applicable Provincial regulations.

1.17 REMOVAL OF LEAD-CONTAINING PAINTs

.1 All paints containing TCLP lead concentrations above 5 ppm are classified as hazardous.

.2 Carry out demolition activities involving lead-containing paints in accordance with applicable Provincial regulations.

1.18 ELECTRICAL SAFETY REQUIREMENTS

.1 Comply with authorities and ensure that, when installing new facilities or modifying existing facilities, all electrical personnel are completely familiar with existing and new electrical circuits and equipment and their operation.

.1 Before undertaking any work, coordinate required energizing and de-energizing of new and existing circuits with Departmental Representative.

.2 Maintain electrical safety procedures and take necessary precautions to ensure safety of all personnel working under this Contract, as well as safety of other personnel on site.

1.19 ELECTRICAL LOCKOUT

.1 Develop, implement and enforce use of established procedures to provide electrical lockout and to ensure the health and safety of workers for every event where work must be done on any electrical circuit or facility.

.2 Prepare the lockout procedures in writing, listing step-by-step processes to be followed by workers, including how to prepare and issue the request/authorization form. Have procedures available for review upon request by the Departmental Representative.

.3 Keep the documents and lockout tags at the site and list in a log book for the full duration of the Contract. Upon request, make such data available for viewing by Departmental Representative or by any authorized safety representative.

1.20 OVERLOADING

.1 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.

1.21 CONFINED SPACES

.1 Carry out work in confined spaces in compliance with Occupational Health and Safety Regulation, Part 9.

1.22 POWDER-ACTUATED DEVICES

.1 Use powder-actuated devices in accordance with ANSI A10.3 only after receipt of written permission from the Departmental Representative.

1.23 FIRE SAFETY AND HOT WORK

.1 Obtain Departmental Representative's authorization before any welding, cutting or any other hot work operations can be carried out on site.

.2 Hot work includes cutting/melting with use of torch, flame heating roofing kettles, or other open flame devices and grinding with equipment which produces sparks.

1.24 FIRE SAFETY REQUIREMENTS

.1 Store oily/paint-soaked rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

1.25 FIRE PROTECTION AND ALARM SYSTEM

.1 Fire protection and alarm systems shall not be:
- .1 Obstructed.
- .2 Shut off.
- .3 Left inactive at the end of a working day or shift.

.2 Do not use fire hydrants, standpipes and hose systems for purposes other than firefighting.

.3 Be responsible/liable for costs incurred from the fire department, the building owner and the tenants, resulting from false alarms.

1.26 UNFORESEEN HAZARDS

.1 Should any unforeseen or peculiar safety-related factor, hazard or condition become evident during performance of the work, immediately stop work and advise the Departmental Representative verbally and in writing.

1.27 POSTED DOCUMENTS

.1 Post legible versions of the following documents on site:
- .1 Health and Safety Plan.
- .2 Sequence of work.
- .3 Emergency procedures.
- .4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station,and the emergency transportation provisions.
- .5 Notice of Project.
- .6 Floor plans or site plans.
- .7 Notice as to where a copy of the Workers' Compensation Act and Regulations are available on the work site for review by employees and workers.
- .8 Workplace Hazardous Materials Information System(WHMIS) documents.
- .9 Material Safety Data Sheets (MSDS).
- .10 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.

.2 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.

.3 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

1.28 MEETINGS

.1 Attend health and safety pre-construction meeting and all subsequent meetings called by the Departmental Representative.

1.29 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.

.2 Provide Departmental Representative with written report of action taken to correct non-compliance with health and safety issues identified.

.3 The Departmental Representative may issue a "stop work order" if non-compliance of health and safety regulations is not corrected immediately or within posted time. The General Contractor/subcontractors will be responsible for any costs arising from such a "stop work order".

END OF SECTION 01 35 33

1.1 DEFINITIONS

.1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.

.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Prior to commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Departmental Representative. Environmental Protection Plan is to present comprehensive overview of known or potential environmental issues which must be addressed during construction.

.3 Address topics at level of detail commensurate with environmental issue and required construction tasks.

.4 Environmental protection plan to include:

- .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
- .2 Names and qualifications of persons responsible for manifesting contaminated soils and hazardous waste to be removed from site.
- .3 Names and qualifications of persons responsible for training site personnel.
- .4 Descriptions of environmental protection personnel training program.
- .5 Erosion and sediment control plan which identifies type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- .6 Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plans include measures to minimize amount of mud transported onto paved public roads by vehicles or runoff.
- .7 Spill Control Plan: including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .8 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .9 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, do not become air borne and travel off project site.

.10 Contaminant prevention plan that: identifies potentially hazardous substances to be used on job site; identifies intended actions to prevent introduction of such materials into air, water, or ground; and details provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

.11 Waste water management plan that identifies methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.

1.3 FIRES

.1 Fires and burning of rubbish on site is not permitted.

1.4 DISPOSAL OF WASTES

.1 Do not bury rubbish and waste materials on site.

.2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways.

1.5 DRAINAGE

.1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.

.2 Do not pump water containing suspended materials into waterways, sewer or drainage systems.

.3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.6 WORK ADJACENT TO WATERWAY

.1 Do not dump excavated fill, waste material or debris in waterways.

1.7 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this contract.

.2 Control emissions from equipment and plant to local authorities' emission requirements.

.3 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.8 HISTORICAL/ARCHAEOLOGICAL CONTROL

.1 Give immediate notice to the Departmental Representative if evidence of archaeological finds are encountered during construction and await written instructions before proceeding with work in the vicinity of any such finds.

.2 Relics, antiquities and items of historical or scientific interest shall remain the property of the Crown. Protect such articles and request directives from the Departmental Representative.

1.9 NOTIFICATION

.1 Departmental Representative will notify Contractor in writing of observed non-compliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.

.2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.

.3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.

.4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

1.10 SPILLS OR RELEASE OF DELETERIOUS SUBSTANCES

.1 Measures to be implemented to prevent, control or mitigate spills or release of deleterious substances:

.1 Contractor shall take due care to ensure no deleterious materials enter any surface drainage pathways located in the project area.

.2 Emergency response procedure for spills of deleterious substances must be in place. In the event of a spill, the contractor will immediately implement their Spill Response Protocol.

.3 The Contractor is responsible for all costs associated with a spill or release as a result of their actions. This will include but not limited costs of spill response equipment and materials, associated sampling, analysis and any required restoration of the impacted area.

.4 Response equipment to be on site at all times (i.e. spill kits) and workers trained in their location and use. The resources on hand must be sufficient to respond effectively and expediently to any spill that could occur on site.

.5 All construction equipment brought onto the site will be clean and properly maintained.

.6 Any equipment maintenance must occur in a designated area and must be conducted away from any surface water drains or collection points.

.7 Any equipment remaining on site overnight shall have appropriately placed drip pans.

.8 Waste generated will be prevented from entering the environment.

.9 Prevent discharges containing asphalt, grout, concrete or other waste materials from reaching storm drains or the marine environment. This includes, but is not limited to:

.1 Cleaning equipment off site; and

.2 Protection of any other drainage structures not identified here with filter fences and/or silt socks, if required.

.10 Protection of the roadways from tracking of mud, soil and debris needs to be maintained throughout the work.

.11 Limit of work activities to normal business hours to minimize noise outside of those hours. Ensure that equipment and machinery is properly maintained to minimize unnecessary noise pollution. Consider local municipal noise bylaws when mobilizing equipment.

.12 All utilities must be located prior to excavation.

1.11 IMPORT OF FILL MATERIAL

.1 Prior to import of any material used for surfacing, backfilling or any other use requiring fill material the Contractor will provide sufficient documentation, as agreed on by Departmental Representative, to ensure that the imported material meets the Canadian Council of Ministers of the Environment (CCME) Residential/Parkland (RL/PL) Land Usage Soil Quality Guidelines.

.2 Environmental characterization of fill material must be conducted in accordance with the following: British Columbia, Ministry of Environment, Technical Guidance Document #1 – Site Characterization and Confirmation Testing.

.3 Prior to import of any material the Contractor must inform the Departmental representative of the proposed fill source(s) and identify the nature of current and historic activities conducted at the source.

.4 The Departmental Representative reserves the right to request additional testing of imported material at the source and at the deposit site to satisfy their requirements. All testing will be done at the Contractor's cost.

.5 All material brought to the site that does not meet the CCME RL/PL Guidelines will be removed from the property immediately at the Contractors cost.

END OF SECTION 01 35 43

1.0 GENERAL

1.1 INSPECTION

.1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work

.3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.4 Departmental Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

1.2 INDEPENDENT INSPECTION AGENCIES

.1 Independent Inspection/Testing Agencies will be engaged by Contractor for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Contractor.

.2 Provide equipment required for executing inspection and testing by appointed agencies.

.3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

.4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and re-inspection.

1.3 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.

.2 Co-operate to provide reasonable facilities for such access.

1.4 PROCEDURES

.1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.

.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.5 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

.2 Make good other Contractor's work damaged by such removals or replacements promptly.

.3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Departmental Representative.

1.6 REPORTS

.1 Submit electronic copy of inspection and test reports to Departmental Representative. Testing and Inspection companies engaged by the Contractor will furnish paper copies of reports on site to allow for work to proceed in a timely manner.

.2 Provide copies to subcontractor of work being, inspected or tested or manufacturer or fabricator of material being inspected or tested.

1.7 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as requested.

.2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by Departmental Representative and may be authorized as recoverable.

1.8 MOCK-UPS

.1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.

.2 Construct in locations acceptable to Departmental Representative as specified in specific Section.

.3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in orderly sequence, to not cause delays in Work.

.4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.5 If requested, Departmental Representative will assist in preparing schedule fixing dates for preparation.

.6 Specification section identifies whether mock-up may remain as part of Work or if it is to

be removed.

1.9 MILL TESTS

.1 Submit mill test certificates as requested.

1.10 EQUIPMENT AND SYSTEMS

.1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

.2 Refer to Divisions 22, 23, 25, 26, 27 and 28 for definitive requirements.

END OF SECTION 01 45 00

1.0 GENERAL

1.1 ACCESS AND DELIVERY

.1 Only the designated entrance may be used for access to the site. The designated entry and exit will be via the Main Esquimalt Graving Dock gate on Admirals Road. EGD does not guarantee access to any road within the facility. Alternate roads within the facility may be closed to meet operation requirements.

.2 Vehicular movement in and out of the Esquimalt Graving Dock will pass through check points and be monitored by EGD security. All Contractor's and Subcontractor's staff must carry current photo identification and a PWGSC security pass.

.3 Contractor is required to use only the designated entrance to access the work site, for deliveries to site, and as the exit for offsite disposal.

- .1 Maintain for duration of contract.
- .2 Make good damage resulting from Contractor's use.
- .3 Maintain road cleanliness utilizing mechanical means from project site to main entrance on a daily basis.

.4 Use of the Esquimalt Graving Dock facility will be granted to the Contractor through the Departmental Representative.

- .1 The contractor's work site is to be used for loading and unloading purposes

.5 Provide and maintain access roads, sidewalk crossing ramps and construction runways as may be required for access to the work. All roadways and walkways outside of the Contractor's work site must be kept clear of materials and equipment at all times.

.6 Provide and maintain competent flag operators, traffic signals, barricades and flares, lights or lanterns as may be required to perform work and protect other users of the Esquimalt Graving Dock.

1.2 CONSTRUCTION PARKING

.1 Construction staff shall be responsible for their own parking in nearby private facilities.

1.3 STORAGE FACILITIES

.1 Confine work and operations of employees to areas indicated on Contract Documents. Do not unreasonably encumber premises with products. Storage space to be limited to the area of construction.

.2 Do not load or permit to load any part of Work with weight or force that will endanger Work or existing structure or elements.

.3 Provide and pay for all off-site storage as required. Note that storage space is limited on site. Refer to site plan for location of Contractor's site storage and lay-down area.

1.4 POWER

.1 Contractor to provide connection to existing 120/208V distribution board for connection of temporary power for office trailer. Contractor shall install a revenue approved energy meter suitable for measuring kwH consumed. Temporary construction power shall be drawn from this metered source.

.2 Contractor will be charged power at a standard BC hydro rate typical for this service size (BC Hydro Schedule 1220).

1.5 AIR

.1 Contractor to supply his own compressed air for the duration of the contract. Some equipment and utilities can be rented at the site for a fee. See EGD *Schedule of Dock Charges* in Appendix G.

1.6 WATER SUPPLY

.1 Water supply is available at existing site and may be rented at the site for a fee. See EGD *Schedule of Dock Charges* in Appendix G.

1.7 SANITARY FACILITIES

.1 Contractor will provide their own *portable* sanitary facilities. Maintain in a safe and sanitary condition. Construction staff will not be allowed to use Esquimalt Graving Dock's washrooms.

1.8 HEATING AND VENTILIATION

.1 Do not begin work until arrangements have been made with the Departmental Representative for protection of on-floor heating, ventilating and air conditioning.

.2 If there is any dirt in the heating and ventilation system, at the completion of work, it will be the Contractor's responsibility to return system to its original state in accordance with the Departmental Representative's directions.

.3 Prevent dust and odour migration to other occupied areas.

.1 Do not deactivate HVAC system to occupied floors. Purge air from construction floors only when directed by Departmental Representative, where dust and fumes will be generated.

.2 Change filters in existing HVAC system frequently.

1.9 SCAFFOLDING

.1 Construct and maintain scaffolding in rigid, secure and safe manner.

.2 Erect scaffolding independent of walls. Remove promptly when no longer required.

1.10 HOISTING

.1 Provide, operate and maintain hoists required for moving of workers, materials and equipment. Make financial arrangements with Sub-contractors for their use of hoists.

.2 Hoists shall be operated by qualified operator.

1.11 HOARDING

.1 Prior to all demolition and construction, install plywood hoarding or protective barrier as detailed. Maintain in safe and clean condition throughout duration of project. Submit hoarding plan to Departmental Representative for approval.

.2 Erect and maintain safety barricades around all openings and other danger areas as required by Building Code and WCB.

.3 Installation of hoarding must not create permanent damage to existing wall cladding or flooring finish which is of heritage value.

1.12 SITE OFFICE

.1 Contractor to provide their own trailer as temporary site office within the fenced project work area.

.2 Contractor should clear and demolish site office at end of project according to contract requirement.

1.13 REMOVAL OF TEMPORARY FACILITIES

.1 Remove temporary facilities from site when directed by the Departmental Representative.

1.14 SIGNS AND NOTICES

.1 Signs and notices for safety and instruction shall be in both official languages or graphic symbols conforming to CAN/CSA-Z321.

.2 Maintain approved signs and notices in good condition for duration of Project, and dispose of offsite on completion of Project when directed by Departmental Representative.

1.15 CLEAN-UP

.1 Remove construction debris, waste materials, packaging material from work site daily.

.2 Clean dirt of mud tracked onto paved or surfaced roadways.

.3 Store materials resulting from demolition activities that are salvageable.

.4 Stack stored new or salvaged material not in construction facilities.

.5 At completion of Project: Remove and dispose of all debris, thoroughly clean and restore site to condition found at commencement of Work. Repair and make good to all damage caused by construction activities.

END OF SECTION 01 51 00

1.0 GENERAL

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.

.2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.

.2 Canadian Standards Association (CSA International)

.1 CSA-O121-M1978(R2003, Douglas Fir Plywood.

.3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as Of: May 14, 2004.

1.3 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

1.4 HOARDING

.1 Refer to Section 01 51 00 Temporary Utilities Clause 1.11.

1.5 GUARD RAILS AND BARRICADES

.1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, and open edges of floors and roofs,

.2 Provide as required by governing authorities.

1.6 WEATHER ENCLOSURES

.1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.

.2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.

.3 Design enclosures to withstand wind pressure and snow loading.

1.7 ACCESS TO SITE

.1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.8 PUBLIC TRAFFIC FLOW

.1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

1.9 FIRE ROUTES

.1 Maintain access to property including overhead clearances for use by emergency response vehicles.

.2 Maintain clearance for all egress routes.

1.10 PROTECTION OFF-SITE AND PUBLIC PROPERTY

.1 Protect surrounding private and public property from damage during performance of Work.

.2 Be responsible for damage incurred.

1.11 PROTECTION OF EXISTING PROPERTY

.1 Provide protection for finished and partially finished property and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.

.4 Be responsible for damage incurred due to lack of or improper protection.

1.12 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

END OF SECTION 01 56 00

1.0 GENERAL

1.1 PRODUCTS/MATERIAL AND EQUIPMENT

.1 Use NEW products/material and equipment unless otherwise specified. The term "products" is referred to throughout the specifications.

.2 Use products of 1 manufacturer for material and equipment of the same type or classification unless otherwise specified.

.3 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods.

.4 Notify Departmental Representative in writing of any conflict between these specifications and manufacturer's instructions. Departmental Representative will designate which document is to be followed.

.5 Provide metal fastenings and accessories in the same texture, colour and finish as base metal in which they occur.

- .1 Prevent electrolytic action between dissimilar metals.
- .2 Use non-corrosive fasteners, anchors and spacers for securing exterior work.
- .3 Fastenings which cause spalling or cracking are not acceptable.
- .4 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .5 Use heavy hexagon heads, semi-finished unless otherwise specified.
- .6 Bolts may not project more than 1 diameter beyond nuts.
- .7 Types of washers as follows:
  - .1 Plain type washers: use on equipment and sheet metal.
  - .2 Soft gasket lock type washers: use where vibrations occur.
  - .3 Resilient washers: use with stainless steel.
- .8 Deliver, store and maintain packaged material and equipment with manufacturer's seals and labels intact.
- .9 Prevent damage, adulteration and soiling of products during delivery, handling and storage. Immediately remove rejected products from site.
- .10 Store products in accordance with suppliers' instructions.
- .11 Touch up damaged factory finished surfaces to Departmental Representative's satisfaction.
  - .1 Use primer or enamel to match original.
  - .2 Do not paint over nameplates.

1.2 QUALITY OF PRODUCTS

.1 Products, materials and equipment (referred to as products) incorporated into work shall be new, not damaged or defective, and of the best quality (compatible with the specifications) for the purpose intended. If requested, furnish evidence as to type, source and quality of the products provided.

.2 Defective products will be rejected regardless of previous inspections.

- .1 Inspection does not relieve responsibility, but is precaution against oversight or error.
- .2 Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.3 Retain purchase orders, invoices and other documents to prove that all products utilized in this Contract meet the requirements of the specifications. Produce documents when
requested by the Departmental Representative.

.4 Should any dispute arise as to quality or fitness of products, the decision rests strictly with the Departmental Representative based upon the requirements of the Contract documents.

.5 Unless otherwise indicated in the specifications, maintain uniformity of manufacture for any particular or like item throughout the building.

.6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 AVAILABILITY OF PRODUCTS

.1 Immediately upon signing the Contract, review product delivery requirements and anticipate foreseeable supply delays for any items.

.2 If delays in supply of products are foreseeable, notify Departmental Representative of such in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of the work.

.3 In event of failure to notify Departmental Representative at the start of work and should it subsequently appear that the work may be delayed for such reason, the Departmental Representative reserves the right to substitute more readily available products of similar character, at no increase in either the Contract price or the Contract time.

1.4 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in the specifications, install or erect products in accordance with the manufacturer's instructions.

.1 Do not rely on labels or enclosures provided with products.

.2 Obtain written instructions directly from the manufacturer.

.2 Notify Departmental Representative in writing of conflicts between the specifications and the manufacturer's instructions so that the Departmental Representative may establish the course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Departmental Representative to require removal and reinstallation at no increase in either the Contract price or the Contract time.

1.5 CONTRACTOR'S OPTIONS FOR SELECTION OF PRODUCTS FOR TENDERING

.1 Products are specified by "Prescriptive" specifications: select any product meeting or exceeding specifications.

.2 Products specified under "Acceptable Products": select any one of the indicated manufacturers, or any other manufacturer meeting or exceeding the Prescriptive specifications and indicated Products.

.3 Products specified by performance and referenced standard: select any product meeting or exceeding the referenced standard.

.4 Products specified to meet particular design requirements or to match existing materials: use only material specified Approved Product. Alternative products may be considered provided full technical data is received in writing by Departmental Representative in accordance with "Special Instructions to Tenderers".

.5 When products are specified by a referenced standard or by or Performance specifications, upon request of Departmental Representative obtain from manufacturer an independent
laboratory report showing that the product meets or exceeds the specified requirements.

1.6 SUBSTITUTION AFTER CONTRACT AWARD

.1 No substitutions are permitted without prior written approval of the Departmental Representative.

.2 Proposals for substitution may only be submitted after Contract award. Such request must include statements of respective costs of items originally specified and the proposed substitution.

.3 Proposals will be considered by the Departmental Representative if:

.1 Products selected by tenderer from those specified are not available;

.2 Delivery date of products selected from those specified would unduly delay completion of Contract, or;

.3 Alternative product to that specified, which is brought to the attention of and considered by Departmental Representative as equivalent to the product specified,and will result in a credit to the Contract amount.

.4 Should the proposed substitution be accepted either in part or in whole, assume full responsibility and costs when substitution affects other work on the project. Pay for design or drawing changes required as result of substitution.

.5 Amounts of all credits arising from approval of the substitutions will be determined by the Departmental Representative and the Contract price will be reduced accordingly.

END OF SECTION 01 61 00

1.0 GENERAL

1.1 REFERENCES

.1 A set of construction drawings of existing pumphouse in pdf format are available for viewing and reference only upon request. The set of drawings may not be full completed set and do not necessarily represent as-built conditions. All existing conditions measurements need to be verified on site.

1.2 QUALIFICATIONS OF SURVEYOR

.1 Qualified registered land surveyor, licensed to practice in the province of British Columbia, acceptable to Departmental Representative.

1.3 EXISTING SERVICES

.1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.

.2 Contractor is responsible to provide GPR Survey of existing services as required to verify existing underground condition prior to excavation.

1.4 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

.3 Inform Departmental Representative of impending installation and obtain approval for actual location.

.4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

1.5 RECORDS

.1 Maintain a complete, accurate log of control and survey work as it progresses.

.2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.

.3 Record locations of maintained, re-routed and abandoned service lines.

1.6 SUBMITTALS

.1 Submit name and address of Surveyor to Departmental Representative.

.2 On request of Departmental Representative, submit documentation to verify accuracy of field engineering work.

.3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform and do not conform with Contract Documents.

1.7 SUBSURFACE CONDITIONS

.1 Promptly notify Consultant in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.

.2 After prompt investigation, should Consultant determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

END OF SECTION 01 71 00

1.0 GENERAL

1.1 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit written request in advance of cutting or alteration which affects:
- .1 Structural integrity of elements of project.
- .2 Integrity of weather-exposed or moisture-resistant elements.
- .3 Efficiency, maintenance, or safety of operational elements.
- .4 Visual qualities of sight-exposed elements.
- .5 Work of Owner or separate contractor.

.3 Include in request:
- .1 Identification of project.
- .2 Location and description of affected Work.
- .3 Statement on necessity for cutting or alteration.
- .4 Description of proposed Work, and products to be used.
- .5 Alternatives to cutting and patching.
- .6 Effect on Work of Owner or separate contractor.
- .7 Written permission of affected separate contractor.
- .8 Date and time work will be executed.

1.2 MATERIALS

.1 Required for original installation.

.2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

1.3 PREPARATION

.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

.2 After uncovering, inspect conditions affecting performance of Work.

.3 Beginning of cutting or patching means acceptance of existing conditions.

.4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.

.5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.

1.4 EXECUTION

.1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.

.2 Fit several parts together, to integrate with other Work.

.3 Uncover Work to install ill-timed Work.

.4 Remove and replace defective and non-conforming Work.

.5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

.6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.

.7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.

.8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.

.9 Restore work with new products in accordance with requirements of Contract Documents.

.10 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00 - Firestopping, full thickness of the construction element.

.12 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

.13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management And Disposal.

END OF SECTION 01 73 00

1.0 GENERAL

1.1 REFERENCES

.1 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: 2020, Title: General Conditions. In Effect as Of: April 25, 2013.

1.2 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by Owner or other Contractors.

.2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.

.3 Clear snow and ice from access to building, bank/pile snow in designated areas only.

.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.5 Provide on-site containers for collection of waste materials and debris.

.6 Provide and use marked separate bins for recycling. Refer to Section 01 74 19 - Waste Management and Disposal.

.7 Dispose of waste materials and debris off site.

.8 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.

.9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.3 FINAL CLEANING

.1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.3 Prior to final review remove surplus products, tools, construction machinery and equipment.

.4 Remove waste products and debris including that caused by Owner or other Contractors.

.5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.

.6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

.8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, millwork floors and ceilings.

.9 Clean lighting reflectors, lenses, and other lighting surfaces.

.10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

.11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.

.12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.

.14 Remove dirt and other disfiguration from exterior surfaces.

.15 Clean and sweep gutters.

.16 Sweep and wash clean paved areas.

.17 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.

.18 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

.19 Remove snow and ice from access to buildings.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management And Disposal.

END OF SECTION 01 74 11

1.0 GENERAL

1.1 WASTE MANAGEMENT GOALS

.1 Prior to start of Work conduct meeting with Departmental Representative to review and discuss PWGSC's Waste Management Plan and Goals.

.2 Accomplish maximum control of solid construction waste.

.3 Preserve environment and prevent pollution and environment damage.

1.2 DEFINITIONS

.1 Class III: non-hazardous waste - construction renovation and demolition waste.

.2 Cost/Revenue Analysis Workplan (CRAW): based on information from WRW, and intended as financial tracking tool for determining economic status of waste management practices.

.3 Demolition Waste Audit (DWA): relates to actual waste generated from project.

.4 Inert Fill: inert waste - exclusively asphalt and concrete.

.5 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.

.6 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.

.7 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.

.8 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

.9 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:

- .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
- .2 Returning reusable items including pallets or unused products to vendors.

.10 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.

.11 Separate Condition: refers to waste sorted into individual types.

.12 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.

.13 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to Schedule A.

.14 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.

.15 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

1.3 DOCUMENTS

.1 Maintain at job site, one copy of following documents:
- .1 Waste Audit.
- .2 Waste Reduction Workplan.
- .3 Material Source Separation Plan.
- .4 Schedules A, B, C, D, E completed for project.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Prepare and submit following prior to project start-up:
- .1 Submit 2 copies of completed Waste Reduction Workplan (WRW): Schedule B.
- .2 Submit 2 copies of completed Demolition Waste Audit (DWA): Schedule C.
- .3 Submit 2 copies of Materials Source Separation Program (MSSP) description.

.3 Submit before final payment summary of waste materials salvaged for reuse, recycling or disposal by project using deconstruction/disassembly material audit form.
- .1 Failure to submit could result in hold back of final payment.
- .2 Provide receipts, scale tickets, waybills, and show quantities and types of materials reused, recycled, co-mingled and separated off-site or disposed of.
- .3 For each material reused, sold or recycled from project, include amount quantities by number, type and size of items and the destination.
- .4 For each material land filled or incinerated from project, include amount in tonnes of material and identity of landfill, incinerator or transfer station.

1.5 WASTE AUDIT (WA)

.1 Conduct WA prior to project start-up.

.2 Prepare WA: Schedule A.

.3 Record, on WA - Schedule A, extent to which materials or products used consist of recycled or reused materials or products.

1.6 WASTE REDUCTION WORKPLAN (WRW)

.1 Prepare WRW prior to project start-up.

.2 WRW should include but not limited to:
- .1 Destination of materials listed.
- .2 Deconstruction/disassembly techniques and sequencing.

.3 Schedule for deconstruction/disassembly.
.4 Location.
.5 Security.
.6 Protection.
.7 Clear labelling of storage areas.
.8 Details on materials handling and removal procedures.
.9 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.

.3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.

.4 Describe management of waste.

.5 Identify opportunities for reduction, reuse, and recycling of materials. Based on information acquired from WA.

.6 Post WRW or summary where workers at site are able to review content.

.7 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.

.8 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

1.7 DEMOLITION WASTE AUDIT (DWA)

.1 Prepare DWA prior to project start-up.

.2 Complete DWA: Schedule C.

.3 Provide inventory of quantities of materials to be salvaged for reuse, recycling, or disposal.

1.8 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)

.1 Prepare MSSP and have ready for use prior to project start-up.

.2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Departmental Representative.

.3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.

.4 Provide containers to deposit reusable and recyclable materials.

.5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.

.6 Locate separated materials in areas which minimize material damage.

.7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.
.1 Transport to approved and authorized recycling facility.

1.9 STORAGE, HANDLING AND PROTECTION

.1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.

.2 Unless specified otherwise, materials for removal become Contractor's property.

.3 Protect surface drainage, mechanical and electrical from damage and blockage.

.4 Separate and store materials produced during dismantling of structures in designated areas.

.5 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.

.1 On-site source separation is recommended.
.2 Remove co-mingled materials to off-site processing facility for separation.
.3 Provide waybills for separated materials.

1.10 DISPOSAL OF WASTES

.1 Do not bury rubbish or waste materials.

.2 Do not dispose of waste, volatile materials, mineral spirits, oil, paint thinner, into waterways, storm, or sanitary sewers.

.3 Keep records of construction waste including:

.1 Number and size of bins.
.2 Waste type of each bin.
.3 Total tonnage generated.
.4 Tonnage reused or recycled.
.5 Reused or recycled waste destination.

.4 Remove materials from deconstruction as deconstruction/disassembly Work progresses.

.5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.

1.11 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises.

.2 Provide temporary security measures approved by Departmental Representative.

1.12 SCHEDULING

.1 Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work.

2.0 PRODUCTS

2.1 NOT USED

.1 Not Used.

3.0 EXECUTION

3.1 APPLICATION

.1 Do Work in compliance with WRW.

.2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 CLEANING

.1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.

.2 Clean-up work area as work progresses.

.3 Source separate materials to be reused/recycled into specified sort areas.

3.3 DIVERSION OF MATERIALS

.1 From following list, separate materials from general waste stream and stockpile in separate piles or containers, as reviewed by Departmental Representative, and consistent with applicable fire regulations.
- .1 Mark containers or stockpile areas.
- .2 Provide instruction on disposal practices.

.2 On-site sale of salvaged recovered reusable and/or recyclable materials is not permitted.

.3 Demolition Waste:

Material Type	Recommended Diversion %	Actual Diversion %
Acoustical Insulation	100	
Doors and Frames	100	
Electrical Equipment	80	
Mechanical Equipment	100	
Metals	100	
Rubble	100	
Wood (uncontaminated)	100	
Other		

.4 Construction Waste:

Material Type	Recommended Diversion %	Actual Diversion %
Cardboard	100	
Plastic Packaging	100	
Rubble	100	
Steel	100	
Wood (uncontaminated)	100	
Other		

3.4 WASTE AUDIT (WA)

The following pertains to Schedule A - Waste Audit (WA). Column-1 refers to the category of waste, and a physical description of the material (e.g. off-cuts, clean drywall, etc.). Column-2 refers to the total quantity of materials received by the Contractor. Measurement units must be specified. Column-3 refers to the estimated percentage of material that is waste. Column-4 refers to the total quantity of waste (column-2 x column-3). Column-5 refers to the areas(s) in which the waste was generated. Column-6 refers to the total percentage of recycled material from the specified total quantity of waste (column-4). Column-7 refers to the total percentage of reused material from the specified total quantity of waste (column-4).

.1 Schedule A - Waste Audit (WA):

(1) Material Category	(2) Material Quantity Unit %	(3) Estimated Waste	(4) Total Quantity of Waste (unit)	(5) Generation Point	(6) % Recycled	(7) % Reused
Wood & Plastics						
Material Description						
Off-Cuts						
Warped						
Plastic						
Cardboard						
Other						
Doors & Windows						
Material Description						
Frames						
Glass						
Wood						
Metal						

3.5 WASTE REDUCTION WORKPLAN (WRW)

The following pertains to Schedule B - Waste Reduction Workplan (WRW). Column-1 refers to the category and type of waste materials. Column-2 refers to the persons responsible for completing the WRW. Column-3 refers to Column-4 of Schedule A. Column-4 refers to the amount of reused waste predicted and realized. Column-5 refers to the amount of recycled waste predicted and realized. Column-6 refers to the approved recycling facility.

.1 Schedule B:

(1) Material Quantity Category	(2) Person Amount Responsible Waste	(3) Total of Project (unit)	(4) Reused Actual (units)	(5) Recycle Actual (s) Amount	(6) Material Destination (s)
Wood & Plastics					
Material Description					
Chutes					
Warped					
Plastic					
Cardboard Packaging					
Other					
Doors & Windows					
Material Description					
Painted					
Frames					
Glass					
Wood					
Metal					
Other					

3.6 DEMOLITION WASTE AUDIT (DWA)

The following pertains to Schedule C - Demolition Waste Audit (DWA). Column-1 refers to the type of material salvaged. Column-2 refers to the material quantity shown in column-1. Several columns may be required to identify specific demolition areas. Column-3 refers to the unit of measurement used to describe Column-2. Column-4 refers to the total quantity of salvaged material. Column-5 refers to the cumulative volume of salvaged material. Column-6 refers to the total weight in kilograms. Column-7 refers to remarks and assumptions made about the specified material.

.1 Schedule C - Demolition Waste Audit (DWA):

(1) Material Description Assumptions	(2) Quantity	(3) Unity	(4) Total	(5) Volume (cum)	(6) Weight (cum)	(7) Remarks & Assumptions
Wood						
Wood						
Stud						
Plywood						
Baseboard -wood						
Door						
Trim-Wood						
Cabinet						
Doors & Windows						
Panel						
Regular						
Slab Regular						
Wood						
Laminate						
Byfold-Closet						
Glazing						

3.7 CANADIAN GOVERMENTAL DEPARTMENTS CHIEF REPSONSIBLITY FOR THE ENVIROMENT

.1 Schedule E - Government Chief Responsibility for the Environment:

.1 Ministry of Environment Lands and Parks
810 Blanshard Street, 4th Floor
Victoria, BC V8V 1X4
604-387-1161 / 604-356-6464

.2 Waste Reduction Commission Soils and Hazardous Waste
770 South Pacific Blvd, Suite 303
Vancouver BC, V6B 5E7
604-660-9550 / 604-660-9596

1.0 GENERAL

1.1 SECTION INCLUDES

.1 Administrative procedures preceding preliminary and final inspections of Work.

1.2 RELATED SECTIONS

.1 Section 01 78 00 - Closeout Submittals.

1.3 INSPECTION AND DECLARATION

.1 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.

- .1 Notify Departmental Representative in writing 3 weeks prior to the satisfactory completion site visit of the Contractor’s Inspection to allow Departmental Representative to schedule relevant authorities.
- .2 Attend Departmental Representative's Inspection.
- .3 Departmental Representative's Review: Departmental Representative and Contractor will perform review of Work to identify obvious defects or deficiencies. Contractor and Departmental Representative will agree to the values set forth in the deficiencies identified in the Certificate of Final Completion and set a schedule of completion for all deficiencies.
- .4 Completion: submit written certificate that following have been performed:
  - .1 Work has been completed and inspected for compliance with Contract Documents.
  - .2 Defects have been corrected and deficiencies have been completed.
  - .3 Equipment and systems have been tested, adjusted, and balanced and are fully operational.
  - .4 Certificates required by authorities having jurisdiction.
  - .5 Commissioning of all systems: Final commissioning reports have been submitted to the Departmental Representative.
  - .6 Operation of systems have been demonstrated to Owner's personnel.
  - .7 Work is complete and ready for Final Inspection.

.2 Submit required forms as described in General Conditions and Standard Acquisition Contract Clause (SACC) manual.

END OF SECTION 01 77 00

1.0 GENERAL

1.1 RELATED SECTIONS

.1	Quality Control	Section 01 45 00
.2	Examination & Preparation	Section 01 71 00
.3	Closeout Procedures	Section 01 77 00
.4	Demonstration and Training	Section 01 79 00
.5	General Commissioning CX Requirements	Section 01 91 31
.6	Building Management Manual	Section 01 91 51

1.2 SUBMISSION

.1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.

.2 Copy of operating and maintenance manual will be returned after Substantial Completion Inspection, with Departmental Representative's comments.

.3 Revise content of documents as required prior to formal submittal.

.4 Two weeks prior to Substantial Completion of the Work, submit to the Departmental Representative, four draft copies of operating and maintenance manuals in English.

.5 An electronic copy Interactive Operating and Maintenance Manual System is required as specified under clause 1.3. Provide 4 sets of the Electronic Interactive Operating and Maintenance Manual System to the Departmental Representative.

.6 Hard copies of the Operating and Maintenance Manual System is required as specified under clause 1.4. Provide 4 sets of the Hard Copy Interactive Operating and Maintenance Manual System to the Departmental Representative.

.7 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.

.8 If requested, furnish evidence as to type, source and quality of products provided.

.9 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

.10 Pay costs of transportation.

.11 Certificate of Completion.

1.3 INTERACTIVE OPERATING AND MAINTENANCE MANUAL SYSTEM

.1 In addition to the printed copies, submit provide an Interactive Operating and Maintenance Manual System as specified herein.

.2 System Description and Requirements

.1 All as constructed drawings and operation and maintenance (O&M) manuals listed under the Scope of Work shall be converted, where necessary, into Portable Data File (PDF) format for viewing using the Adobe Acrobat Reader.

.2 Documentation storage and retrieval system shall be structured based on a database framework with direct links to the appropriate PDF files. Documents retrieval and viewing shall be executed through a menu driven approach.

.3 Program shall be capable of storing separately and independently data of multiple buildings and shall be expandable for addition of new buildings and systems.

.4 Data of each building shall be accessible by the input of either the building name or building number as defined by the Departmental Representative.

.5 O&M data and as constructed drawings shall be classified by their corresponding disciplines, including:

.1 Architectural
.2 Mechanical
.3 Electrical
.4 Data & Communication
.5 BSCS

.6 Under each discipline, data shall be grouped into the following four major categories:

.1 Basic Documents

.1 'Basic Documents' shall, according to the type of services or disciplines, include the full contents of each hard copy of the O&M manuals with the addition of Miscellaneous Maintenance Reports and Records, or as defined by the user. In general the following shall be included unless specifically excluded by the Departmental Representative:

.1 Introduction
.2 Consultant/Contractor/Suppliers List
.3 System Description
.4 Maintenance and Lubrication Schedules
.5 Testing and Commissioning (T&C) Reports
.6 Misc. Reports
.7 Specifications
.8 Equipment and/or point schedules as identified in the hard copy documents
.9 Others as stipulated by the Departmental Representative

.2 All Basic Documents PDF files shall be enhanced with appropriate bookmarks to facilitate searching of information within the document or linking to other relevant documents for references.

.2 'As-Constructed' Drawings

.1 'As-Constructed' drawings shall be converted from the original electronic files, such as CAD, into PDF format. If only the hard copies of the 'as constructed' drawings are available, they shall

be scanned and saved in PDF format. PDF files of the 'As-Constructed' drawings shall be enhanced with the following bookmarks to zoom into legible views on the computer screen as a minimum:

.1 Drawing Number and Title
.2 Drawing Notes
.3 Major Equipment Locations
.4 Cross-links to other related drawings
.5 Revisions

.3 System Data

.1 Building systems shall be identified by their services, disciplines, function, nature and specific scope. System data shall be classified into the following categories:

.1 System Description
.2 Schematic (where applicable)
.3 Equipment List

.2 Provide hot key buttons, where applicable, for direct access to drawings/data referenced on the schematics. The same shall be applied to listed equipment for direct links to the corresponding equipment data.

.4 Equipment Data

.1 Equipment data shall be classified into the following categories:

.1 Equipment submittals
.2 T&C Report
.3 Maintenance Data
.4 Maintenance Records
.5 Photo

.2 Provide a summary screen to list all equipment classified under a specific system. On the summary screen, provide direct links to the corresponding equipment data under each category with addition links to the relevant 'As Constructed' drawings.

.6 The system shall be executed by Professional Engineers with a minimum of 10 years post qualification experience in the field of Building Services Engineering.

.7 The Contractor shall provide a minimum of 3 past job references as proven record of similar undertakings.

.8 The Contractor shall provide a demonstration of the system to the Departmental Representative to provide verification that the requirements of the specification are fulfilled.

1.4 FORMAT HARD COPY MANUALS

.1 Organize data in the form of an instructional manual.

.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.

.3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

.4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content by Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Text: Manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.9 Provide 1:1 scaled CAD files in .dwg format on CD.

1.5 CONTENTS - EACH VOLUME

.1 Table of Contents: provide title of project;
- .1 date of submission;
- .2 names, addresses, and telephone and fax numbers of Contractor, Subcontractors, Suppliers with name of responsible parties;
- .3 schedule of products and systems, indexed to content of volume.
- .4 copy of hardware schedule and paint schedules, complete with the actual manufacturer, supplier and identification names and numbers.
- .5 all extended guarantees, warranties, maintenance bonds, certificates, letters of guarantees, registration cards, as called for in the various sections of the specification.
- .6 complete set of all final reviewed shop drawings.
- .7 certificates of inspection by authorities having jurisdiction.
- .8 test reports and certificates as applicable.
- .9 complete set of as constructed drawings.

.2 For each product or system:
- .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

.6 Training: Refer to Section 01 79 00 - Demonstration and Training.

1.6 'AS CONSTRUCTED' DRAWINGS AND SAMPLES

.1 In addition to requirements in General Conditions, maintain at the site one record copy of:
- .1 Contract Drawings.
- .2 Specifications.
- .3 Addenda.
- .4 Change Orders and other modifications to the Contract.
- .5 Reviewed shop drawings, product data, and samples.
- .6 Field test records.
- .7 Inspection certificates.
- .8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by Departmental Representative.

.6 Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring. Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed. Use different colour waterproof ink for each service.

.7 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings. Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.8 Provide an electronic copy of as constructed drawings.

1.7 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on set of black line opaque drawings, provided by Departmental Representative.

.2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.

.4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
- .1 Measured depths of elements of foundation in relation to finish first floor datum.
- .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
.4 Field changes of dimension and detail.
.5 Changes made by change orders.
.6 Details not on original Contract Drawings.
.7 References to related shop drawings and modifications.

.5 Specifications: legibly mark each item to record actual construction, including:
.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
.2 Changes made by Addenda and change orders.

.6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

1.8 EQUIPMENT AND SYSTEMS

.1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
.1 Operation data to include:
.1 Control schematics for systems including environmental controls.
.2 Description of systems and their controls.
.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
.4 Operation instruction for systems and component.
.5 Description of actions to be taken in event of equipment failure.
.6 Valves schedule and flow diagram.
.7 Colour coding chart.
.2 Maintenance data to include:
.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
.2 Data to include schedules of tasks, frequency, tools required and task time.
.3 Description of plumbing specialties and accessories, giving manufacturer's name, type, model, year, capacity. List of recommended spare parts.
.3 Performance data to include:
.1 Equipment performance verification test results.
.2 Special performance data as specified.

.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and 01 91 13 – General Commissioning (Cx) Requirements.

.15 Additional requirements: As specified in individual specification sections.

1.9 MATERIALS AND FINISHES

.1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional Requirements: as specified in individual specifications sections.

1.10 SPARE PARTS

.1 Provide spare parts, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.11 MAINTENANCE MATERIALS

.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in the Operating and Maintenance Manuals.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.12 SPECIAL TOOLS

.1 Provide special tools, in quantities specified in individual specification section.

.2 Provide items with tags identifying their associated function and equipment.

.3 Deliver to location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

1.13 STORAGE, HANDLING AND PROTECTION

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Store paints and freezable materials in a heated and ventilated room.

.5 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.

1.14 WARRANTIES AND BONDS

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers within ten days after completion of the applicable item of work.

.4 Except for items put into use with Owner's permission; leave date of beginning of time of warranty until the Date of Substantial Performance is determined.

.5 Verify that documents are in proper form, contain full information, and are notarized.

.6 Co-execute submittals when required.

.7 Retain warranties and bonds until time specified for submittal.

END OF SECTION 01 78 00

1.0 GENERAL

1.1 ADMINISTRATIVE REQUIREMENTS

.1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of substantial performance.

.2 Owner: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.

.3 Preparation:

- .1 Verify conditions for demonstration and instructions comply with requirements.
- .2 Verify designated personnel are present.
- .3 Ensure equipment has been inspected and put into operation in accordance with Division.
- .4 Ensure testing, adjusting, and balancing has been performed in accordance with Section 23 08 00 Commissioning of Mechanical Systems.

.4 Demonstration and Instructions:

- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times, at the equipment location.
- .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
- .3 Review contents of manual in detail to explain aspects of operation and maintenance.
- .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

.5 Time Allocated for Instructions: ensure adequate amount of time required for instruction of each item of equipment or system: refer to 1.7 of Section 01 91 31.

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Departmental Representative's approval.

.3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

.4 Give time and date of each demonstration, with list of persons present.

.5 Provide electronic & hard copies (Refer to Section 01 78 00 Closeout Submittals) of completed operation and maintenance manuals for use in demonstrations and instructions.

1.3 QUALITY ASSURANCE

.1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:

.1 Instruct Owner's personnel.

.2 Provide written report that demonstration and instructions have been completed.

1.4 POWER SYSTEM SCADA SYSTEM

.1 Review operation of systems and equipment.

.2 Review of programming setup and hardware setup.

.3 Review of HMI screens, trending functions, alarm operations.

.4 Refer to Section 26 29 23.02 for additional requirements.

END OF SECTION 01 79 00

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 General requirements relating to commissioning of project's components and systems, specifying general requirements to Performance Verification of components, equipment, sub-systems, systems, and integrated systems.

.2 Related Sections:

.1 Section 01 33 00 - Submittal Procedures
.2 Section 01 45 00 - Quality Control.
.3 Section 01 91 31- Commissioning (Cx) Plan
.4 Section 23 05 00 -Common Work Results - Mechanical
.5 Section 23 05 93 - Testing, Adjusting And Balancing for HVAC.
.6 Section 23 08 00 - Commissioning of Mechanical Systems
.7 Section 25 05 01 – EMCS General Requirements
.8 Section 25 90 11 – EMCS: Sequence of Operations
.9 Section 26 05 00 - Common Work Results - Electrical.
.10 Section 26 05 14 - Power Cables (1001V-27kV & 125VDC)
.11 Section 26 05 27 - Grounding – Primary
.12 Section 26 05 43.01 - Installation of Cables in Trenches and Ducts
.13 Section 26 12 16 - Dry Type, Medium and High Voltage Transformers
.14 Section 26 13 18 - Primary Switchgear Assembly to 27kV
.15 Section 26 29 05 - Protective Relays
.16 Section 26 29 10- Motor Starters to 600V.
.17 Section 26 33 16 - Battery Racks & DC Panelboard
.18 Section 26 33 43 - Battery Chargers
.19 Section 26 33 53 - Static Uninterruptible Power Supply.
.20 Section 26 36 23 - Manual and Automatic Transfer Switch.
.21 Section 26 41 13 - Lightning Protection for Structures
.22 Section 28 31 01- Fire Detection and Alarm.

.3 Acronyms:

.1 AFD - Alternate Forms of Delivery, service provider.
.2 BMM - Building Management Manual.
.3 Cx - Commissioning.
.4 EMCS - Energy Monitoring and Control Systems.
.5 O&M - Operation and Maintenance.
.6 PV - Performance Verification.
.7 TAB - Testing, Adjusting and Balancing.
.8 CxA – Commissioning Authority.

.9 DC – Design Consultant.

.10 PWGSC – Public Works and Government Services Canada.

.11 ECxC – Electrical Commissioning Coordinator.

.12 MCxC – Mechanical Commissioning Coordinator.

.13 QCM - .Quality control Manger.

.14 ECA – Electrical Commissioning Agent.

.15 MCA – Mechanical Commissioning Agent.

.16 O&M – Operations and Maintenance.

1.2 REFERENCE

.1 CSA Standards for Building Commissioning Z320-11.

.1 ANSI/NETA Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 GENERAL

.1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:

.1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.

.2 Ensure appropriate documentation is compiled into the BMM.

.3 Effectively train O&M staff.

.2 Cx is to be performed by an independent third party professional Cx Agent(s) after work is completed and prior to energizing any equipment. The independent third party must have performed similar HV work for a minimum of 5 years. Qualifications of Cx Agent submitted by General Contractor shall be reviewed by Commissioning Authority and can only be hired after acceptance by Departmental Representative.

.3 General Contractor to retain the services of an independent third party professional Cx Agent to carry out the tests and calibration as required herein. Testing Agency shall be familiar with NETA Standards as specified herein and shall have accreditation equivalent to a full NETA member company:

.1 This project shall only be undertaken by firms familiar with and having a long and demonstrable successful track record in the field of switchgear and transformer modification and installation, protection and control, and arc flash mitigation. The proponent shall be experienced in working with an industrial type primary voltage distribution system using parallel feeders. Provide documented experience on projects of this type.

.2 All protection settings must be reviewed by a Professional Engineer registered in British Columbia who is an employee of Cx Agency. Provide documentation naming this individual along with their credentials.

.3 All work must be performed by qualified technicians/electricians with applicable accreditation for the appropriate permitting required. Provide a list of all personnel and their qualifications.

.4 Provide three references, including contact information for completed projects similar to this in scope and technical content.

.5 Qualifications of the Cx Agency must be submitted and reviewed by Departmental Representative and only after acceptance will the Testing Agency be allowed to perform the work.

.4 Furnish Independent Cx agency professional engineer's letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions. The letter is to be submitted stamped by a Professional Engineer, registered in BC, and provided to the Commissioning Authority.

.5 Employ only personnel who are qualified and experienced in high voltage work. Personnel must be familiar with the equipment and procedures necessary to complete the work as specified herein.

.6 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.

.1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems must interact with each other as intended in accordance with Contract Documents and design criteria.

.2 During these checks, adjustments will be made to enhance performance to meet environmental or user requirements.

.7 Design Criteria: as per client's requirements or determined by designer to meet Project functional and operational requirements.

1.4 COMMISSIONING OVERVIEW

.1 Cx to be a line item of General Contractor's cost breakdown.

.2 Cx activities supplement field quality and testing procedures described in relevant technical sections.

.3 Cx is to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes the transfer of critical knowledge to facility operational personnel.

.4 Complete all start-up and verification of systems prior to review by Commissioning Agent.

.1 To bring mechanical, electrical and building architectural systems and components from a state of static completion to a state of dynamic operation.

.2 To verify conformance to contract requirements.

.3 To confirm installations meet requirements of Contract Documents.

.4 To provide all testing documents and records.

.5 To ensure completed facility meets contract requirements.

.6 To provide a documented operator training program.

.7 To verify accuracy of project record drawings and operating and maintenance manuals.

.5 Departmental Representative will issue Certificate of Substantial Completion when:

.1 Completed Cx documentation has been received, reviewed for suitability and approved by Commissioning Authority.

.2 Equipment, components and systems have been commissioned.

.3 O&M staff training has been completed.

1.5 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

.1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the un-functional system, including related systems as deemed required by Commissioning Authority, Commissioning Authority to ensure effective performance.

.2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by General Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.6 PRE-CX REVIEW

.1 Before Construction:

.1 Review contract documents, confirm by writing to Commissioning Authority.

.1 Adequacy of provisions for Cx.

.2 Aspects of design and installation pertinent to success of Cx.

.2 During Construction:

.1 Co-ordinate provision, location and installation of provisions for Cx.

.3 Before start of Cx:

.1 Have completed Cx Plan up-to-date.

.2 Ensure installation of related components, equipment, sub-systems, systems is complete.

.3 Fully understand Cx requirements and procedures.

.4 Have Cx documentation shelf-ready.

.5 Understand completely design criteria and intent and special features.

.6 Submit complete start-up documentation to Departmental Representative.

.7 Have Cx schedules up-to-date.

.8 Ensure systems have been cleaned thoroughly.

.9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.

.10 Submit factory testing report of Electrical Equipment to Departmental Representative for review and approval.

.11 Ensure "As-Built" system schematics are available.

.12 Conduct coordination and protection study of upstream breakers, as indicated in drawings, to determine if trip settings are adequate for additional demand. Determine trip setting adjustments and where required, re-set breaker parameters accordingly. The study shall be performed at both 12.5 kV and 25 kV distribution voltages.

.13 Factory test each transformers, regulator and switchgear assemblies and all accessories. Notify Commissioning Authority 7 days in advance of tests and confirm 2 days in advance. Commissioning Authority and Engineer will attend/witness tests. Tests must be conducted in the Lower Mainland area of British Columbia. Alternatively, if tests are conducted elsewhere, pay the costs of travel time (at $130/hour) and all travel/living expenses for two attendees (at actual cost) associated with Commissioning Authority and engineer's attendance at factory tests and at repeat tests if necessary.

.4 Inform Commissioning Authority in writing of discrepancies and deficiencies on finished works.

1.7 CONFLICTS

.1 Report conflicts between requirements of this section and other sections to Departmental Representative before start-up and obtain clarification.

.2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.8 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit no later than 4 weeks after award of Contract:

.1 Name of Contractor's Cx agent.

.2 Draft Cx documentation.

.3 Preliminary Cx schedule.

.2 Request in writing to Commissioning Authority for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.

.3 Submit proposed Cx procedures to Commissioning Authority where not specified and obtain written approval at least 8 weeks prior to start of Cx.

.4 Provide additional documentation relating to Cx process required by Commissioning Authority, specifically;

.1 Cx Plan and Schedule

.2 Accepted Shop drawings

.3 Completed PI forms

.4 Approved TAB report

.5 Approved PV forms

.6 Approved O&M manuals

.7 Approved System and Integrated System Test Report

.8 Approved Factory testing reports

.9 Approved Training and Attendance forms

.10 Accepted “As-built” Plans and Specifications

.11 Final Cx Report

1.9 COMMISSIONING DOCUMENTATION

.1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Static Verification Forms, Start-up and Functional Performance Testing Forms for requirements and instructions for use.

.2 General Contractor to review and approve Cx documentation submitted by Cx Agent prior to submission to Departmental Representative for review.

.3 Provide completed and approved Cx documentation to Commissioning Authority.

1.10 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.07 Construction Progress Schedule Bar (GANTT Chart).

.2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:

.1 Approval of Cx reports.

.2 Verification of reported results.

.3 Repairs, retesting, re-commissioning, re-verification.

.4 Training.

1.11 COMMISSIONING MEETINGS

.1 Convene Cx meetings following project meetings: Section 01 32 16.07 Construction Progress Schedule Bar (GANTT Chart) and as specified herein.

.2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.

.3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.

.4 At 60% construction completion stage. Section 01 32 16.07 Construction Progress Schedule Bar (GANTT Chart). General Contractor to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:

.1 Review duties and responsibilities of General Contractor and subcontractors, addressing delays and potential problems.

.2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

.5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.

.6 Meeting will be chaired by General Contractor with their Commissioning Agent, who will record and distribute minutes.

.7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.12 STARTING AND TESTING

.1 General Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

1.13 WITNESSING OF STARTING AND TESTING

.1 Provide 14 days' notice prior to commencement.

.2 Commissioning Authority to witness of start-up and testing.

.3 General Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

.1 Minimum of 5 years experience in design, installation and operation of equipment and systems.

.2 Ability to interpret test results accurately.

.3 To report results in clear, concise, logical manner.

1.14 PROCEDURES

.1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.

.2 Conduct start-up and general testing in following distinct phases

.1 Included in delivery and installation

.1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.

.2 Visual inspection of quality of installation.

.2 Prior to start-up:

.1 Insulation resistance test and continuity test of all new cables and all cables with connections changed during construction

.2 All high voltage terminations tested with infrared imaging. Spot temperature readings are not acceptable

.3 Refer to the NETA Acceptance Testing specifications for detailed commissioning requirements for the following equipment:

.1 Cables, Low Voltage, 600 volt maximum.

.2 Switches, Air, Low Voltage

.3 Circuit Breakers, Air, Insulated/Molded Case

.4 Circuit Breakers, Air, Low-Voltage Power

.5 Instrument Transformers

.6 Metering Devices, Microprocessor-Based

.7 Motor Control, Motor Starters, Low-Voltage

.8 Emergency Systems, Uninterruptable Power Systems

.9 Emergency Systems, Automatic Transfer Switches

.10 Fiber-Optic Cables

.4 Start-up: follow accepted start-up procedures.

.5 Operational testing: document equipment performance.

.6 System PV: include repetition of tests after correcting deficiencies.

.7 Post-substantial performance verification: to include fine-tuning.

.3 Conduct following tests in accordance with Section 01 45 00 - Quality Control.

.1 Power distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Lighting and its control.

.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.5 Systems: fire alarm system communications.

.6 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Megger 600-2.4kV circuits, feeder and equipment with a 5000V instrument.

.4 Check resistance to ground before energizing.

.4 Correct deficiencies and obtain approval from Commissioning Authority after distinct phases have been completed and before commencing next phase.

.5 Document required tests on approved PV forms.

.6 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Commissioning Authority. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:

.1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.

.2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Commissioning Authority.

.3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.

.1 Rejected equipment to be removed from site and replace with new.

.2 Subject new equipment/systems to specified start-up procedures.

1.15 START-UP DOCUMENTATION

.1 Assemble start-up documentation and submit to Commissioning Authority for approval before commencement of commissioning.

.1 Start-up documentation to include:

.1 Factory and on-site test certificates for specified equipment.

.2 Pre-start-up inspection reports.

.3 Signed installation/start-up check lists.

.4 Start-up reports,

.5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

.1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.

.2 With assistance of manufacturer develop written maintenance program and submit to Departmental Representative for approval before implementation.

.3 Operate and maintain systems for length of time required for commissioning to be completed.

.4 After completion of commissioning, operate and maintain systems until issuance of Certificate of Substantial Performance.

1.17 TEST RESULTS

.1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.

.2 Provide manpower and materials, assume costs for re-commissioning.

1.18 START OF COMMISSIONING

.1 Notify Commissioning Authority at least 4 weeks prior to start of Cx.

.2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.19 INSTRUMENTS / EQUIPMENT

.1 Submit to Commissioning Authority for review and approval:

.1 Complete list of instruments proposed to be used.

.2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.

.2 Provide the following equipment as required:

.1 2-way radios.

.2 Ladders.

.3 Equipment as required to complete work.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

.1 Carry out Cx:

.1 Under accepted simulated operating conditions, over entire operating range, in all modes.

.2 On independent systems and interacting systems.

.2 Cx procedures to be repeatable and reported results are to be verifiable.

.3 Follow equipment manufacturer's operating instructions.

.4 EMCS trending to be available as supporting documentation for performance verification.

1.21 WITNESSING COMMISSIONING

.1 Departmental Representative to witness activities and verify results.

1.22 AUTHORITIES HAVING JURISDICTION

.1 Where start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.

.2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.

.3 Provide copies to Departmental Representative within 5 days of test and with Cx report.

.4 Authorities having jurisdiction in this project include Township of Esquimalt and BC Safety Authority.

1.23 EXTRAPOLATION OF RESULTS

.1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by Commissioning Authority in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.24 SUNDRY CHECKS AND ADJUSTMENTS

.1 Make adjustments and changes which become apparent as Cx proceeds.

.2 Perform static and operational checks as applicable and as required.

1.25 DEFICIENCIES, FAULTS, DEFECTS

.1 Correct deficiencies found during start-up and Cx to satisfaction of Commissioning Authority.

.2 Report problems, faults or defects affecting Cx to Commissioning Authority in writing. Stop Cx until problems are rectified. Proceed with written approval from Commissioning Authority.

1.26 COMPLETION OF COMMISSIONING

.1 Upon completion of Cx, leave systems in normal operating mode.

.2 Except for warranty and seasonal verification activities, complete Cx prior to issuance of Certificate of Substantial Performance.

.3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Commissioning Authority.

1.27 ACTIVITIES UPON COMPLETION OF COMMISSIONING

.1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

1.28 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

.1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

1.29 OCCUPANCY

.1 Cooperate fully with Departmental Representative during stages of acceptance and occupancy of facility.

1.30 INSTALLED INSTRUMENTATION

.1 Use instruments installed under Contract for TAB and PV if:

.1 Accuracy complies with these specifications.

.2 Calibration certificates have been deposited with Commissioning Authority.

.2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.31 PERFORMANCE VERIFICATION TOLERANCES

.1 Application tolerances:

.1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.

.2 Instrument accuracy tolerances:

.1 To be of higher order of magnitude than equipment or system being tested.

.3 Measurement tolerances during verification:

.1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

1.32 OWNER'S PERFORMANCE TESTING

.1 Performance testing of equipment or system by Commissioning Authority will not relieve Contractor from compliance with specified start-up and testing procedures.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Description of overall structure of Cx Plan and roles and responsibilities of Cx team.

.2 Related Requirements

.1 Section 01 91 33 Cx Forms.

.2 Section 01 91 41 Cx Training.

1.2 REFERENCES

.1 American Water Works Association (AWWA)

.2 Public Works and Government Services Canada (PWGSC)

.3 Underwriters' Laboratories of Canada (ULC)

.4 CSA Standards for Building Commissioning Z320-11.

.5 ANSI/NETA Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 GENERAL

.1 Provide fully functional facilities:

.1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.

.2 Facility user and O M personnel have been fully trained in aspects of installed systems.

.3 Complete documentation relating to installed equipment and systems.

.2 Term "Cx" in this section means "Commissioning".

.3 Use this Cx Plan as master planning document for Cx:

.1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.

.2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.

.3 Sets out deliverables relating to O M, process and administration of Cx.

.4 Describes process of verification of how built works meet design requirements.

.5 Produces a complete functional system prior to issuance of Certificate of Substantial Performance.

.6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:

.1 Overview of Cx.

.2 General description of elements that make up Cx Plan.

.3 Process and methodology for successful Cx.

.4 Acronyms:

.1 Cx - Commissioning.

.2 BMM - Building Management Manual.

.3 EMCS - Energy Monitoring and Control Systems (aka DDC or BAS).

.4 MSDS - Material Safety Data Sheets.

.5 PI - Product Information.

.6 PV - Performance Verification.

.7 TAB - Testing, Adjusting and Balancing.

.8 WHMIS - Workplace Hazardous Materials Information System.

.9 CxA – Commissioning Authority.

.10 DC – Design Consultant.

.11 PWGSC – Public Works and Government Services Canada.

.12 ECxC – Electrical Commissioning Coordinator.

.13 MCxC – Mechanical Commissioning Coordinator.

.14 QCM - .Quality control Manger.

.15 ECA – Electrical Commissioning Agent.

.16 MCA – Mechanical Commissioning Agent.

.17 O&M – Operations and Maintenance.

1.4 Five Phases of Cx to be Used on This Project

.1 Each system is to be checked, verified and documented 4 times at the appropriate phase of installation, and to have the training & demonstration phase accepted and documented:

PHASE	DESCRIPTION	STATIC TEST	DYNAMIC TEST	FUNCTIONAL PERFORMANCE TEST
1	System readiness or Pre-functional Testing	✓		
2	System start-up, testing, balancing, and adjustment		✓	✓
3	Verification of integrated system performance		✓	✓
4	Demonstration and training	N/A	N/A	N/A
5	Seasonal testing and verification	✓	✓	✓

1.5 DEVELOPMENT OF 100% CX PLAN

.1 Cx Plan to be 95% completed before added into Project Specifications.

.2 Cx Plan to be 100% completed by Contractor within 12 weeks of award of contract to take into account:

- .1 Approved shop drawings and product data.
- .2 Approved changes to contract.
- .3 Contractor's project schedule.
- .4 Cx schedule.
- .5 Contractor's, sub-contractor's, suppliers' requirements.
- .6 Project construction team's and Cx team's requirements.

.3 Submit completed Cx Plan to Commissioning Authority and obtain written approval.

1.6 REFINEMENT OF CX PLAN

.1 During construction phase, revise, refine and update Cx Plan to include:

- .1 Changes resulting from Client program modifications.
- .2 Approved design and construction changes.

.2 Submit each revised Cx Plan to Commissioning Authority for review every 3 months, and obtain written approval.

1.7 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

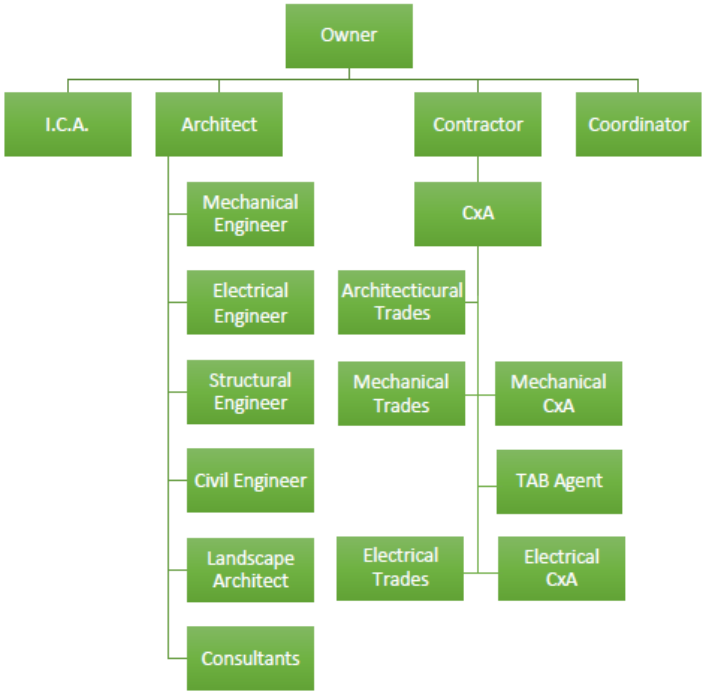
.1 General Contractor to maintain overall responsibility for project and is sole point of contact between members of commissioning team.

.2 The "Commissioning Team" consists of various participants involved in the Cx process. The table below lists team members, and shows some required tasks.

	Provide Design Intent	Review CxA's Design Review	Review Cx Plan	Respond to CxA Tender Review	Attend Cx Meetings	Other Duties Described Herein
Client: Esquimalt Graving Dock, Cliff Rhodes, Joe Lezetc		✓	✓	✓	✓	✓
Client: PWGSC, Danny Wong, George Strazicich, Norm Paul		✓	✓	✓	✓	✓
Architect (Consultant): Chernoff Thompson Architects, Tony Yip		✓	✓		✓	✓
General Contractor: To be determined			✓			✓
Coordinator:					✓	✓
Owner's Commissioning Authority: AES, Pat McCooey; AMC, Bob Landell			✓		✓	✓
Contractor's Mechanical Commissioning Agent: To be determined	✓	✓	✓	✓	✓	✓
Mechanical Engineer: JM Bean & Co. Raul Valderama	✓	✓	✓	✓	✓	✓
Electrical Engineer: AES	✓	✓	✓	✓		✓
Envelope: Morrison Hershfield, Chris Raudoy	✓	✓	✓	✓		✓
Civil Engineer: Westbrook Consulting, Bruce Crawshaw	✓	✓	✓	✓		✓
Landscape Architect:			✓		✓	✓
Testing and Balancing Agent: To be determined			✓		✓	✓
Controls Trade Contractor: To be determined			✓		✓	✓
Electrical Contractor: To be determined					✓	✓
Manufacturer's Representatives (as applicable): To be determined						✓
Inspectors and Testing Agencies: To be determined						✓

.3 This list is to be updated on an ongoing basis as tendering and hiring occurs.

.4 The project's preliminary Cx Organization Chart is as follows:



The team members' commissioning responsibilities are detailed in the specifications and this Commissioning Plan. The following is a summary table to assist team members in better understanding their roles:

LEGEND: "**A**" denotes ACCEPT; "**L**" denotes LEAD;
"**P**" denotes PARTICIPATE

TASK	Building owner or rep.	Building op's and maint. staff	Cx authority	Cx provider	Design consultants	Contractor & sub-contractors	Manuf' rep's	Independent testing specialists
Concept Phase								
Define owner's project req's	**L**				**P**			
Select a Cx authority	**L**							
Form a Cx team		**P**	**L**		**P**	**P**	**P**	
Review OPRs			**P**		**P**			
Include Cx responsibilities		**P**	**L**		**P**	**P**	**P**	
Determine scope and initial Cx budget	**A/L**		**P**		**P**			
Develop basis of design			**P**		**L**	**P**	**P**	

(BOD)								
Develop initial Cx plan outline			**L**		**P**	**P**	**P**	
Acceptance	**A**							
Design Phase								
Hold design phase Cx meetings		**P**	**L**		**P**	**P**	**P**	**P**
Identify project-specific Cx responsibilities		**P**	**L**		**P**	**P**	**P**	**P**
Verify OPR and BOD for completeness and clarity			**L**		**P**			
Perform Cx-focused design reviews of drawings and specs		**P**	**P**		**L**			
Plan/prepare verification checklists and test procedures			**L**		**P**	**P**	**P**	**P**
Define requirements for systems manuals		**P**	**P**		**L**	**P**		
Determine operational training requirements		**P**	**L/P**		**L/P**			
Develop Cx specifications	**A**		**P**		**L**			
Prepare Cx report			**L**					
Update Cx plan			**L**					
Acceptance	**A**							
Construction Phase								
Integrate Cx activities into project schedule			**P**			**L**		
Hold construction Cx phase kickoff and progress meetings		**P**	**L**	**P**	**P**	**P**	**P**	**P**
Review contractor submissions and shop drawings			**P**		**L**	**P**		
Construct mock-ups	**A**	**P**	**P**	**P**	**P**	**L**	**P**	**P**
Update OPR and BOD	**A**		**P**		**L**			
Perform and document static verification			**P**	**L/P**		**L/P**	**P**	**P**
Perform and document start-up			**P**	**P**		**L**	**P**	**P**
Perform and document functional performance testing		**P**	**P**	**L**		**P**	**P**	**P**
Prepare and update issues logs			**L**		**P**	**P**		
Resolve issues resulting from all tests			**P**	**P**	**L**	**P**		

Verify, review, and conduct training		**P**	**P**	**L**	**P**	**P**	**P**	
Review maintenance and data manuals		**P**	**P**		**L**	**P**		
Review operations manuals		**P**	**P**		**L**	**P**		
Prepare Cx report			**P**	**L**				
Update Cx plan			**L**					
Prepare Cx manual			**L**					
Acceptance	**A**							
Occupancy & operations phase								
Resolve outstanding Cx issues		**P**	**P**	**L**	**P**	**P**	**P**	**P**
Perform seasonal/deferred testing		**P**	**P**	**L**		**P**	**P**	**P**
Resolve issues resulting from seasonal/deferred tests		**P**	**P**	**L**	**P**	**P**	**P**	**P**
Update issues logs resulting from seasonal/deferred tests			**L**		**P**	**P**		
Complete final Cx report		**P**	**L**	**P**	**P**	**P**		
Acceptance	**A**							

1.8 Civil Cx

.1 The Civil Engineer (Design Consultant) will specify and witness tests. The CxA will coordinate and collect the following reviewed tests:

.1 Hydrostatic pressure test for water main

.2 Hydrostatic pressure test for force main

.3 Concrete test (same as structural)

.4 Nuclear densometer for gravel compactions.

1.9 DELIVERABLES RELATING TO O&M PERSPECTIVES

.1 General requirements:

.1 Compile English documentation.

.2 Documentation to be computer-compatible format ready for inputting for data management.

.2 Provide deliverables:

.1 Warranties.

.2 Project record documentation.

.3 Inventory of spare parts, special tools and maintenance materials.

.4 Maintenance Management System (MMS) identification system used.

.5 WHMIS information.

.6 MSDS data sheets.

.7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

.8 Other deliverables described later in this section.

1.10 DELIVERABLES RELATING TO THE CX PROCESS

.1 Consultants and CxA to witness and review sample tests and reports of results provided by Contractors.

1.11 CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Perform Cx by specified Cx agency using procedures reviewed by Commissioning Authority and Consultant.

.2 Commissioning Authority and Consultant to monitor Cx activities.

.3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.

.4 Commissioning Authority reserves right to verify a percentage of reported results at no cost to contract.

1.12 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

.1 Cx to be performed by specified Cx specialist, using procedures developed by Contractor and approved by Commissioning Authority, and reviewed by Consultant.

.2 Sample of tests to be witnessed by Commissioning Authority and/or Consultant and documented on approved report forms.

.3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be reviewed by Commissioning Authority and Consultant.

.4 Commissioning Authority reserves right to verify percentage of reported results.

.5 Identification:

.1 In later stages of Cx, before hand-over and acceptance Consultant, Contractor, Project Manager, Property Manager and Cx Manager to co-operate to complete inventory data sheets and provide assistance to PWGSC in full implementation of MMS identification system of components, equipment, sub-systems, systems.

1.13 STATIC VERIFICATION FORMS

.1 Refer to Section 01 91 33 1.2 - Commissioning (Cx) Forms: Static Verification Forms.

1.14 START-UP FORMS

.1 Refer to Section 01 91 33 1.3 - Commissioning (Cx) Forms: Start-up Forms.

1.15 FUNCTIONAL PERFORMANCE TESTING

.1 Refer to Section 01 91 33 1.4 - Commissioning (Cx) Forms: Functional Performance Testing Forms.

1.16 DELIVERABLES RELATING TO ADMINISTRATION OF CX

.1 General:

.1 Complete Cx of occupancy, weather and seasonal-sensitive equipment and systems in these areas before building is occupied.

1.17 CX SCHEDULES

.1 Prepare detailed Cx Schedule and submit to Commissioning Authority and Consultant for review at the same time as project Construction Schedule. Include:

.1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:

.1 Design criteria, design intents.

.2 Pre-TAB review: 14 days after contract award, and before construction starts.

.3 Cx agents' credentials: 14 days after contract award and before start of Cx.

.4 Cx procedures: 14 days after contract award.

.5 Cx Report format: 14 days after contract award.

.6 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.

.7 Notification of intention to start TAB: 21 days before start of TAB.

.8 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.

.9 Notification of intention to start Cx: 14 days before start of Cx.

.10 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.

.11 Identification of deferred Cx.

.12 Implementation of training plans.

.13 Cx of smoke management/control systems: after Cx of related systems is completed and 7 days before proposed date of Cx these systems.

.14 Cx reports: immediately upon successful completion of Cx.

.2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Departmental Representative.

.3 9 months in Cx schedule for verification of performance in all seasons and load conditions.

.2 After approval, incorporate Cx Schedule into Construction Schedule.

.3 Consultant, Contractor, Contractor's Cx agent, and Commissioning Authority will monitor progress of Cx against this schedule.

1.18 CX REPORTS

.1 Submit reports of tests, witnessed and reviewed by Commissioning Authority and Consultant.

.2 Include completed and certified PV reports in properly formatted Cx Reports.

.3 Before reports are accepted, reported results to be subject to verification by Commissioning Authority and Consultant.

1.19 ACTIVITIES DURING WARRANTY PERIOD

.1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:

.1 Fine tuning of HVAC and electrical systems.

.2 Adjustment of ventilation rates to ensure adequate cooling of electrical equipment.

.3 Load testing inspection and IR inspection to coincide with high EGD client load.

1.20 TRAINING PLANS

.1 Refer to Section 01 91 41 - Commissioning (Cx) - Training.

1.21 FINAL SETTINGS

.1 Upon completion of Cx to satisfaction of Commissioning Authority, lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 Systems to be Cx'd

.1 The proposed system is generally comprised of the following:

.1 25 KV switchgear and circuit breakers

.2 Remote breaker operators for 2nd floor primary voltage breakers

.3 2400 volt switchgear and circuit breakers for cranes.

.4 LV Power Equipment:

.1 Voltage regulator

.2 1000kVA transformer600/347V power for buildings, Air compressor and refeed of existing shore power.

.3 3000kVA transformer and a 3000 amp switchboard.

.4 480/277V power for buildings and existing south jetty and drydock shore power.

.5 3000kVA 3 winding transformer and 2, 2000 amp switchboards.

.6 208/120V power for buildings and existing south jetty and drydock shore power.

.7 3000kVA 3 winding transformer and 2, 2000 amp switchboards.

.8 430-600V variable voltage shore power: 1500kVA transformer

.5 The existing power factor controller / harmonic filter bank will be relocated into the new SSSR.

.6 The existing standby generator at the SSS will remain intact, and distribution will be relocated into the new SSSR for lighting, convenience receptacles, communications equipment, etc. in the SSSR.

.7 DC Battery and Charging System for protection and control systems.

.8 Inspections - Box, Conduit & Cable Installations

.9 Underground Services/Manholes

.10 Ground system inspection/report

.11 Communications Room, with D/X cooling.

.12 Interior lighting and controls

.13 Exterior lighting and controls

.14 CCTV

.15 Access Control

.16 Fire Alarm and emergency alarm system.

.17 Digital Power Metering

.18 SCADA-controlled remote breaker operation.

.19 Heating

.20 Ventilation and exhaust

.21 Air conditioning

.22 EMCS

.23 Water supply

.24 Water drain, vent and waste, including lift station

.25 Storm water drainage

.2 The Contractor shall use the 5 phase Cx process and document the proper operation of these systems, and the sub-systems they depend on, at least.

.3 Building Envelope Systems – insulation, air & water leakage.

.1 Building has a relatively straightforward envelope. The Cx approach is expected to be as described in the table below, with separate detailed field tests, if required.

Envelope	Lab Test	Field Review	Field Test	Standard
Water Leakage	Note 1	FR	?	As per Specifications
Membrane	Note 1	FR	No	As per Specifications
Condensation	Note 1	FR	No	As per Specifications
Structure	Note 1	FR	No	As per Specifications
Moisture	Note 1	FR	No	As per Specifications
Security	Note 1	FR	No	As per Specifications

LEGEND

Note 1 DENOTES THAT SHOP DRAWINGS CONFIRM SPEC'D CERTIFICATIONS
FR Denotes that design consultant or Cx Provider has done visual review.

.2 Architect will coordinate with Morrison Hershfield to develop a protocol for field test of below-grade water proofing, which will be executed by the contractor.

.4 This plan, or any other commissioning document or correspondence, does not relieve contractors from other testing, verification and commissioning duties that may be described in the project specifications or other agreements.

3.2 CxA's Duties

.1 The Commissioning Authority (CXA) serves as an objective advocate for the Owner, oversees the commissioning process and presents final recommendations to the Owner regarding the performance of the commissioned building. Avalon Energy Management (Contact Bob Landell) will perform the following tasks:

.1 Support efforts to implement the Building Systems Commissioning requirements throughout the project.

.2 List all relevant features and systems included in the Commissioning scope. The designers and contractors are to provide the detailed equipment lists, checklists, and schedules.

.3 Review the Owner's requirements and basis of design.

.4 Help coordinate the commissioning-related activities of the "Commissioning Team".

.5 Review the Contract Documents to help verify inclusion of commissioning responsibilities.

.6 Review Contractor's testing plans and criteria for each of the 5 Cx Phases

.7 Organize and chair Cx meetings of the Commissioning Team; facilitate the process of distributing minutes to all Commissioning Team members as required.

.8 Monitor construction for commissioning-related installation issues.

.9 Review start up process by observing a sampling of measurements.

.10 Verify commissioning process of automatic control systems by:

.1 Observing a sampling of point to point checks

.2 Obtaining and reviewing a copy of installation end-to-end check sheets.

.3 Observing a sampling of actuator travel ranges

.4 Observing a sampling of sensor calibration

.5 Observing a sampling of controls functional response

.6 Reviewing sample trend logs

.7 Verifying documentation of the testing of control sequences under all operating modes.

.11 Verify the documentation of performance of all systems being commissioned and witness a sample of functional performance tests, and review whether the results meet test criteria.

.12 Verify reported Testing and Balancing results by observing a sampling of measurements.

.13 Review consultant-approved Operating and Maintenance Manuals for compliance with specified content.

.14 Review seasonal testing by contractors, and carry out warranty year duties.

.15 Compile a commissioning report in accordance with the requirements.

3.3 General Contractor`s Duties

.1 The General Contractor shall ensure that the following Cx procedures and tests are within the scope of appropriate trades and sub-trades, and that they are performed and documented as required to meet the Owner's Project Requirements:

System	PRE-START	STARTUP	MANUF START RPT	TAB	FUNCTIONAL PERFORMANCE	VALIDATION & VERIFICATION
Heating	☐	☐	☐	☐	☐	☐
Cooling	☐	☐	☐	☐	☐	☐
Water distribution	☐	☐	☐	☐	☐	☐
Air distribution	☐	☐	☐	☐	☐	☐
Ventilation	☐	☐	☐	☐	☐	☐
Controls	☐	☐	☐	☐	☐	☐
Domestic Hot & Cold Water Systems	☐	☐	☐	☐	☐	☐
Light delivery	☐	☐	☐		☐	☐
Lighting controls	☐	☐	☐	☐	☐	☐
CCTV	☐	☐	☐	☐	☐	☐
Access Control	☐	☐	☐	☐	☐	☐
Fire Alarm	☐	☐	☐	☐	☐	☐
Digital Power Metering	☐	☐	☐	☐	☐	☐
SCADA-controlled remote breaker operation.	☐	☐	☐	☐	☐	☐
Power distribution Systems	☐	☐	☐	☐	☐	☐

.2 General Contractor will select independent Commissioning Agents and/or Coordinators to ensure Cx activities are carried out to ensure delivery of a fully operational project including:

.1 Organizing Cx.

.2 Monitoring operations Cx activities.

.3 Review of Cx documentation from operational perspective.

.4 Review for performance, reliability, durability of operation, accessibility, maintainability,

.5 Operational efficiency under conditions of operation.

.6 Protection of health, safety and comfort of occupants and O&M personnel.

.7 Monitoring of Cx activities, training, and development of Cx documentation.

.8 Work closely with members of Cx Team.

.9 Certifying accuracy of reported results

.10 Certifying tabs and other results

.11 Developing BMM.

.12 Ensuring implementation of final Cx Plan.

.3 The General Contractor shall incorporate the mechanical and electrical Cx schedules into the project's construction schedule, and coordinate milestones with the CXA.

.4 The General Contractor shall oversee or delegate the preparation for testing and Cx. The following are examples:

DYNAMIC TEST READINESS CHECKLIST

	YES	NO	N/A	DATE	INITIALS
GENERAL					
Applicable tests such as duct/pipe pressure tests submitted					
Construction, painting, millwork and flooring complete in areas served					
Building rooms clean and ready for fan start-up; "All Clean" declared					
AIRSIDE MECHANICAL					
TAB contractor has reviewed the system and completed job preparation					
Ductwork complete, terminals installed, dampers open					
Duct and fan plenum cleaning complete					
Correct filters installed					
Piping complete, gauges installed					
Piping filled, tested, treated and documented					
Valves positioned for testing					
Equipment mounts complete, shipping bolts removed, vibration isolation active					
Equipment lubricated					
Manufacturer's start-up reports received					
PLUMBING & WATERSIDE MECHANICAL					
Drainage connected					
Piping systems flushed out and treated					
Air removed from the system					
DHW systems activated					
CONTROLS					
Control wiring complete					
Control panels mounted and connected					
Thermostats, sensors, actuators, etc. installed					
End-to-end checks completed					
POWER					

Permanent electrical connections complete, including power to starters, rotation checks and overload sizes and settings checked					
Fire alarm system as per ULC					
Other tests and checks cited herein					

VERIFICATION READINESS CHECKLIST

	YES	NO	N/A	DATE	INITIALS
MECHANICAL					
Balancing complete					
Drive changes complete (as required)					
Applicable inspections by authorities having jurisdiction received					
FIRE PROTECTION					
Fire alarm installed and tested					
CONTROLS					
Control program installed, and verification checklist or de-bugging documentation completed with changes noted. Major changes copied to consultant for review					

.5 The General Contractor shall ensure that Training Plans are developed by the appropriate trades and sub-trades, and that they are submitted to the Architect for review. See section

.6 The General Contractor shall ensure that Seasonal and Deferred Testing is performed and documented by the appropriate trades and sub-trades, and that the reports are submitted to the CxA for review.

3.4 The Commissioning Agent is responsible for:

.1 Witnessing reported results.

.2 Witnessing TAB and other tests.

.3 Provides basis of design data not included in the Contract Documents.

.4 Reviews commissioning checklists and test forms to ensure applicability to the project and provide comments to the Commissioning Agent.

.5 Attends commissioning activities as required to certify the site adaptation and related work meet the design intent and the project requirements.

3.5 EGD Facility Manager: represents lead role in Operation Phase and onwards and is responsible for:

.1 Receiving facility on completion.

.2 Day-To-Day operation and maintenance of facility.

3.6 Mechanical Contractor`s Duties

.1 The Mechanical Commissioning Agent (MCA) shall be engaged by the Mechanical Trade Contractor to execute the requirements set out by the CaGBC's documentation, and the Contract Documents. The Commissioning Agent shall perform the following tasks:

.1 Prepare an MCA's Commissioning Plan outlining each of the following five phases involved in the Cx process:

.1 Phase 1 - System readiness.

.2 Phase 2 - System start-up, testing, balancing, and adjustment.

.3 Phase 3 - Verification of system performance.

.4 Phase 4 - Demonstration and instruction.

.5 Phase 5 – Seasonal testing and verification.

.2 Prepare an equipment inventory and all functional testing criteria as required by the specifications and Commissioning Plan for all features and systems requiring commissioning.

.3 Submit all required testing documentation to the Commissioning Authority and Mechanical Consultant for review.

.4 Attend all commissioning meetings as required by the Commissioning Authority or Owner.

.5 Execute or delegate all commissioning tasks as set out in the final functional testing criteria documents.

.6 Coordinate with Trade Contractors regarding sequencing of work. For example, before manufacturer site start-up of AHUs, safety features must be in place, ductwork must be ready, "All Clean" must be declared, power must be connected, hydronics must be cleaned, filled and free of air, controls must have been tested, etc.. Manufacturer start-up must be done prior to air balance, and so on.

.7 Record and document the verification of the specified Pre-Start checks, including but not limited to the following:

Compliant make and model,
CSA label,
no visible damage,
proper equipment installation as per specifications and manufacturer's recommendations,
mounting as specified,
seismic restraint as specified,
electrical connection safe and complete,
safety controls & interlocks functional,
operating controls connected and adequately functional,
pre-start safety checks (where applicable),
connection of other services complete,
supporting or related systems in place,
access for maintenance in place,
strainers/filters clean and firmly in place,
isolation valves, dampers or switches in place, set correctly and functional,
alignment of drives and components correct,
proper coil drain pan draining,
bypasses in place and appropriately positioned open or closed,
vibration isolation adjusted,
insulation as specified and full coverage,
lubrication complete,
penetrations through fire separations in place as specified,
purges and pressure/leak tests complete and passed,
environment (cleanliness, clearance, cooling, drainage, freeze protection, etc.) good,
water tightness of mechanical service roof and exterior wall penetrations,
air and water distribution cleaned degreased,
charges & pressures correctly set; proper air and water pressure relief in place.

.8 Record and document the verification of the specified Startup checks, including but not limited to the following:

pre-start test passed and conditions still in effect,
qualified personnel present,
confirmation of regulatory authorities' inspections, including reports,
manufacturer or vendor representative present,
factory technician test and start-up (where applicable),
correct rotation,
safety controls operate properly,
operating controls function properly
sequencing correct,
desired temperature/pressure/humidity maintained,
electrical characteristics conform to ratings,
no leaks,
noise as per ratings,
obtain certificates of approval and for compliance with regulations from Authorities Having Jurisdiction; include copies of certificates with startup reports.

.9 Immediately after start-up, submit Pre-start checklists and Start-up checklists, signed by the person performing the start-up, to the CxA.

.10 Prepare Functional performance test checklists containing the step-by-step procedures by which the functional requirements of a system, and its various components, will be confirmed. System's response is to be verified and clearly documented according to the respective manufacturer's written instructions, this plan, and the Contract Documents.

.11 The MCA is to prepare Functional Performance Test Checklists, including but not limited to the following:

.1 individual test procedures,

.2 the expected system response or acceptance criteria for each procedure,

.3 a place to record the actual response or findings,

.4 comments pertinent to the ongoing performance of the system and building.

.12 Each control sequence and strategy shall be tested, verified and documented by the Contractor, including:

.1 start-up, and shut down,

.2 modulation up and down over unit's range of capacity, and/or component staging,

.3 unoccupied and manual modes,

.4 power failure and backup/restart,

.5 abnormal or emergency modes,

.6 interlocks and alarms,

.7 sensor calibration.

.13 The checklists are to confirm the Owner's Project Requirements and design intent with respect to the following:

.1 electrical characteristics

.2 flows,

.3 pressures,

.4 temperatures

.5 overall system control programming and automatic performance and alarms.

The goal is to determine whether the installation functions properly under all specified conditions, not that it can be shown to function under one condition. Functional Performance Checklists, signed by the person performing the tests, must be submitted to the CXA immediately after testing.

.14 Participate in troubleshooting those systems that do not meet the functional testing criteria and provide all necessary follow-up testing and documentation.

.15 Submit completed functional test documentation to the Commissioning Authority and Mechanical Design Consultant for inclusion into the final Commissioning Report.

.16 Within 2 months of award, provide a preliminary Cx schedule for pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion to the Project Manager and the CXA. Update the schedule as appropriate. Submit information to the Project Manager on a monthly basis to refine the schedule for the commissioning phase of the work. Provide the following information:

.17 Building "All Clean"

.18 Equipment start-up schedule.

.19 Submission dates for the various documents required prior to substantial performance.

.20 Timing of the various phases of the commissioning, testing, balancing and training/demonstration process.

.21 Provide a certificate of building cleanliness: An "All Clean" declaration is to be signed by the Architect, Mechanical Engineer, and General Contractor. It shall signify that the building and ductwork is adequately clean to allow air distribution start-up without contaminating coils, controls, fan chambers, etc.

.22 Provide regular updates on project progress, of and witnessing of Cx. MCA to contact Avalon prior to Cx, and to provide 48 hours' notice of tests.

.23 Provide a Commissioning Report as specified in the contract documents and herein.

.24 Plan, coordinate and execute Owner and Building Operator training and demonstrations as set out in the specifications and Commissioning Plan.

.25 Provide two follow-up site visits to re-test and verify occupancy and seasonal-sensitive systems after the facility has been fully occupied. Coordinate seasonal performance verification with CXA. Tests must be done during normal (high) occupancy working hours, and at near winter design conditions, and near summer design conditions. Cx Agent shall review equipment operation, status of energy saving strategies. Submit a report of findings to CXA for each visit. Report to contain the following:

.1 Verification of whether conditions meet the Owner Requirements (as documented by Cx Authority), and whether equipment performance meets the design intent.

.2 List of out-of-tolerance conditions, and malfunctioning equipment, components and systems.

.3 Recommendations addressing each problem that was identified.

Seasonal Test Report – **Mechanical Cx Agent** - Required Sections:

WINTER	**SUMMER**
Date: Time of visit: Outdoor Temperature: Outdoor Cloud Cover: Areas too hot: Areas too cold: Areas Humidity: Areas With High Noise:	Date: Time of visit: Outdoor Temperature: Outdoor Cloud Cover: Areas too hot: Areas too cold: Areas Humidity: Areas With High Noise:
Air distribution equipment operating properly: Occupant Concerns Operator Concerns	Air distribution equipment operating properly: Occupant Concerns Operator Concerns
Owner Requirements being met for plumbing. List of Equipment Functioning Improperly	*Owner Requirements* being met for plumbing. List of Equipment Functioning Improperly
Problems:	**Problems:**
1 Description: Solution: Recommendation:	1 Description: Solution: Recommendation:
2 Description: Solution: Recommendation:	2 Description: Solution: Recommendation:
3 Description: Solution: Recommendation:	3 Description: Solution: Recommendation:

.26 Depending on the details of the contractors' contracts among themselves, either the Mechanical Cx Agent, or the mechanical trade shall provide further Seasonal Testing as follows:

Seasonal Test Report – **Mechanical Contractor** Required Sections

	Six Months After Occupancy
	Date: Time of visit: Outdoor Temperature: Outdoor Cloud Cover: Areas too hot: Areas too cold: Areas Humidity: Areas With High Noise:
	Air distribution equipment operating properly: Filters not bypassing and clean Vibration/noise acceptable Leaks found and plugged Warranty Issues
	Owner Requirements being met (details) List of Equipment Functioning Improperly
	Problems:
1	Description: Solution: Recommendation:
2	Description: Solution: Recommendation:
3	Description: Solution: Recommendation:

.27 Provide a report, for inclusion in the Re-commissioning Manual, which describes problems, solutions, and suggested improvements revealed in the first months of operation (Word and Excel format).

3.7 Testing & Balancing Agent Duties

.1 The Testing and Balancing Agent (TAB) shall be engaged by the Mechanical Trade Contractor to execute the contract requirements to meet the design intent and the Commissioning Authority. The TAB Agent must perform the following tasks:

.1 Prepare all functional testing criteria (including specific documentation) as required by the Commissioning Plan for all features and systems requiring testing or balancing.

.2 Submit all required testing documentation to the Commissioning Authority and Mechanical Consultant for review, including schedule, proposed procedures, and sample forms.

.3 Visit the site prior to TAB to review adequacy (quantities, locations and types) of balance-related devices.

.4 Attend all commissioning meetings as required by the Commissioning Authority.

.5 Provide Avalon with 7 days' notice of TAB testing periods.

.6 Execute or delegate all TAB tasks as set out in the final functional testing criteria documents.

.7 Coordinate with trade contractors regarding sequencing of work. For example, before balancing, ductwork must be ready, safeties must be functioning, power must be connected, hydronics to be filled and free of air, controls to have been tested, and, in the case of air distribution, the "All Clean" status must have been granted. Manufacturer start-up must be done prior to air balance, and so on.

.8 Provide the following TAB Process Quality Assurance Review to the CxA 2 months prior to commencement of balancing:

PROJECT: **EGD**
(Month)
DATE: 2016

	Test process	Test Equip	Equip Calibration	Test Staff	Staff Experience	Pass/Fail Criteria
AHU CFM			Certificate from X dated X	Mr John Doe	X yr; X projects; Qualifications	+/- X% from spec
Max/Min OAD Volumes			Certificate from X dated X	Ms Jane Doe	X yr; X projects; Qualifications	+/- X% from spec
Exhaust Fan Flows			Certificate from X dated X	Mr John Doe	X yr; X projects; Qualifications	+/- X% from spec
Diffuser Flows			Certificate from X dated X	Ms Jane Doe	X yr; X projects; Qualifications	+/- X% from spec
Pump Flows			Certificate from X dated X	Mr John Doe	X yr; X projects; Qualifications	+/- X% from spec
Heat Terminals			Certificate from X dated X	Ms Jane Doe	X yr; X projects; Qualifications	+/- X% from spec
DX AC			Certificate from X dated X	Mr John Doe	X yr; X projects; Qualifications	heat, cool, air change, OA CFM, controls

.9 At the completion of balancing, and following review of the TAB report, visit the site with the CXA and retest a sampling of balanced air. The CXA could require that up to 5% of terminals be verified, depending on the results of initial tests.

.10 Participate in troubleshooting those systems that do not meet the functional testing criteria and provide all necessary follow-up testing and documentation.

.11 Submit completed functional test documentation to the Commissioning Authority and Mechanical Design Consultant for inclusion into the final Commissioning Report.

.12 Provide O&M Manuals as specified. Provide sections of O&M Manual for inclusion in Systems Recommissioning Manual to CxA, in Word and Excel file format, as required.

.13 Plan and execute demonstrations and training as set out in the Commissioning Plan or specifications.

.14 Provide deferred or seasonal functional performance testing and documentation of proper operation during warrantee period. Seasonal test to be done so that systems' performance is reviewed during both warm (summer) days and cold (winter) days. Correct deficiencies and make necessary adjustment to O&M manuals and as-built drawings.

3.8 Seasonal Test Report – TAB Agent- Required Sections:

	Three, Six or Nine Months After Occupancy
	Date: Time of visit: Outdoor Temperature: Outdoor Cloud Cover: Areas too hot: Areas too cold: Areas Humidity: Areas With High Noise:
	Air distribution equipment operating properly: Motor rotation Volumes still as per design intent Supply Air Temperatures appropriate and efficient Outdoor Air volumes minimal for heating, max for free cooling
	Flow and ventilation Owner Requirements being met (details) List of Equipment Functioning Improperly **Problems:**
1	Description: Solution: Recommendation:
2	Description: Solution: Recommendation:
3	Description: Solution: Recommendation:

3.9 Controls Contractor Duties

.1 The Controls Trade Contractor shall provide a Commissioning Agent (CCA) from their staff to:

.2 Prepare a CCA's Commissioning Plan outlining each of the following five phases involved in the Cx process:

.1 Phase 1 - System readiness (clean, grounded, interlocked, mounted properly, accessible, etc.).

.2 Phase 2 - System start-up, testing, balancing, and adjustment.

.3 Phase 3 - Verification of system performance.

.4 Phase 4 - Demonstration and instruction.

.5 Phase 5 – Seasonal testing and verification.

.3 Prepare Functional Performance Test Checklists as a record that all controls provided have been inspected, checked and verified for proper installation and performance. Prepare an equipment inventory and all functional testing criteria as required by the specifications and Commissioning Plan for all features and systems requiring commissioning. Example checklists are as follows:

CONTROLLERS	**Controller**	**Card**	**Card**
ITEM INSPECTED	1	**Expansion Module 1**	**Expansion Module 2**
	Y/N/na	Y/N/na	Y/N/na
Shop drawings approved			
Software licensing in place			
QC inspection report reviewed and deficiencies corrected			
Device matches specified products			
Devices mounted and restrained properly			
Number of control panels & system architecture correct			
Number of points monitored is correct			
Conduit, plenum-rated cable and flex connections selected and installed appropriately			
Wire shielding is correct			
Control device properly located and installed			

CONTROLLERS	**Controller**	**Card**	**Card**
ITEM INSPECTED	1	**Expansion Module 1**	**Expansion Module 2**
	Y/N/na	Y/N/na	Y/N/na
Devices and components tagged and identified at all terminations, splices, and junctions			
Point lists present inside panel			
Software and hardware alarms are in place			
Connection to EMCS Server DDC network is made			
Graphics accepted by ME & Owner			
BACnet interface between proprietary controls and DDC system are functioning properly			
Trend-log in place for all necessary inputs, outputs, variables			
Operating software complete, including energy strategies (weekly and annual schedules, economizers, optimized water and air set points, optimized motor speeds, etc.).			
REMARKS/COMMENTS:			
ACKNOWLEDGED			
Controls Contractor:			
MCA:			

INPUT POINTS	**Card**	**Inputs**	
ITEM INSPECTED	**1**	1ip1	1ip2
		Y/N/na	Y/N/na
Shop drawings approved			
QC inspection report reviewed and deficiencies corrected			
Devices matches specified products			
Devices mounted and restrained properly			
Number of points monitored is correct			
Conduit, plenum-rated cable and flex connections selected and installed appropriately			
Wire shielding is correct			
Control device properly located and installed			
Sensors and devices calibrated and verified			
Devices and components tagged and identified at all terminations, splices, and junctions			
Trend-log in place for all necessary (inputs, outputs, variables)			
REMARKS/COMMENTS:			
ACKNOWLEDGED			
Controls Contractor:			
MCA:			

OUTPUT POINTS	**Card**	**Outputs**	
ITEM INSPECTED	**1**	1OP1	1OP2
	Y/N/na	Y/N/na	Y/N/na
Shop drawings approved			
Sequences of operation are understood and make sense			
QC inspection report reviewed and deficiencies corrected			
Devices matches specified products			
Devices mounted and restrained properly			
Conduit, plenum-rated cable and flex connections selected and installed appropriately			
Wire shielding is correct			
Control device properly located and installed			
Sensors and devices calibrated and verified			
Devices and components tagged and identified at all terminations, splices, and junctions			
Software and hardware alarms are in place			
BACnet interface between proprietary controls and DDC system are functioning properly			
Trend-log in place for all necessary (inputs, outputs, variables)			
REMARKS/COMMENTS:			
ACKNOWLEDGED			
Controls Contractor:			
MCA:			

.4 Submit all required testing documentation to the Commissioning Authority and Mechanical Consultant for review.

.5 Attend all commissioning meetings as required by the Commissioning Authority or Owner.

.6 Execute or delegate all commissioning tasks as set out in the final functional testing criteria documents.

.7 Verify that systems are functionally meeting the design intent, and produce a Cx Report documenting this, and identifying where design intent is not being met.

.8 Controls Contractor to provide O&M Manual, including sequences of operation, network diagrams, graphics, shop drawings, recommended post-occupancy calibration, test and maintenance procedures, etc. to CXA for inclusion in Systems Recommissioning Manual. Submit in Word and Excel file format, as required.

.9 Controls Contractor to provide training and training materials for temperature controls, DDC operation and reporting, energy conservation strategies, and other control items having an impact on building or system operation.

.10 Provide deferred or seasonal functional performance testing and documentation of proper operation during warrantee period. Seasonal test to be done during normal working hours, and so that systems' performance is reviewed during both warm (summer) days and cold (winter) days. Correct deficiencies and make necessary adjustment to O&M manuals and as-built drawings.

Seasonal Test Report – **Controls Contractor** - Required Sections:

Three, Six or Nine Months After Occupancy

Date:
Time of visit:
Outdoor Temperature:
Outdoor Cloud Cover:

Areas too hot:
Areas too cold:
Areas Humidity:
Areas With High Noise:

Control system operating properly:
Sequences in "auto"

Minimal simultaneous heating and cooling
Heat recovery dampers operating properly
Minimal heating O/A ventilation (MAD, CO2/RH) and proper free cooling operation
Motor speeds no higher than necessary
Lighting interface and unoccupied sweeps functioning
Time Schedules correct

Owner Energy and Temp Control Requirements being met (details)

List of Equipment Functioning Improperly

Problems:

1	Description: Solution: Recommendation:
2	Description: Solution: Recommendation:
3	Description: Solution: Recommendation:

3.10 Electrical Trade Contractor Duties

.1 The Electrical Trade Contractor shall provide a Commissioning Agent or Coordinator (ECA) to

.1 Prepare an ECA's Commissioning Plan outlining each of the following five phases involved in the Cx process:

.1 Phase 1 - System readiness (clean, grounded, interlocked, mounted properly, accessible, etc.).

.2 Phase 2 - System start-up, testing, balancing, and adjustment.

.3 Phase 3 - Verification of system performance.

.4 Phase 4 - Demonstration and instruction.

.5 Phase 5 – Seasonal testing and verification.

.2 Conduct and pay for tests of the following:

.1 Medium voltage switchgear commissioning and testing.

.2 Protective systems coordination study

.3 Setup, calibration, programming and documentation of multifunction protective relays.

.4 Medium voltage breaker set-up calibration, testing and reporting.

.5 Low voltage breaker set-up, calibration, testing and reporting.

.6 Arc flash arc fault study.

.7 Testing protection and control DC supply, voltage, current and wiring systems.

.8 Station ground resistance testing and certification.

.9 Lightning protective grounding system and certification.

.10 Transformer testing and commissioning

.11 Dobel power factor testing

.12 Hipiot testing.

.13 Megger testing

.14 Voltage testing

.15 Phase rotation testing

.16 Motors heaters and controls.

.17 Polarization testing of receptacles and utilization devices

.18 Lighting systems and controls

.19 Illumination testing

.20 Testing and reporting fiber optic inside plant and outside plant cables and systems.

.21 Testing and reporting copper communications and data cabling inside plant and outside plant cables and systems.

.22 Testing and reporting and certification of fire alarm and emergency alarm systems.

.23 Such additional testing as required for completion of the test forms laid out in 01 91 31 3.9.24

.3 Furnish manufacturer's certificate or letter confirming that entire installation relating to their product has been installed to manufacturer's instructions.

.4 Carry out tests in presence of the Commissioning Authority.

.5 Give advance notice of proposed time of tests so that the Commissioning Authority can be represented at the tests.

.6 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.7 Submit test results for review by the Commissioning Authority.

.8 Test all systems in accordance with details in appropriate sections.

.9 Testing methods and test results: in accordance with CSA, CEC, NETA MTS, and regulations of the supply authority and other authorities having jurisdiction.

.10 Liability: During tests, assume responsibility for damages in the event of injury to personnel, building or equipment and bear costs for liability, repairs and restoration.

.11 Remove and replace with new materials all conductors that are found to be shorted or grounded.

.12 Conduct dielectric tests, hi-pot tests, insulation resistance tests and ground continuity tests as required by the nature of the various systems and equipment.

.13 With the systems completely connected and lamped, conduct and document the following tests on the power system:

.1 Control and Switching: test all circuits for the correct operation of devices, switches and controls.

.2 Polarity Tests: test all circuits for correct operation of devices, switches and controls.

.3 Voltage Tests: make a voltage test at the last outlet of each circuit. Maximum drop in potential permitted will be 2% on 120V, and 208V branch circuits. 2% on 208V feeder circuits, and 5% on 600V feeder circuits. Correct any deficiency in this respect.

.4 Phase Balance: measure the load on each phase at each switchboard, splitter, distribution panel board and lighting and power panel board. Report results in writing to the Commissioning Authority. Re-arrange phase connections as necessary to balance the load on each phase as instructed by the Commissioning Authority with the re-arrangement being restricted to the exchanging of connections at the distribution points mentioned in this paragraph. After marking any such changes, make available to the Commissioning Authority, drawings or marked prints showing the modified connections.

.5 Supply Voltage: measure the line voltage of each phase at the load terminals of the main breakers and report the results in writing to the Commissioning Authority. Perform this test with the majority of electrical equipment in use.

.6 Motor Loading: measure the line current of each phase of each motor with the motor operating under load and report the results in writing to the Commissioning Authority. Upon indications of any imbalance or overload, thoroughly examine electrical connections and rectify any defective parts or wiring. If electrical connections are correct, overloads due to defects in the driven machines shall be reported in writing to the Departmental Representative. Verify motor full load amps and overload relays are properly sized and adjusted accordingly.

.7 General Operations: energize and put into operation each and every electrical circuit and item. Make repairs, alterations, replacements, tests and adjustments necessary for a complete and satisfactory operating electrical system.

.14 Carry out tests covering "General Operation" at the time of acceptance of the work.

.15 Test all systems and obtain written confirmation from the manufacturer of each system that all components have been installed correctly and that the system is functioning as intended. Present separate certification for all systems including: fire alarm, power distribution, to the Commissioning Authority.

.16 Provide labour, instruments, apparatus and pay all expenses required for the tests. The Departmental Representative reserves the right to demand proof of the accuracy of all instruments used.

.17 When tests are performed, the Departmental Representative may require that equipment be opened and removed from their housings to examine interior of equipment, terminations and connections. Provide all required labour and tools.

.18 Co-ordinate the testing of motors with the trades providing the equipment driven by the motors so that they are carried out at the time the driven equipment is put on test. In addition to the motor loading tests, provide labour and instruments to take and record all motor load readings required to supplement the tests on the driven equipment through various load sequences, as required by the trades involved.

.19 Immediately prior to building occupancy, test the entire electrical system by performing a loss and return of utility power test. Demonstrate the operation of:

.1 High and low voltage service equipment and metering.

.2 Exit and emergency lighting.

.3 Fire alarm operation during power outage, including remote monitoring system.

.4 EMCS system shut down and auto restart, including re-stabilization of systems after power return. Attach printouts as evidence of expected operation on all systems including all air handling systems and pump systems.

.5 User equipment shutdown and auto-restart.

.20 Insulation Resistance Testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Megger 600-2.4kV circuits, feeder and equipment with 5000 V instrument.

.4 Check resistance to ground before energizing.

.21 Harmonic Testing and Report:

.1 Conduct a harmonic test of the system and individual CDP's utilizing the DMS systems. Ensure all available loads are fully operational.

.2 Prepare a harmonic analysis report to IEEE 519 requirements, duly signed and stamped by a Professional Engineer.

.22 Fire Alarm System Testing and Adjusting:

.1 Ensure that the manufacturer makes an inspection of the fire alarm and smoke comprise an examination of such equipment for the following:

.1 detection system and equipment including those components necessary to the direct operation of the system such as manual stations, heat detectors, smoke detectors and controls whether or not manufactured by the manufacturer. The inspection and tests to conform to CANIULC-S536 Inspection and Testing of Fire Alarm System and CANIULC S537 Verification of Fire Alarm Systems and also to comprise an examination of such equipment for the following:

.1 That the type of equipment installed is as described by these electrical specifications.

.2 That the wiring connections to all equipment components show that the installer undertook to have observed ULC and CSA requirements.

.3 That equipment of the manufacturer has been installed in accordance with the manufacturer's recommendations and that all signaling devices of whatever manufacturer have been operated or tested to verify their operation.

.4 That the supervisory wiring of those items of equipment connected to a supervised circuit is operating and that the governmental regulations, if any, concerning such supervisory wiring have been met to the satisfaction of inspection authorities.

.2 On completion of the inspection and when all of the above conditions have been complied with, the manufacturer shall issue to the Commissioning Agent the following:

.1 A copy of the inspecting technician's report showing the location of each device and certifying the test results of each device.

.2 A certificate of verification confirming that the inspection has been completed and showing the conditions upon which such inspection and certification have been rendered.

.3 Proof of liability insurance for the inspection.

.3 Verification procedures, testing requirements, documentation required, etc. shall be in accordance with the requirement of ULC Standard CAN/ULC-S537.

.4 The Commissioning Agent must be present at and during the verification and certification in order for the verification to be valid.

.5 Start-up:

.1 The verification and certification hereinafter described shall include the following tests:

.1 Initiate alarm from each manual pull station.

.2 Initiate alarm from each automatic heat and/or smoke detector by operation of device or by jumpering out device in the case of fixed temperature heat detectors

.3 Initiate alarm at control panel to check supervisory function.

.4 Initiate one test alarm to central supervisory station after notice of test is given.

.5 Check correctness of identification of annunciator zones for each device.

.6 Check operation of all auxiliary contacts and devices and verify that auxiliary control of door holders, fans, etc. is fully operational.

.7 Above noted system shall be compatible with Base system.

.8 After verification of the fire alarm system, demonstrate the system to the satisfaction of the Commissioning Authority.

.23 A revised arc flash assessment will be completed and the equipment will be labeled with the appropriate decals as per CSA-Z462.

.24 Prepare Functional Performance Test Checklists that will be a record that all electrical services provided have been inspected, checked and verified for proper installation and performance. Prepare an equipment inventory and all functional testing criteria as required by the specifications and Commissioning Plans for all features and systems requiring commissioning. The system list overview is; but not limited to the following:

	Cx Plans			Cx Execution			
CHECKLIST	**Submitted**	**Reviewed**	**Updated**	**Complete**	**Reviewed**	**Notes**	**Comments**
Medium Voltage Duct-Banks							
Medium Voltage Manholes							
Medium Voltage Cables							
Station Ground Electrode							
Lightning Protective Ground							
Circuit Switchers							
Medium Voltage Metal Enclosed Switches							
Medium Voltage Vacuum Circuit Breakers							
Medium Voltage Transformers Liquid Cooled							
Medium Voltage Transformers Air Cooled							
Medium Voltage Regulator Liquid Cooled							
Multi-Function Protective Relay Test Reports/Settings							
DC Systems for Protection and Control							

	Cx Plans			Cx Execution			
CHECKLIST	**Submitted**	**Reviewed**	**Updated**	**Complete**	**Reviewed**	**Notes**	**Comments**
Low Voltage Duct Banks							
Low Voltage Manholes							
Low Voltage Cables							
Insulated Case Circuit Breakers							
Low Voltage Breaker Testing and Coordination							
Molded Case Circuit Breakers							
Low Voltage Ground Fault Protection							
Low Voltage Switchgear Switchboard Assemblies							
Low Voltage Panelboard Assemblies							
Low Voltage Disconnect Switch							
Low Voltage Surge Arresters							
Low Voltage Transformers Air Cooled							
Low Voltage Systems Grounding and Bonding							
Capacitor/Reactor Harmonic Filter Bank.							
Dry Type Reactors							
Installation of Electrical Equipment: Conduits, trays Cables and Boxes							

	Cx Plans			Cx Execution			
CHECKLIST	**Submitted**	**Reviewed**	**Updated**	**Complete**	**Reviewed**	**Notes**	**Comments**
Installation of Electrical Equipment: Utilization Devices – Outlets and Heating/Cooling							
Interior Lighting Systems							
Exterior Lighting Systems							
Metal Enclosed Busways							
Motor Control and Motor Starters							
Sanitary Lift Station Commissioning Reports							
Transfer Switchboard Assemblies Manual and Automatic							
Uninterruptable Power Supplies							
Digital Metering Systems							
Low Voltage Ship Shore Power Supply							
Arc Flash Arc Fault Study and Report							
Metering and SCADA Communications							
Communications Sys. Inside Plant							
Communications Sys. Outside Plant							
Fire Detection and Alarms Systems							
SCADA Systems							

	Cx Plans			Cx Execution			
CHECKLIST	**Submitted**	**Reviewed**	**Updated**	**Complete**	**Reviewed**	**Notes**	**Comments**
Electronic Safety and Security							
Variable Frequency Drive							
Video Surveillance CCTV System							

Note: there may be Cx requirements in other sections of the specification.

.2 Submit all required testing documentation to the Commissioning Authority and Electrical Consultant for review. For example:

- .1 Implementation of Coordination Study Settings
- .2 Certificates and/or Equipment Test Report
- .3 Equipment Spare Parts Report
- .4 Generic Acceptance Report
- .5 Final Acceptance Report.

.3 Attend all commissioning meetings as required by the Commissioning Authority or Owner.

.4 Execute or delegate all commissioning tasks as set out in the final functional testing criteria documents.

.5 Verify that systems are functionally meeting the design intent, and produce a Cx Report documenting this, and identifying where design intent is not being met.

.6 Electrical Trade Contractor to provide O&M Manual, sequences of operation, recommended post-occupancy calibration, test and maintenance procedures, etc. to CXA for inclusion in Systems Recommissioning Manual. Submit in Word and Excel file format, as required.

.7 Electrical Trade Contractor to provide training and training materials

.8 Provide deferred or seasonal functional performance testing and documentation of proper operation during warrantee period. Seasonal test to be done during normal working hours, and so that systems' performance is reviewed during both long (summer) days and short (winter) days. Correct deficiencies and make necessary adjustment to O&M manuals and as-built drawings.

.9 Allow minimum 8 hours for each of two site visits for seasonal/deferred testing and reporting. 16 hours total.

Seasonal Test Report – **Electrical Contractor & Cx Agent** - Required Sections:

3, 6 or 9 Months After Occupancy. One electrical seasonal test will take place during high power demand events (such as large retrofit of ship) within warranty period.

Date:

Time of visit:

Outdoor Temperature:

Outdoor Cloud Cover:

Power equipment operating properly:

Perform:

- IR scan of all equipment installed.
- Visual inspections.
- Check metering system operation.
- Heating cooling system operation.
- Protection and control battery.
- Sanitary lift pump station operation.
- Ship shore power supplies.
- Lighting systems operation.

Items identified by Users and Occupants

Owner Requirements for lighting and energy being met (details).

List of Equipment Functioning Improperly.

Problems:

1	Description: Solution: Recommendation:
2	Description: Solution: Recommendation:

3.11 Required Written Work Products – Consultants, and Trades Other Than Cx Agencies, Controls and Electrical

.1 COMMISSIONING AUTHORITY

.1 Schematic design review.

.2 CxA'S Cx Plan (this document),

.3 Review of construction documents,

.4 Commissioning Binder, Systems Manual and 10 Month Warranty Report.

.2 DESIGN CONSULTANTS

.1 Contract Documents by consultants. The Consultants' (Architect, Designers and Engineers) Contract Documents shall clearly require that features, equipment and systems are to be installed in such a way that TAB and commissioning are facilitated. The documents shall also identify Trade Contractors' responsibilities for execution and documentation of the Commissioning Process.

.2 Shop drawing process:

.1 The contractor is to forward the shop drawings, via architect, to the consultants, who review them.

.2 The architect shall forward mechanical, electrical and lighting shop drawings to the CxA at the same time as the engineers.

.3 All sustainability-related Change Orders and Site Instructions are to be copied to the CxA. Consultants to verify that changes are in keeping with the Owner's Project Requirements.

.4 Reviews and approvals of insulation, air barrier, walls, windows, roof and skylights by Architect or envelope consultant to document that envelope assemblies control water and air leakage, and condensation properly - so that negative impact on energy required is minimized, and negative impact on IAQ is eliminated. CXA to receive copies of all such Field Reviews and test reports.

.5 Training overview material is required from the Architect, including how the building keeps air and water out; what kind of envelope maintenance may be required and when; unusual items, etc. Design intents are required from the mechanical and electrical engineers.

.6 Reviews and acceptance of electrical power and lighting components and of proper system installation and operation, provided by Electrical Engineer.

.7 Reviews and acceptance of mechanical components, and of proper system installation and operation, to be provided by Mechanical Engineer.

.8 Building "All Clean" certification is required to allow fan operation. The Architect, General Contractor and Owner shall jointly sign a letter declaring that the building and systems are clean enough to run the fans.

.9 Reviews of TAB and commissioning submittals and documents by Design Consultants, with written acceptance forwarded to the CXA for inclusion in the Commissioning Report.

.3 TRADE CONTRACTORS

.1 Construction Schedule integrating all divisions of the work, and allowing adequate time for submittal reviews, commissioning of equipment, verification of systems' operation, and the demonstration to (and training of) the Owner, review of operating and maintenance and Cx manuals. The schedule shall include, but not be limited to, the following items:

- .1 Installation and testing of piping systems and equipment, including protection of heat exchangers during cleaning.
- .2 Installation and cleaning of air distribution systems and equipment.
- .3 Connection of electrical services to equipment by electrical trade contractor.
- .4 Chemical cleaning and treatment of water distribution systems.
- .5 Control system installation.
- .6 Pre-start checks.
- .7 Start-up of equipment and systems.
- .8 Air/Water balancing, including samples witnessed by CXA.
- .9 Check-out of control systems.
- .10 Commissioning of systems, including samples witnessed by CXA.
- .11 Correction of deficiencies and retests.
- .12 Demonstration of systems and equipment to Consultant.
- .13 Demonstration of systems and equipment to Owner.
- .14 Preparation of maintenance manuals and as-built drawings.
- .15 Submission of the various documents required prior to substantial performance.
- .16 Project closeout documents.

.2 Contractor Submittal Drawings and Equipment Data: Submittals will be reviewed by Design consultants and CXA to help verify that the systems and equipment being supplied are consistent with the required commissioning test procedures, and if not, that the variances are acceptable to the Team, and that commissioning checklists are revised accordingly.

.3 Approved Pre-start checklists and Start-up checklists must be completed prior to start-up of each specific system or piece of equipment. Checklists, signed by the person performing the start-up, must be submitted to the CXA immediately after start-up.

.4 Functional performance verifications for equipment and systems must be performed, and redone until proper system performance is verified.

.5 As-built drawings forwarded by installing contractors. The various trades shall mark-up the consultants' drawings to indicate design or layout changes that took place during construction.

.6 Training materials by sub-trades to meet the requirements of See Section 01 91 41.

.7 Reports on seasonal testing and documentation of proper operation during warrantee period.

.8 See other sections for specific MCA, ECA, CCA, and TAB Trade requirements and duties.

.9 The following tables provides a <u>partial</u> checklist of submittals required by each sub-trade:

DESCRIPTION	FORMAT			FROM			
	PDF	.doc .xls	sign-off	Consultant	Cx Agent	TAB	Mech Contractor
Cx Plan (5 Phases), Process, Inventories and Checklists		☐			☐	☐	☐
Cx Schedule (5 Phases)		☐			☐	☐	☐
Preliminary O&M Manual from Cx Agents		☐			☐	☐	☐
Reviewed TAB Report	☐	☐		☐			
TAB Report Test Performance Sheets	☐	☐			☐	☐	☐
Reviewed O&M Manual	☐		☐	☐			
System Descriptions and all sections described in Contract Doc's	☐	☐			☐	☐	
Validation Of Testing and Balancing			☐		☐	☐	
Training Plans		☐			☐	☐	☐
Validation of Fire Damper Operation			☐		☐	☐	
Training Materials and Validation of Owner's Training	☐	☐	☐	☐	☐	☐	☐
Deferred & Seasonal System Tests, Adjustments and Reports	☐				☐	☐	☐

DESCRIPTION	FORMAT				
	PDF	.doc .xls	sign-off	Mech Contractor	Controls Contractor
Controls Cx Plan (5 Phases), Inventories and Checklists		☐			☐
Cx Schedule (5 Phases)		☐			☐
Preliminary O&M Manual from Cx Agents		☐		☐	☐
Signed Commissioning Checklists	☐	☐		☐	☐
DDC & Other Controls Sequences of Operation	☐	☐			☐
Controls Checkouts	☐	☐			☐
Recommended Post-Occ Calib, Test & Maint Procedures		☐			☐
Training Plan	☐	☐		☐	☐
Training Materials and Validation of Owner's Training		☐	☐	☐	☐
Seasonal System Tests, Adjustments and Reports		☐		☐	☐

DESCRIPTION	FORMAT			FROM
	pdf	.doc .xls	Sign off	Electrical Contractor
Cx Plan (5 Phases) Inventories and Checklists				☐
Cx Schedule (5 Phases)				☐
Preliminary O&M Manual from Cx Agents		☐		☐
Validation of Power Systems Operation			☐	☐
Reviewed Commissioning Report	☐	☐		
Start-up and Operation Requirements – Electrical Systems			☐	☐
Signed Commissioning Checklists	☐	☐		☐
Reviewed O&M Manual	☐		☐	☐
System Descriptions	☐	☐		
Reviewed Controls Manual	☐	☐		
Line Voltage Controls Checkouts	☐	☐		☐
Electrical Training Plan				☐
Validation of Penetrations Through Separations			☐	☐
Validation of Seismic Restraint Installation			☐	☐
Validation of Vibration Isolation			☐	☐
Validation of Electrical System Demonstration			☐	☐
Training Materials and Validation of Owner's Training	☐	☐	☐	☐
Problems & Suggestions in First Few Months		☐		☐
Seasonal System Tests, Adjustments and Reports	☐			☐

DESCRIPTION	FORMAT			FROM
	PDF	.doc .xls	sign-off	Electrical Trade
Cx Schedule (5 Phases)				☐
Power Shop Drawings	☐			☐
Electrical Training Plan	☐			☐
Validation of Fire Stopping	☐		☐	☐
Letters of Assurance from Trades' Engineers	☐			☐
Validation of Items To Be Handed Over To Owner	☐		☐	☐
Validation of Electrical System Demonstration	☐		☐	☐
Training Materials and Validation of Owner's Training	☐	☐	☐	☐
Record Drawings	☐	☐	☐	☐

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Commissioning forms to be completed for equipment installation (static verification), initial start-up, functional performance testing, and integration of each system.

1.2 STATIC VERIFICATION FORMS

.1 Shall include as a minimum, the following data:

.1 Field review of equipment and systems installation. That the systems elements have been installed in accordance to the applicable contract documents and manufacturer's instructions.

.2 Special procedures as outlined in relevant technical sections.

.3 That equipment has been installed according to good installation and engineering practice.

.2 Where equipment manufacturer's installation and start-up documentation is provided, it shall be attached to the appropriate commissioning documents. Additional documentation is required regarding physical installation, anchoring, labeling, condition and physical or functional location, etc.

.3 Use checklists to document each phase of equipment or system installation. Document all values including failing quantities. Report failures to Commissioning Authority for review of failure and proposed remediation.

.4 Check lists are required to be signed off by the installation contractor, the commissioning agent, and the Commissioning Authority.

.5 Static verification forms must be completed and signed off prior to proceeding to the start-up or functional performance testing.

.6 All static verification forms are to be included in the (BMM) Building Management Manual.

1.3 START-UP FORMS

.1 Shall include as a minimum, the following data:

. Verification of the completion of static verification for each installation or system.

1 The initial energization or pressurization of specific systems.

. The recording of initial pressure, temperature voltage and relevant data.

2 The rotation and initial function of each system element.

. Load balance and flow balancing of individual systems.

3 Visual and operational inspections of individual systems.

. Include all start-up forms in the BMM (Building Management Manual).

4

1.4 FUNCTIONAL PERFORMANCE TESTING

.1 **FORMS:** Shall include as a minimum the following

.
5
data: Verification of the completion of the static verification and start-up phases prior to commencing the functional performance testing forms.

.
6
.2 All labeling and documentation must be completed.

.7

.2 Commissioning procedures shall be carried out to ensure that all of the building component systems are functionally operating in accordance with contract documents and shop drawings. Functional performance tests shall include but not be limited to the following procedures:

.1 Tests to ensure that equipment and systems including components such as interlocks, PLC programs, metering and automation systems are operational under all normal operating modes (including partial or full load) and abnormal or emergency conditions.

.2 Power quality measurements.

.3 Voltage and voltage drop measurements.

.4 Receptacle testing.

.5 Thermographic survey.

.6 Illumination measurement.

.7 Sound level measurement.

.8 Vibration measurement.

.9 Audibility and function of alarms systems.

.10 Verification of temperatures, flows and pressures.

.3 Include all functional performance documentation in the BMM (Building Management Manual).

1.5 COMMISSIONING FORMS INDEX

.1 Commissioning forms are required for, but not limited to the following list of divisions and systems installations.

.2 Commissioning forms for each division and shall include but not be limited to the following:

.1 Architectural systems of a less complex nature do not require static verification start-up and functional performance testing. Some of the following Architectural Divisions and systems can be suitably reported and documented by use of field reviews attached to the commissioning manual.

.2 Architectural:

.1 Architectural Field Review and Compliance - Below Grade - Crawl spaces

.2 Architectural Field Review and Compliance - Below Grade - Perimeter drainage

.3 Architectural Field Review and Compliance - Below Grade - Slabs-on grade

.4 Architectural Field Review and Compliance - Below Grade - Wall systems

.5 Architectural Field Review and Compliance - Common Interior - Acoustic barriers

.6 Architectural Field Review and Compliance - Common Interior - Active coatings

.7 Architectural Field Review and Compliance – Common Interior - Door Hardware

.8 Architectural Field Review and Compliance - Common Interior - Finishes

.9 Architectural Field Review and Compliance - Common Interior - Glazing

.10 Architectural Field Review and Compliance - Common Interior - Insulation

.11 Architectural Field Review and Compliance - Common Interior - Joints junctions interfaces

.12 Architectural Field Review and Compliance - Exterior Wall - Back-up walls

.13 Architectural Field Review and Compliance - Exterior Wall - Cladding
.14 Architectural Field Review and Compliance - Exterior Wall - Fenestration
.15 Architectural Field Review and Compliance - Exterior Wall - Interior finishes
.16 Architectural Field Review and Compliance - Floor Ceiling - Access floors
.17 Architectural Field Review and Compliance - Floor Ceiling - Membranes
.18 Architectural Field Review and Compliance - Floor Ceiling – Penetrations
.19 Architectural Field Review and Compliance - Floor Ceiling - Protective coatings
.20 Architectural Field Review and Compliance - Interior Walls - Cladding
.21 Architectural Field Review and Compliance - Interior Walls - Fenestration
.22 Architectural Field Review and Compliance - Interior Walls - Interior finishes
.23 Architectural Field Review and Compliance - Roof - Four ply
.24 Architectural Field Review and Compliance - Roof - Inverted
.25 Architectural Field Review and Compliance - Roof - Penetrations
.26 Architectural Field Review and Compliance - Roof - Walkways

.3 Electrical

.1 Medium Voltage Duct-Banks
.2 Medium Voltage Manholes
.3 Medium Voltage Cables
.4 Station Ground Electrode
.5 Lightning Protective Ground
.6 Circuit Switchers
.7 Medium Voltage Metal Enclosed Switches
.8 Medium Voltage Vacuum Circuit Breakers
.9 Medium Voltage Transformers Liquid Cooled
.10 Medium Voltage Transformers Air Cooled
.11 Medium Voltage Voltage Regulator Liquid Cooled
.12 Multi-Function Protective Relays
.13 DC Systems for Protection and Control
.14 Low Voltage Duct Banks
.15 Low Voltage Manholes
.16 Low Voltage Cables
.17 Insulated Case Circuit Breakers
.18 Low Voltage Breaker Testing and Coordination
.19 Molded Case Circuit Breakers
.20 Low Voltage Ground Fault Protection
.21 Low Voltage Switchgear Switchboard Assemblies
.22 Low Voltage Panelboard Assemblies
.23 Low Voltage Disconnect Switches
.24 Low Voltage Surge Arresters
.25 Low Voltage Transformers Air Cooled

.26 Low Voltage Systems Grounding and Bonding
.27 Capacitor/Reactor Harmonic Filter Bank
.28 Dry Type Reactors
.29 Installation of Electrical Equipment
.30 Interior Lighting Systems
.31 Exterior Lighting Systems
.32 Metal Enclosed Busways
.33 Motor Control and Motor Starters
.34 Sanitary Lift Stations
.35 Transfer Switchboard Assemblies
.36 Uninterruptable Power Supplies
.37 Digital Metering Systems
.38 Low Voltage Ship Shore Power Supplies
.39 Metering and SCADA Communications
.40 Communications Sys. Inside Plant
.41 Communications Sys. Outside Plant
.42 Fire Detection and Alarms Systems
.43 SCADA Systems
.44 Electronic Safety and Security
.45 Variable Frequency Drives
.46 Video surveillance

.4 Control Systems and Integration
.1 Building System Integration
.2 Control Points
.3 DDC Field Control Panel
.4 Domestic Cold Water System
.5 Domestic Hot Water System
.6 Operators Work Station
.7 Variable Frequency Drives

.5 Mechanical
.1 Air Handling Unit
.2 Backflow Preventors
.3 Cabinet Unit Heaters
.4 Direct Fired Markup Air Units
.5 Domestic Cold Water System
.6 Domestic Hot Water System
.7 Domestic Hot Water Tank
.8 Drainage System
.9 Ductwork Inspection and Tests
.10 Exhaust Fans

.11 Heat Pump
.12 Pressure Regulating Station
.13 Pump
.14 Specialized Systems
.15 Split System Air Conditioning Unit
.16 Sump Pump
.17 Unit Heaters
.18 Water Heaters
.19 Water Meters

1.6 LANGUAGE

.1 To suit the language profile of the awarded contract.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

This Section specifies roles and responsibilities of Commissioning

.2 Training. Related Sections:

.1	General Commissioning Cx	Section 01 91 13
.2	Requirements Commissioning Plan	Section 01 91 31

1.2 TRAINEES

.1 Trainees: personnel selected for operating and maintaining this facility. Includes Departmental Representative, building operators, maintenance staff, security staff, and technical specialists as required.

.2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

1.3 INSTRUCTORS

.1 Commissioning Authority will provide:

.1 Descriptions of systems.

.2 Instruction on design philosophy, design criteria, and design intent.

.2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:

.1 Start-Up, operation, shut-down of equipment, components and systems.

.2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.

.3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.

.3 Contractor and equipment manufacturer to provide instruction on:

.1 Start-up, operation, maintenance and shut-down of equipment they have installed and connected, after completion of static verification, start-up and functional performance testing.

1.4 TRAINING OBJECTIVES

.1 Training to be detailed and duration to ensure:

.1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.

.2 Effective on-going inspection, measurements of system performance.

.3 Proper preventive maintenance, diagnosis and trouble-shooting.

.4 Ability to update documentation.

.5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

.1 Instructors to be responsible for content and quality.

.2 Training materials to include:

.1 "As-Built" Contract Documents.

.2 Operating Manual.

.3 Maintenance Manual.

.4 Management Manual.

.5 TAB and PV Reports.

.3 Project Manager, Commissioning Authority and Departmental Representative will review training manuals.

.4 Training materials to be in a format that permits future training procedures to same degree of detail.

.5 Supplement ARV training materials:

.1 Transparencies for overhead projectors.

.2 Multimedia presentations.

.3 Manufacturer's training videos.

.4 Equipment models.

1.6 SCHEDULING

.1 Include in Commissioning Schedule time for training.

.2 Deliver training during regular working hours, training sessions to be 8 hours in length.

.3 Training to be completed prior to acceptance of facility.

1.7 RESPONSIBILITIES

.1 Be responsible for:

.1 Implementation of training activities,

.2 Coordination among instructors,

.3 Quality of training, training materials.

.2 Commissioning Authority will evaluate training and materials.

.3 Upon completion of training, provide written report, signed by Instructors, witnessed by Commissioning Authority.

1.8 MECHANICAL SYSTEM TRAINING

.1 Organize and conduct training courses to instruct the Departmental Representative in the operation and preventative maintenance of equipment and systems provided at the completion of the project.

.2 Provide services of qualified personnel, including each sub-trade, each major equipment supplier and design engineer to and instruct on their equipment or systems.

.3 One-person day shall be eight hours including one half hour for breaks, and one person week shall be five person days.

.4 Submit sessions schedule and list of representatives to the Commissioning Authority for approval 30 days prior to course starting date. Confirm attendance of course by written notification to all participants, followed by verbal confirmation just prior to course starting date.

.5 Submit final copies of record drawings and operating and maintenance manuals to Commissioning Authority.

.6 Submit a written follow-up of all courses, complete with an attendants list to the Departmental Representative.

.7 Systems Course: Allow a minimum of 8 hours of instruction to conduct systems training courses addressing the following topics:

- .1 Air Systems:
  - .1 Review operation of systems and equipment:
    - .1 Air systems
    - .2 All exhaust systems
  - .2 Review equipment maintenance.
  - .3 Air system site tour (air handling units/ventilation/ fans)
    - .1 Demonstrate start/stop
    - .2 Components.
    - .3 Maintenance.
- .2 Cooling Systems:
  - .1 Review operation of system and equipment
  - .2 Review condensing unit and maintenance
  - .3 Review system maintenance.
  - .4 Cooling system site tour.
  - .5 Demonstrate start/stop.
    - .1 Auto control.
    - .2 Maintenance.
- .3 Heating System:
  - .1 Review operation of system and equipment.
  - .2 Review equipment maintenance.
  - .3 Heating system site tour.
- .4 Plumbing:
  - .1 Review system operation equipment.
  - .2 Review equipment maintenance including:
    - .1 Compressed Air
    - .2 Fixtures
- .5 Site Services:
  - .1 Sanitary/storm/domestic water.

.8 Controls Course: Allow a minimum of 8 hours of instruction and an additional 8 hours of instructions to conduct the controls systems training courses as follows:

.1 Provide the services of competent instructors who will give instruction to designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements of the equipment and system specified. The training shall be specifically for the system installed rather than being a general "canned" training course. The Commissioning Authority shall have the right to approve/reject the instructors based on their qualifications. All equipment and material required for classroom training shall be provided by the General Contractor.

.2 Training Program: provide in two phases over a 6 month period, the time interval specified for each phase.

.1 First phase: this phase shall be for a period of 1 day prior to the 30 day test period. Operating personnel will be trained in the functional operations of the system installed and the procedures that the operators will employ for system operation. First phase training shall include the following:

.1 General EMCS Architectural (overview).

.2 System Communications (overview).

.3 Operation of computer and peripherals (overview).

.4 Operator Interface functions for control of HV AC systems (detailed).

.5 Control Logic (detailed for each system).

.6 Report Generation (overview).

.7 Colour graphics generation.

.8 Elementary preventive maintenance (detailed).

.2 Second Phase: this phase of training shall be conducted eight weeks after system acceptance for a period of one day. Training will be provided for three categories of personnel: operators, equipment maintenance personnel. The training shall include as a minimum, but not be limited to:

.1 Operator Training and Equipment Maintainer’s Training include:

.1 General equipment layout.

.2 Troubleshooting of all EMCS components.

.3 Preventive maintenance of all EMCS components.

.4 Sensors and controls maintenance and calibration

1.9 ELECTRICAL SYSTEM TRAINING

.1 Organize and conduct training courses to instruct the Departmental Representative in the operation and preventative maintenance of equipment and systems provided at the completion of the project.

.2 Provide services of qualified personnel, including each sub-trade, each major equipment supplier and design engineer to and instruct on their equipment or systems.

.3 One-person day shall be eight hours including one half hour for breaks, and one person week shall be five person days.

.4 Submit sessions schedule and list of representatives to the Commissioning Authority for approval 30 days prior to course starting date. Confirm attendance of course by written notification to all participants, followed by verbal confirmation just prior to course starting date.

.5 Submit final copies of record drawings and operating and maintenance manuals to Commissioning Authority. Submit a written follow-up of all courses, complete with an attendants list to the Departmental Representative.

.6 Systems Course: Allow a minimum of 64hours of instruction (Eight 8-hour training sessions) to conduct systems training courses addressing but not limited to the following topics:

.1 Site Civil Works, Manholes and Infrastructure.

.1 Review: Duct banks manholes and site civil works.

.2 Medium Voltage Cables and Distribution Equipment.

.1 Review: Medium voltage cable installation, single line diagram and medium voltage distribution equipment.

.3 Medium Voltage Protection and Control, Metering and SCADA Systems.

.1 Review: Protective relays, metering systems, SCADA systems maintenance and operation.

.4 Low Voltage Distribution Systems.

.1 Review: Switchboards, breakers, transformers, grounding and bonding.

.5 Low Voltage Distribution Systems – Specialized Equipment.

.1 Review: Transfer switches, UPS systems, power factor correction, ship shore power supplies.

.6 Lighting and Lighting Systems.

.1 Review: Lighting equipment installations, lighting controls and emergency lighting systems.

.7 Waste Water Lift Stations:

.1 Review and demonstrate lift station controls, power, alarms and SCADA.

.8 Fire Alarm and Emergency Alarm Systems:

.1 Review and demonstrate the operation, and maintenance of the alarms systems.

.9 Communications Systems:

.1 Review communications infrastructure and inside/outside plant distribution.

.2 Review security camera systems infrastructure and distribution.

.3 Review SCADA systems infrastructure, distribution, and software.

.10 Power Metering Systems:

.1 Review system design and infrastructure.

.2 Review system programming, data capture and troubleshooting.

.3 Review of HMI screens, trending functions, alarm operations.

.4 Refer to Section 26 29 23.02 for additional requirements.

.11 Voltage Regulator and Power Connections

.1 Review operation of systems and equipment.

.2 Review of setting adjustment.

.3 Review of control software.

.4 Review and demonstrate bypass function.

END OF SECTION

1.0 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 This section is limited to portions of the Building Management Manual (BMM) provided to Departmental Representative by Contractor.

.2 Acronyms:

.1 BMM - Building Management Manual.
.2 Cx - Commissioning.
.3 HVAC - Heating, Ventilation and Air Conditioning.
.4 PI - Product Information.
.5 PV - Performance Verification.
.6 TAB - Testing, Adjusting and Balancing.
.7 WHMIS - Workplace Hazardous Materials Information System.

1.2 GENERAL REQUIREMENTS

.1 Standard letter size paper 216 mm x 279 mm.

.2 Methodology used to facilitate updating.

.3 Drawings, diagrams and schematics to be professionally developed.

.4 Electronic copy of data to be in a PDF with hyperlink from content page to individual sections.

1.3 APPROVALS

.1 Prior to commencement, co-ordinate requirements for preparation, submission and approval with Departmental Representative.

1.4 GENERAL INFORMATION

.1 Provide Departmental Representative the following for insertion into appropriate Part and Section of BMM:

.1 Complete list of names, addresses, telephone and fax numbers of contractor, sub-contractors that participated in delivery of project - as indicated in Section 1.2 of BMM.
.2 Summary of architectural, structural, fire protection, mechanical and electrical systems installed and commissioned - as indicated in Section 1.4 of BMM.
.1 Including sequence of operation as finalized after commissioning is complete as indicated in Section 2.0 of BMM.
.3 Description of building operation under conditions of heightened security and emergencies as indicated in Section 2.0 of BMM.
.4 System, equipment and components Maintenance Management System (MMS) identification - Section 2.1 of BMM.
.5 Information on operation and maintenance of architectural systems and equipment installed and commissioned - Section 2.0 of BMM.
.6 Information on operation and maintenance of fire protection and life safety systems and equipment installed and commissioned - Section 2.0 of BMM.
.7 Information on operation and maintenance of mechanical systems and equipment installed and commissioned - Section 2.0 of BMM.
.8 Operating and maintenance manual - Section 3.2 of BMM.
.9 Final commissioning plan as actually implemented.

.10 Completed commissioning checklists.
.11 Commissioning test procedures employed.
.12 Completed Product Information (PI) and Performance Verification (PV) report forms, approved and accepted by Departmental Representative.
.13 Commissioning reports.

1.5 CONTENTS OF OPERATING AND MAINTENANCE MANUAL

.1 For detailed requirements refer to Section 01 78 00 - Closeout Submittals.

.2 Departmental Representative to review and approve format and organization within 12 weeks of award of contract.

.3 Include original manufactures brochures and written information on products and equipment installed on this project.

.4 Record and organize for easy access and retrieval of information contained in BMM.

.5 Include completed PI report forms, data and information from other sources as required.

.6 Inventory directory relating to information on installed systems, equipment and components.

.7 Approved project shop-drawings, product and maintenance data.

.8 Manufacturer's data and recommendations relating: manufacturing process, installation, commissioning, start-up, O&M, shutdown and training materials.

.9 Inventory and location of spare parts, special tools and maintenance materials.

.10 Warranty information.

.11 Inspection certificates with expiration dates, which require on-going re-certification inspections.

.12 Maintenance program supporting information including:
.1 Recommended maintenance procedures and schedule.
.2 Information to removal and replacement of equipment including, required equipment, points of lift and means of entry and egress.

1.6 LIFE SAFETY COMPLIANCE (LSC) MANUAL

.1 Samples of LSC Manual will be available from Departmental Representative.

.2 Content of Manual:
.1 All possible Emergency situations modes including: presence of fire and smoke, power failure, lose of water or pressure, chemical spills and refrigerant release.
.2 HVAC emergencies and fuel supply failures.
.3 Intrusion and security breach.
.4 Emergency provisions for natural disasters, bomb threats and other disruptive situations.
.5 Dedicated emergency generators for high security projects, medical facilities and computer systems.
.6 Emergency control procedures for fire, power and major equipment failure.

.7 Emergency contacts and numbers.
.8 Manual to be readily available and comprehensible to non- technical readers.

1.7 SUPPORTING DOCUMENTATION FOR INSERTION INTO SUPPORTING APPENDICES

.1 Provide Departmental Representative supporting documentation relating to installed equipment and system, including:
  .1 General:
    .1 Finalized commissioning plan.
    .2 WHMIS information manual.
    .3 Approved "as-built" drawings and specifications.
    .4 Procedures used during commissioning.
    .5 Cross-Reference to specification sections.
  .2 Architectural and structural:
    .1 Inspection certificates, construction permits.
    .2 PV reports.
  .3 Fire prevention, suppression and protection:
    .1 Test reports.
    .2 Smoke test reports.
    .3 PV reports.
  .4 Mechanical:
    .1 Installation permits, inspection certificates.
    .2 Piping pressure test certificates.
    .3 Ducting leakage test reports.
    .4 TAB and PV reports.
    .5 Charts of valves and steam traps.
    .6 Copies of posted instructions.
  .5 Electrical:
    .1 Installation permits, inspection certificates.
    .2 TAB and PV reports.
    .3 Electrical work log book.
    .4 Charts and schedules.
    .5 Locations of cables and components.
    .6 Copies of posted instructions.

.2 Assist Departmental Representative with preparation of BMM.

1.8 LANGUAGE

.1 Provide documentation in English only.

1.9 IDENTIFICATION OF FACILITY

.1 When submitting information to Departmental Representative for incorporation into BMM, use following system for identification of documentation:
  .1 As advised by Departmental Representative.

1.10 USE OF CURRENT TECHNOLOGY

.1 Use current technology for production of documentation. Emphasis on ease of accessibility at all times, maintain in up-to-date state, compatibility with user's requirements.

.2 Obtain Departmental Representative's approval before starting Work.

END OF SECTION 01 91 51

1.0 GENERAL

1.1 RELATED REQUIREMENTS
.1 Health and Safety Section 01 35 33

1.2 REFERENCES
.1 CSA International
.1 CSA S350-M1980 (R2003), Code of Practice for Safety in Demolition of Structures.

1.3 ACTION & INFORMATIONS SUBMITTALS
.1 Submit in accordance with Section 01 33 00 - Submittal Procedures and 01 74 19 - Waste Management and Disposal.

.2 Submit hoarding layout plan for approval by Departmental Representative at each stage of work.
.3 Sustainable Design Submittals:
.1 Construction Waste Management:
.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.4 SITE CONDITIONS
.1 If material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous is encountered, stop work, take preventative measures, and notify Departmental Representative immediately.
.1 Proceed only after receipt of written instructions have been received from Consultant.

.2 Notify Departmental Representative before disrupting building access or services.

.3 Extent of Demolition - refer to drawing including removal and disposal of all existing furniture and tables in the galleria and atrium only after arrival and installation of new furniture.

3.0 EXECUTION

3.1 EXAMINATION
.1 Inspect building with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.

.2 Perform GPR scan prior to demolition of floor slab. Locate and protect utilities. Preserve active utilities traversing site in operating condition.

.3 Notify and obtain approval of utility companies before starting demolition.

.4 Disconnect, cap, plug or divert, as required, existing utilities within the building where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or

plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.

.1 Immediately notify Departmental Representative and the Owner concerned in case of damage to any utility or service designated to remain in place.

.2 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

3.2 PREPARATION

.1 Protection of In-Place Conditions:

.1 Prevent movement, settlement, or damage to adjacent structures, and utilities.

.2 Keep noise, dust, and inconvenience to occupants to minimum.

.3 Protect building systems, services and equipment.

.4 Provide temporary dust screens, covers, railings, supports and other protection as required.

.5 Do Work in accordance with Section 01 35 33 - Health and Safety Requirements.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION 02 41 99

1.0 GENERAL

1.1 RELATED WORK

.1	Excavating, Trenching and Backfilling	Section 31 33 00.01
.2	Concrete Reinforcing	Section 03 20 00
.3	Cast-In-Place Concrete	Section 03 30 00

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)
- .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .2 CSA-O86-09, Engineering Design in Wood.
- .3 CSA O121-08, Douglas Fir Plywood.
- .4 CSA O151-09, Canadian Softwood Plywood.
- .5 CSA O153-13, Poplar Plywood.
- .6 CAN/CSA-O325-07, Construction Sheathing.
- .7 CSA O437 Series-93 (R2006), Standards for OSB and Waferboard.
- .8 CSA S269.1- Falsework for Construction Purposes.
- .9 CAN/CSA-S269.3-M92 (R2003), Concrete Formwork, National Standard of Canada

.2 Underwriters' Laboratories of Canada (ULC)
- .1 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 –Submittal Procedures.

.2 Submit shop drawings for formwork and falsework.
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada. Submit schedule B and C-B as per BCBC 2012.

.3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 33 – Health and Safety Requirements.

.4 Co-ordinate submittal requirements and provide submittals required by Section 01 33 00.

.5 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings and Comply with CAN/CSA-S269.3 for formwork drawings.

.6 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.

.7 Indicate sequence of erection and removal of formwork/falsework as directed by Departmental Representative.

.8 The contractor is responsible for the design of all formwork and shoring and for complying with all Workers' Compensation Board regulations pertaining to formwork construction,

design and inspection. Formwork and shoring shall be designed by a qualified professional engineer registered or licensed in British Columbia.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Store and manage hazardous materials in accordance with Section 01 51 00 – Temporary Facilities.

.2 Waste Management and Disposal:

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

2.0 PRODUCTS

2.1 MATERIALS

.1 Materials and resources in accordance with Section 01 61 00 – Product Requirements.

.2 Formwork materials:

.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CAN/CSA-O86, CSA O437 Series, CSA-O153.

.2 Rigid insulation board: to CAN/ULC-S701.

.3 Form ties:

.1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.

.4 Form liner:

.1 Plywood: high density overlay, medium density overlay, Douglas Fir to CSA O121, Canadian Softwood Plywood to CSA O151 or Poplar to CSA O153 grade, square edge, 20 mm thick.

.5 Form release agent: non-toxic, biodegradable, low VOC.

.6 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 70 and 110s Saybolt Universal 15 to 24 mm^2/s at 40 degrees C, flashpoint minimum 150 degrees C, open cup.

.7 Falsework materials: to CSA-S269.1.

.8 Sealant: to Section 07 92 00 – Joint Sealants.

3.0 EXECUTION

3.1 FABRICATION AND ERECTION

.1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.

.2 Obtain Departmental Representative's approval for use of earth forms framing openings not indicated on drawings.

.3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.

.4 Fabricate and erect falsework in accordance with CSA S269.1.

.5 Do not place shores and mud sills on frozen ground.

.6 Provide site drainage to prevent washout of soil supporting mud sills and shores.

.7 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.

.8 Align form joints and make watertight.
- .1 Keep form joints to minimum.

.9 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.

.10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

.11 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.
- .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.12 Line forms for following surfaces:
- .1 Exposed faces of abutments, wingwalls, piers and pylons: do not stagger joints of form lining material and align joints to obtain uniform pattern. Secure lining taut to formwork to prevent folds.
- .2 Pull down lining over edges of formwork panels.
- .3 Ensure lining is new and not reused material.
- .4 Ensure lining is dry and free of oil when concrete is poured.
- .5 Application of form release agents on formwork surface is prohibited where drainage lining is used.
- .6 If concrete surfaces require cleaning after form removal, use only pressurized water stream so as not to alter concrete's smooth finish.
- .7 Cost of textile lining is included in price of concrete for corresponding portion of Work.

.13 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND SHORING

.1 Leave formwork in place for following minimum periods of time after placing concrete.
- .1 Three days for walls and sides of beams.
- .2 Three days for columns.
- .3 Twenty eight days for beam soffits, slabs, decks and other structural members, or one days when replaced immediately with adequate shoring to standard specified for falsework.
- .4 One days for footings and abutments.

.2 Remove formwork when concrete has reached 75% of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.

.3 Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

.4 Space reshoring in each principal direction at not more than 3000 mm apart.

.5 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

END OF SECTION 03 10 00

1.0 GENERAL

1.1 RELATED WORK

.1 Concrete Forming and Accessories Section 03 10 00

.2 Cast-In-Place Concrete Section 03 30 00

1.3 REFERENCES

.1 American Concrete Institute (ACI)

.1 SP-66-04, ACI Detailing Manual 2004.

.1 ACI 315-99, Details and Detailing of Concrete Reinforcement.

.2 ACI 315R-04, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A143/A143M-03, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.

.2 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.

.3 ASTM A497/A497M-07, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.

.3 Canadian Standards Association (CSA International)

.1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA-A23.3-04, Design of Concrete Structures.

.3 CAN/CSA-G30.18-M92(R2002), Billet-Steel Bars for Concrete Reinforcement, A National Standard of Canada.

.4 CSA-G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.5 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles, A National Standard of Canada.

.6 CSA W186-M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.

.4 Reinforcing Steel Institute of Canada (RSIC)

.1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 –Submittal Procedures.

.2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice and ACI 315.

.3 Submit shop drawings including placing of reinforcement and indicate:

.1 Bar bending details.

.2 Lists.

.3 Quantities of reinforcement.

.4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings.

.5 Indicate sizes, spacings and locations of chairs, spacers and hangers.

.4 Detail lap lengths and bar development lengths to CSA-A23.3, unless otherwise indicated.

.1 Provide type A tension lap splices where indicated unless otherwise indicated.

.5 When Chromate solution is used as replacement for galvanizing non-prestressed reinforcement, provide product description for review by Departmental Representative prior to its use.

.6 Quality Assurance: Provide the following to the Departmental Representative.

.1 Mill Test Report: upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, minimum 4 weeks prior to beginning reinforcing work.

.2 Upon request submit in writing to Departmental Representative proposed source of reinforcement material to be supplied.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Store and manage hazardous materials in accordance with Section 01 51 00 – Temporary Facilities.

.2 Waste Management and Disposal:

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

2.0 PRODUCTS

2.1 MATERIALS

.1 Materials and resources in accordance with Section 01 61 00- Product Requirements.

.2 Substitute different size bars only if permitted in writing by Departmental Representative.

.3 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.

.4 Reinforcing steel: weldable low alloy steel deformed bars to CAN/CSA-G30.18.

.5 Cold-drawn annealed steel wire ties: to ASTM A497/A497M.

.6 Deformed steel wire for concrete reinforcement: to ASTM A497/A497M.

.7 Welded steel wire fabric: to ASTM A185/A185M.

.1 Provide in flat sheets only.

.8 Welded deformed steel wire fabric: to ASTM A497/A497M.

.1 Provide in flat sheets only.

.9 Epoxy Coating of non-prestressed reinforcement for exterior roadway pavement: to ASTM A775/A775M.

.10 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.

.11 Mechanical splices: subject to approval of Departmental Representative.

.12 Plain round bars: to CSA-G40.20/G40.21.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2, ACI 315 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

.1 ACI 315R unless indicated otherwise.

.2 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.

.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

.1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.

.2 Upon request inform Departmental Representative of proposed source of material to be supplied.

3.0 EXECUTION

3.1 PREPARATION

.1 Galvanizing to include chromate treatment.

.1 Duration of treatment to be 1 hour per 25 mm of bar diameter.

.2 Conduct bending tests to verify galvanized bar fragility in accordance with ASTM A143/A143M.

3.2 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.

.2 When field bending is authorized, bend without heat, applying slow and steady pressure.

.3 Replace bars, which develop cracks or splits.

3.3 PLACING REINFORCEMENT

.1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA-A23.1/A23.2.

.2 Use plain round bars as slip dowels in concrete.

.1 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.

.1 When paint is dry, apply thick even film of mineral lubricating grease.

.3 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.

.4 Ensure cover to reinforcement is maintained during concrete pour.

.5 Protect epoxy and paint coated portions of bars with covering during transportation and handling.

3.4 FIELD TOUCH-UP

.1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.

END OF SECTION 03 20 00

1.0 GENERAL

1.1 RELATED WORK

.1	Concrete Forming and Accessories	Section 03 10 00
.2	Concrete Reinforcing	Section 03 20 00
.3	Architectural Concrete	Section 03 33 00
.4	Concrete Finishing	Section 03 35 00

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

- .1 ASTM C109-12, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50-mm Cube Specimens).ASTM D260-86 (2001), Standard Specification for Boiled Linseed Oil.
- .2 ASTM C309-11, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- .3 ASTM C332-09, Specification for Lightweight Aggregates for Insulating Concrete.
- .4 ASTM C827-10, Test Method for Early Volume Change of Cementitious Mixtures.
- .5 ASTM D1751-04(R2008), Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non extruding and Resilient Bituminous Types).
- .6 ASTM D1752-04a(2008), Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .7 ASTM C 260 – 10a, Specifications for Air-Entraining Admixtures for Concrete.
- .8 ASTM C 494M – 13, Specifications for Chemical Admixtures for Concrete.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-19.24-M90, Multicomponent, Chemical-Curing Sealing Compound.

.3 Canadian Standards Association (CSA International)

- .1 CSA-A23.1-09 Concrete Materials and Methods of Concrete Construction.
- .2 CSA-A23.2-09, Methods of Test for Concrete.
- .3 CAN/CSA-A3000-08, Cementitious Materials CompendiuM.
- .4 CSA-A3001-03, Cementitious Materials for Use in Concrete.
- .5 CAN/CSA-G30.18-M92(R2002), Billet-Steel Bars for Concrete Reinforcement.

1.3 CERTIFICATES

.1 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA-A23.1.

.2 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1.

1.4 QUALITY ASSURANCE

.1 Minimum 2 weeks prior to starting concrete work, submit proposed quality control procedures for Departmental Representative's approval for following items:

- .1 Falsework erection.
- .2 Hot weather concrete.
- .3 Cold weather concrete.
- .4 Curing.
- .5 Finishes.
- .6 Formwork removal.
- .7 Joints.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Concrete hauling time: maximum allowable time limit for concrete to be delivered to site of Work and discharged not to exceed 120 minutes after batching.
- .1 Modifications to maximum time limit must be agreed to by the Departmental Representative and concrete producer as described in CSA A23.1/A23.2.
- .2 Deviations to be submitted for review by the Departmental Representative.

.2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

2.0 PRODUCTS

2.1 MATERIALS

.1 Portland cement: to CAN/CSA-A3000.

.2 Supplementary cementing materials: with minimum 10% Type F fly ash replacement, by mass of total cementitious materials to CAN/CSA A3000.

.3 Water: to CAN/CSA-A23.1.

.4 Aggregates: to CAN/CSA-A23.1. Coarse aggregates to normal density.

.5 Air entraining admixture: to CAN/CSA-A3000.

.6 Chemical admixtures: to CAN/CSA-A3000. Departmental Representative to approve accelerating or set retarding admixtures during code and hot weather placing.

.7 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents.
- .1 Compressive strength: 50 MPa at 28 days.
- .2 Consistency:
  - .1 Fluid: to ASTM C827. Time of efflux through flow cone (ASTM C939), under 30 s.
  - .2 Flowable: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portion) 125 to 145%.
  - .3 Plastic: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portions) 100 to 125%.
  - .4 Dry pack to manufacturer's requirements.

.7 Non premixed dry pack grout: composition of non metallic aggregate Portland cement with sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compressive strength of 50 MPa at 28 days.

.8 Curing compound: to CAN/CSA-A23.1 white and to ASTM C309, Type 1-chlorinated rubber.

.9 Cushion pads: tough, resilient, weather, moisture, and oil resistant material that will not corrode or cause corrosion, consisting of either layers of approved cotton duck saturated

and bound together by approved rubber or synthetic compounds, or made from specially compounded synthetic materials.

.10 Ribbed waterstops: extruded PVC [Arctic Grade] of sizes indicated with welded corner and intersecting pieces:
- .1 Tensile strength: to ASTM D412, method A, Die "C", minimum 11.4 MPa.
- .2 Elongation: to ASTM D412, method A, Die "C", minimum 275%.
- .3 Tear resistance: to ASTM D624, method A, Die "B", minimum 48 kN/m.

.11 Premoulded joint filler:
- .1 Bituminous impregnated fibreboard: to ASTM D1751.
- .2 Sponge rubber: to ASTM D1752, Type I, flexible grade.

.12 Weep hole tubes: plastic.

.13 Dovetail anchor slots: minimum 0.6 mm thick galvanized steel with insulation filled slots.

.14 Dampproof membrane:
- .1 Kraft/polyethylene membrane:
  - .1 Plain: .05 mm thick polyethylene film bonded to 2.44 kg/m^2 asphalt treated creped kraft.
  - .2 Reinforced: two .05 mm thick polyethylene films bonded each side of 2.44 kg/m^2 asphalt treated creped kraft paper, reinforced with 13 x 13 mm fibreglass scrim.
  - .3 Membrane adhesive: as recommended by membrane manufacturer.

.15 Dampproofing: Emulsified asphalt, mineral colloid type, unfilled: to CAN/CGSB-37.2, and to Section 07 13 52 – Modified Bituminous Sheet Waterproofing.

.16 Polyethylene film: 0.25mm (6 mil) thickness to CAN/CGSB-51.34.

2.2 MIXES

.1 Proportion normal density concrete in accordance with CAN/CSA-A23.1, Alternative 1 to give the following properties:
- .1 Cement: Type GU Portland cement.

.2 Minimum compressive strength at 28 days, class of exposure and nominal size of coarse aggregate:

Member	minimum 28-days strength (MPa)	maximum aggregate size (mm)	exposure class	air content Category
Footings, Walls (Interior)	25	25	N	-
Suspended slab (Interior)	30	20	N	-
Columns (Interior)	35	25	N	-
Perimeter footings/walls,	25	25	C-1	1
Exterior footings, columns	25	25	F-2	1
Slab on grade (Interior)	25	20	C-4	2
Slab on grade (Exterior)	32	20	C-2	1
Roadway Pavement (Exterior)	32	20	C-2	1

.3 Slump at time and point of discharge: To CSA-A23.1 Clause 4.3.2.3. When super plasticizers are used, the slump may be increased by shall kept below the point where segregation will occur. The cost of super plasticizers shall be included in the cost of the concrete. Smaller aggregate size may be used where necessary to increase slump.

.4 Air content: To CSA-A23.1 Table 2 & 4 to suit appropriate exposure class.

.5 Chemical admixtures: following admixtures in accordance with to ASTM C494M. Admixtures shall contain no salts or acids.

.6 Concrete mix designs shall be submitted to a material consultant for approval and to Departmental representative for review prior to any concrete work.

3.0 EXECUTION

3.1 PREPARATION

.1 Obtain Departmental Representative's approval before placing concrete. Provide 72 h notice prior to placing of concrete.

.2 Pumping of concrete is permitted only after approval of equipment and mix.

.3 Ensure reinforcement and inserts are not disturbed during concrete placement.

.4 Prior to placing of concrete obtain Departmental Representative 's approval of proposed method for protection of concrete during placing and curing.

.5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

.6 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.

.7 Do not place load upon new concrete until authorized by Departmental Representative.

3.2 CONSTRUCTION

.1 Perform cast-in-place concrete work in accordance with CSA-A23.1.

.2 Sleeves and inserts.

.1 No sleeves, ducts, pipes or other openings shall pass through joists, beams, column capitals or columns, except where indicated or approved by Departmental Representative.

.2 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 x 100 mm not indicated, must be approved by Departmental Representative.

.3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Departmental Representative before placing of concrete.

.4 Check locations and sizes of sleeves and openings shown on drawings.

.5 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.

.3 Anchor bolts.

.1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.

.2 With approval of Departmental Representative, grout anchor bolts in holes drilled after concrete has set. Drilled holes to be to manufacturer's recommendations.

.3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.

.4 Set bolts and fill holes with epoxy grout.

.5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.

.4 Drainage holes and weep holes:
- .1 Form weep holes and drainage holes in accordance with Section 03 10 00 - Concrete Forms and Accessories. If wood forms are used, remove them after concrete has set.
- .2 Install weep hole tubes and drains as indicated.

.5 Dovetail anchor slots:
- .1 Install continuous vertical anchor slot to forms where masonry abuts concrete wall or columns.
- .2 Install continuous vertical anchor slots at [800] mm oc where concrete walls are masonry faced.

.6 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.

.7 Finishing:
- .1 Finish concrete in accordance with CAN/CSA-A23.1.
- .2 Use procedures acceptable to Departmental Representative or those noted in CAN/CSA-A23.1 to remove excess bleed water. Ensure surface is not damaged.

.8 Waterstops:
- .1 Install waterstops to provide continuous water seal. Do not distort or pierce waterstop in such a way as to hamper performance. Do not displace reinforcement when installing waterstops. Use equipment to manufacturer's requirements to field splice waterstops. Tie waterstops rigidly in place.
- .2 Use only straight, heat sealed butt joints in field. Use factory welded corners and intersections unless otherwise approved by Departmental Representative.

.9 Joint fillers:
- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative. When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
- .2 Locate and form isolation, construction and expansion joints as indicated. Install joint filler.
- .3 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.

.10 Dampproof membrane:
- .1 Install dampproof membrane under concrete slabs-on-grade inside building.
- .2 Lap dampproof membrane minimum 150 mm at joints and seal.
- .3 Seal punctures in dampproof membrane before placing concrete. Use patching material at least 150 mm larger than puncture and seal.

.11 Locations of construction joins shall be submitted to the departmental representative for review in advance and prior to commencement of construction.

.12 Supply and set anchor bolts, sleeves, pipe hangers, expansion joints and other inserts and openings as indicated in the structural drawings and specifications or in documents by other consultants.

.13 All dowels, anchor bolts, embedded plates and other inserts shall be placed before the concrete is poured.

.14 Slab on grade joints shall be 35mm deep sawcuts spaced maximum 4500mm apart, layout of joins shall be approved by the Departmental representative, seal with flexible joint sealer to prevent ingress of water.

3.3 SITE TOLERANCE

.1 All horizontal surfaces shall meet the Class A Slab and Floor Finish classification (+/- 8mm) in accordance with Table 22 of CAN/CSA-A23.1 straight edge method.

.2 Tolerance closer than those specified in CSA-A23.1 may be required at certain locations for structural, architectural and construction requirements.

3.4 FIELD QUALITY CONTROL

.1 Inspection and testing of concrete and concrete materials will be carried out by a CSA certified Testing Laboratory designated by Departmental Representative in accordance with CAN/CSA-A23.1. Submit all concrete testing results to the departmental representative.

.2 Contractor will pay for costs of tests as specified in Section 01 11 55 – General Instructions.

.3 Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

.4 Non-destructive Methods for Testing Concrete shall be in accordance with CAN/CSA-A23.2.

.5 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve him of his contractual responsibility

3.5 VERIFICATION

.1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established in PART 2 - PRODUCTS, by Departmental Representative and provide verification of compliance.

3.6 CLEANING

.1 Use trigger operated spray nozzles for water hoses.

.2 Designate cleaning area for tools to limit water use and runoff.

.3 Cleaning of concrete equipment to be done in accordance with Section 01 35 43: Environmental Procedures.

END OF SECTION 03 30 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1	Concrete Formwork	Section 03 10 00
.2	Concrete Reinforcement	Section 03 20 00
.3	Cast-in-Place Concrete	Section 03 30 00
.4	Water Repellent Coating	Section 07 19 00

1.2 REFERENCES

.1 ASTM International
- .1 ASTM A 123/A 123M-08, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .2 ASTM A 775/A 775M-07b, Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
- .3 ASTM D 412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
- .4 ASTM D 2240-05 (2010), Standard Test Method for Rubber Property - Durometer Hardness.
- .5 ASTM C 494/C 494M-10a, Standard Specification for Chemical Admixtures for Concrete.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.40-97, Anti-corrosive Structural Steel Alkyd Primer.
- .2 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.3 CSA International
- .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .2 CAN/CSA-A23.3-04 (R2010), Design of Concrete Structures.
- .3 CSA A3000-08, Cementitious Materials Compendium.
  - .1 CSA A3001-08, Cementitious Materials for Use in Concrete.
- .4 CSA G30.18-09, Carbon and Steel Bars for Concrete Reinforcement.
- .5 CSA G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .6 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
- .7 CSA W59-03 (R2008), Welded Steel Construction (Metal Arc Welding).
- .8 CSA W186-M1990 (R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction.

.4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
- .1 SCAQMD Rule 1113-A2007, Architectural Coatings.

.5 Master Painters Institute (MPI)
- .1 Architectural Painting Specification Manual - 2007.

.6 Underwriters' Laboratories of Canada (ULC)
- .1 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.7 U.S. Environmental Protection Agency (EPA) / Office of Water
.1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for concrete mixes and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Material samples: submit the following samples of materials for approval to Departmental Representative. Approved samples shall be used as the acceptable standard for all materials used on the project. Samples of the following are required:
.1 Forming materials.
.2 Gaskets, sealing materials, and form jointing system (as applicable).
.3 Ties and cones.
.4 Rustication strip material.
.5 Form release agent.
.6 Chairs and spacers.

.4 Sample panel: in a concealed location designated by Departmental Representative, provide a sample of architectural concrete utilizing proposed formwork materials and methods. If accepted, this panel shall serve as a control sample for the balance of the architectural concrete work.

.5 Shop drawings and formwork design:
.1 The Contractor shall design and prepare detailed drawings showing the forming the proposes for the typical elements of the structure. Submit to Departmental Representative for review a min. of ten (10) days prior to relevant phase of work. Drawings shall be min. 1:100 scale for elevations and 1:50 for details, and shall show all typical details and non-typical areas. Indicate all locations where typical details will be used.

.2 Shop drawings shall show the following principal items:
.1 Type of forming materials, blockouts and bulkheads, and methods of fixing.
.2 Location of joints in forming material.
.3 Location of construction and expansion joints.
.4 Location of rustication strips and method of fixing.
.5 Detailed description of construction methods proposed to be used in the work, including method of sealing forms between construction joints, corners and intersections and texturing of architectural surfaces.
.6 Shoring and re-shoring locations and details.

.3 Formwork design (general): the design of formwork shall follow strictly the standards of appearance as indicated by detailed drawings of typical elements, showing systematically placed tie locations, form joint locations, rustication strip locations, and special formwork materials.

.4 Formwork design (architectural requirements): patterns of individual forming panels, rustication bands, and construction joints shall be reflected in the Contractor's shop drawings, and must be read in conjunction with structural requirements showing configurations, dimensions, and reinforcing as detailed on structural drawings and specified in structural sections of Division 3.

.5 Prior to commencement of shop drawings the contractor shall consult with Departmental Representative regarding tie locations and joint placement.

.6 Adjustment to reinforcing details shown on the drawings including use of couplers or dowels to suit formwork design and joint patterns shall be approved in writing by Departmental Representative. The Contractor shall bear the cost of such adjustments.

.6 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan Waste Reduction Work plan highlighting recycling and salvage requirements.

.2 Recycled Content:

.1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.

.2 Submit evidence, when Supplementary Cementing Materials (SCMs) are used, to certify reduction in cement from Base Mix to Actual SCMs Mix, as percentage.

.3 Low-Emitting Materials:

.1 Submit listing of coatings and sealers used in building, showing compliance with VOC and chemical component limits or restriction requirements.

1.4 TOLERANACES

.1 Formwork shall be constructed and finished in accordance with CSA S269.1. Failure to comply with these limits will result in the Contractor, at his expense, filling and/or grinding the substandard surfaces, or if this is deemed unsatisfactory by Departmental Representative, then the concrete section will be removed and reconstructed at no expense to the Owner. All slabs, stairs, landings, and areas, where detailed, shall have positive slopes to drains sufficient to provide complete water drainage with no ponding.

1.5 WARRANTY

.1 Contractor hereby warrants the architectural concrete will not spall or show visible evidence of cracking, except for normal hairline shrinkage cracks, in accordance with the 12 months warranty period prescribed in General Conditions, is extended to 60 months.

2.0 PRODUCTS

2.1 MATERIALS

.1 Refer to Section 03 30 00- Cast-in-Place Concrete.

.2 Repair Materials:

.1 Cement types and aggregates shall be determined by job site mix.

.2 Other materials proposed for use will be considered based on successful performance based on prototype construction.

.3 Form release agent: chemical non-staining release agent, which will not affect the architectural concrete surface. Release agent shall be used in strict accordance with the manufacturer's recommendations.

2.2 FORMWORK DESIGN AND FABRICATION

.1 Forms shall be tight to prevent loss of mortar. Corner chamfer strips are not allowed on above grade exposed concrete, making mandatory especially tight, well designed corners of the forms. Girts and blocking shall be provided behind all plywood butt joints.

.2 Plug and caulk all cracks, slits, holes, gaps, and apertures in forms, wherever located, with material sufficient to withstand pressures and remain completely watertight.

.3 Seal forms at all joints with the use of gasket materials, such as foam rod and foam tape or other approved method to provide adequate means of maintaining a leak-free seal during concrete placement.

.4 Form removal: design forms to permit removal without damaging architectural finish.

3.0 EXECUTION

3.1 GENERAL

.1 Do concrete work in accordance with CAN/CSA A23.1 unless otherwise indicated.

.2 Concrete placing and consolidation:

.1 Forms shall be thoroughly reconditioned and recoated with a non-staining form release agent prior to each use. Any damage to formwork during placing, removal or storage shall be completely repaired, and approved by Departmental Representative. Formwork with repairs or patches, which would have adverse effects on concrete finish, shall not be used in the work. Store formwork and form materials, as required, to preclude any damage or distortion.

.2 Carry on concreting as a continuous operation until section of approved size and shape is completed. Cut-offs and construction joints shall be as per approved details and location. Cold joints shall be permitted only when specifically approved by Departmental Representative.

.3 The Contractor shall provide such equipment and shall employ only those methods and arrangements of equipment, which will reduce to a minimum separation of coarse aggregate from the concrete. Equipment shall be selected for its ability to handle concrete of the lowest slump that can be consolidated by means of vibration after placement.

.4 Take special care to completely fill forms by depositing as near final position as possible, and to force concrete under and around reinforcement without displacement. After deposited concrete has taken initial set, exercise care to avoid jarring forms or placing strain on ends of projecting reinforcement.

.5 Plunge vibrators in the concrete rapidly to minimize entrapped air between concrete and forms. Thoroughly blend the layers of previously placed and new concrete. Remove vibrator from concrete with a pumping action to break up and release air entrapped between concrete and forms. Min. spacing of vibrator insertions shall be in accordance with manufacturer's recommended radius of influence.

.6 Install lay-in-waterstop at joints in all exposed exterior concrete walls concrete walls of the building. Install as per manufacturer's written instruction.

.3 Stripping, protection, curing and cleaning:
- .1 Curing: use no curing method, which could impair the appearance of arch. Concrete surfaces.
- .2 Protection:
  - .1 Protect architectural concrete from any damage by the elements and defacement of any nature during construction operation.
  - .2 Protect from staining from rebar corrosion.
  - .3 All corners and surfaces subject to possible damage shall be suitably protected with boards or hoardings.
  - .4 Make adequate provision to keep all exposed concrete free from laitance caused by spillage, leaking forms or other contaminants. In no event shall laitance be allowed to penetrate, stain or harden on surfaces, which have been sandblasted.
  - .5 Adequate protection shall be given to all exposed reinforcing steel in architectural concrete to prevent staining of surfaces of concrete due to rust and corrosion. If any rust or corrosion does occur, it shall be removed immediately to avoid permanent staining.

3.2 EXAMINATION

.1 General:
- .1 Areas to be repaired shall be determined by Departmental Representative and shall not exceed 0.2 sm.for each 93 sm. of surface area, and shall be widely dispersed. Repairs shall match the surrounding area. Architectural concrete requiring repair in excess of above standard is subject to rejection by Departmental Representative and subsequent removal and replacement with work at no additional cost to the Owner.
- .2 Before commencing any repair work, the Contractor shall confirm repair procedures with Departmental Representative and establish by trial mix the formula required. The Contractor shall demonstrate his repair techniques on the prototype.
- .3 The following are key steps to making a repair to architectural concrete:
  - .1 Prepare the area to be repaired. This should include achieving the desired finish in the surrounding area. Remove loose particles and chip out part of the sound concrete to avoid feather edge repairs.
  - .2 Proportion the repair mix by weight according to the same proportions as used in the concrete mix but substituting a portion of white cement for grey cement. This should be based on tests to determine what is required to match the finished surface.
  - .3 Apply a coat of bonding material to the root of the areas to be repaired, being careful to avoid dripping on any surface to be exposed.
  - .4 Fill in the area to be repaired and brush it out to match the surrounding area.
  - .5 Cure the repaired area.
  - .6 Clean the repaired area to remove laitance and match the surrounding area.
- .4 Repairs:
  - .1 Repairs shall be carried out under the direction of Departmental Representative. Usual good practices, i.e. cutting out of loose honeycombs, squaring off edges, etc. shall be followed during preparation. Soak the area to be repaired with water. Place a stiff, colour-matching mortar in the void, striking flush with a wood float and texturing, as required, for the finish designated.

.2 Repair mortar mix shall be specially formulated, matching coloured mortar. It shall be non-shrink, and have a twenty-eight day (28) day strength of 35 MPa.

.3 The quantity of mixing water shall be no more than necessary for handling and placing. The repair mortar shall be mixed in advance and allowed to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing. A mixture of one part bonding agent to four parts water shall be used as mixing water.

.4 The repair mix shall be consolidated into place and struck off so as to leave the repaired area slightly higher than the surrounding surface to permit initial shrinkage. The repair shall be left undisturbed for at least one hour before being textured. The repaired area shall be kept damp for seven days.

.5 Sponge or wood floats shall be used in finishing repairs to be left exposed. Metal tools shall not be used in finishing repaired areas to be left exposed. The repairing of architectural concrete shall be done after the concrete is textured except honeycombed or other areas determined by Departmental Representative immediately after form removal.

.6 Heavy grinding will be permitted to correct irregularities of planeness in concealed areas only.

3.3 CLEANING

.1 Obtain approval of cleaning methods from Departmental Representative before cleaning soiled architectural concrete surfaces.

.2 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by architectural concrete installation.

END OF SECTION 03 33 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Cast-In-Place Concrete — Section 03 30 00

.2 Room Finish Schedule — Section 09 06 00

1.2 REFERENCES

.1 Canada Green Building Council (CaGBC)
- .1 LEED Canada-NC 2009, LEED (Leadership in Energy and Environmental Design): LEED Canada Reference Guide for Green Building Design and Construction 2009.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.40-97, Anti-corrosive Structural Steel Alkyd Primer.
- .2 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.3 CSA International
- .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
- .1 SCAQMD Rule 1168-A2005, Adhesive & Sealants Applications.

1.3 QUALITY ASSURANCE

.1 Standards: Conform to CAN/CSA-A23.1, for concrete finishes.

.2 Sandblasting installer operations shall conform to applicable codes and Regulations.

.3 Installer Qualifications:
- .1 Work shall be carried out by personnel who are thoroughly trained and experienced in the floor treatment. The installer to provide a list of a minimum of 3 projects performed within 3 years of equivalent complexity and scope as this contract.

.4 Pre-installation Meeting:
- .1 Prior to commencement of Work on site, convene a pre-installation conference to be attended by the Contractor, Coating Subcontractor, Manufacturer's Technical Representative, Consultant and Owner to review:
  - .1 Convey proper installation and placement of concrete slabs to ensure proper concrete finishing requirements in order to achieve adequate floor polishing application.
  - .2 Convey to Contractor Requirements for protection of concrete slabs to receive concrete floor polishing and to coordinate sequence of work and application during construction.

1.4 SUBMITTALS

.1 Submittals to be in accordance with 01 33 00 Submittal Procedures.

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for concrete finishes and include product characteristics, performance criteria, physical size, finish and limitations.

.1 Provide two copies of WHMIS MSDS in accordance with Section 01 35 33- Health & Safety Requirements. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for concrete floor treatment materials. Indicate VOC content in g/L.

.2 Include application instructions for concrete floor treatments.

.3 Submit maintenance instructions for insertion in operations and maintenance manuals. Instructions shall give specific warning of maintenance or cleaning practices or materials, which may damage installed work.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and acceptance and storage requirements:

.1 Deliver materials to site in manufacturer's original factory packaging, labelled with manufacturer’s name and address.

.2 Store materials in a clean dry area in accordance with manufacturer's instructions.

.3 Keep product from freezing.

.4 Avoid direct contact with this product as it may cause mild to moderate irritation of the eyes and/or skin.

.5 Protect materials during handling and application to prevent damage or contamination.

.3 Dispense special concrete finish material from sealed containers.

.4 Packaging Waste Management: Comply with requirements of Section 01 74 19 Waste Management and Disposal.

.5 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials, and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada.

1.6 ENVIRONMENTAL REQUIREMENTS / PROJECT CONDITIONS

1. Do not apply product when air, surface, or material temperature is below 35°F (2°C) or above135°F (57°C).

2. Do not apply to frozen concrete.

3. Do not use on highly dense or non-porous surfaces.

4. Allow concrete to cure a minimum of 45 days, or as otherwise acceptable by product manufacturer before commencement of work.

5. Do not commence with polishing until Work has been sufficiently advanced, whereby Work yet to be performed will not adversely affect polished concrete floors. Application of products shall take place a minimum of 21 days prior to fixture and trim installation and Substantial Performance of Work.

6. Limit and control dust generated by grinding and polishing procedures in order to prevent potential damage to adjacent surfaces and equipment.

7. Control the use of water. Remove standing water from completed floor surfaces.

8. Ensure that penetrating sealers are not applied to concrete floors that are to be polished.

1.7 EXTENDED WARRANTY

1. Provide two (2) year manufacturer's warranty on products and installation against fading and delamination of finished surfaces.

2.0 PRODUCTS

2.1 MATERIALS

.1 Concrete materials shall conform to requirements of Section 03 30 00-Cast-In-Place Concrete Short Form and CAN/CSA-A23.1.

.2 Sandblasting materials shall conform to CPCA Manual, Chapter 9, Sandblasting.

.3 Bonding Agent: Formulated for bonding new concrete to cured concrete. Acceptable Products:
- .1 “Polymer Bonding Agent” by Target Products Ltd.
- .2 “710 Flex-Con” by Else Construction Products.
- .3 “K-710 Krystobond” by Kryton International Inc.
- .4 “Fabribond-A” by Fabrikem Manufacturing Ltd.
- .5 Or approved alternative.

.4 Curing and Sealing Compound: Surface Sealer: to CAN/CGSB-25.20. Acrylic carnuba wax, Low VOC. Acceptable Products:
- .1 “Masterkure N-Seal” by Master Builder Company Limited.
- .2 “Cure and Seal” by Target Products Ltd.
- .3 “760 Clear Acrylic Sealer” by Elsro Construction Products.
- .4 “Buff Hard” by Symons Corporation.
- .5 Or approved alternative.

.5 Natural Hardener: Premixed, abrasion resistant non-metallic hardener (Type 1). Acceptable Products:
- .1 “Mastercron” by Master Builders Company Limited.
- .2 “Diamag 7” by Sternson Limited.
- .3 “Non-Metallic Floor Hardener” by Target Products Ltd.
- .4 “785 Genflor Non-Metallic Floor Hardener” by Elsro Construction Products.
- .5 Or approved alternative.

.6 Non-Shrink Grout (for patching): Acceptable Products:
- .1 “Embeco Mortar” by Master Builders Company Limited.
- .2 Pre-mixed “Fast-Set Patching Concrete” by Target Products Ltd
- .3 “810 Gengrout” by Elsro Construction Products.
- .4 “K-510 Krystol Patch/Grout” by Kryton International Inc.
- .5 Or approved alternative.

.7 Densifier: Non-flammable non-toxic,water-based formulation used on Portland Cement materials utilizing Quartz-Litium based products. Acceptable Products:
- .1 “Crenz Protect” by Crenz Concrete.
- .2 “Pentra Sil” by Convergent Concrete.
- .3 “Euco Diamond Hard” by The Euclid Chemical Company.
- .4 “Liquihard Ultra” Surface Hardener
- .5 Or approved alternative.

.8 Seeding Aggregates: Aggregate shall be small round, brown pebbles size around 10 mm and be hard, sand, durable and free of all deleterious materials and staining quality.

2.2 FINISHES

.1 Trowelled finish for all concrete floor with surface hardener.

.2 Exposed aggregate finish for tactile warning strip at top of concrete stair landing.

3.0 EXECUTION

3.1 FINISHING-GENERAL

.1 Do concrete finishing work in accordance with CAN/CSA-A23.1-M01, unless otherwise indicated.

.2 Tops of Walls and Columns to be level and true. Allowable tolerance 6 mm in 3,000 mm.

3.2 FORMED SURFACES

.1 Inspect concrete surfaces for defects immediately after removal of formwork.

.2 Remove or cut back to a depth of 3/4" (19 mm) from the surface of the concrete all bolts, ties, nails, or other metal that is not required and repair immediately. Patch all cone and sleeve holes flush with concrete surface in strict accordance with manufacture's printed instructions. Grout all steel inserts in strict conformance with grout manufacturer's printed instructions.

.3 Remove imperfections such as bulges, fins, lips, and stains to permanently exposed surfaces as directed by Departmental Representative by chipping or grinding and patch to match adjacent surfaces. Do not proceed with grinding until the concrete has sufficiently hardened to prevent dislodgment of coarse aggregate particles. Allowable limits of grinding to be 1/16" so as to not expose aggregate.

.4 Repair to exposed surfaces or surfaces to receive paint type finishes: Repairs to be carried out under the direction of the Departmental Representative. Blend cement and aggregate so that, when dry, patching mortar will match colour of surrounding. Provide test areas at inconspicuous location to verify mixture and colour match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface. Patch and fill all concrete imperfections such as "blow holes", "honeycomb" and voids as directed.

.5 Strike off smooth and finish tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces with a texture matching the adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise shown.

3.3 HORIZONTAL SURFACES

.1 Where floor drains occur, floors to be level around walls and have a minimum 1:50 uniform pitch to drains, unless indicated otherwise. Stairs and landings shall have positive slopes to provide complete water drainage with no ponding.

.2 Finish horizontal concrete surfaces as follows:

.1 Exposed horizontal surfaces not intended to receive additional concrete: Smooth steel trowel finish or as indicated on the drawings.

.2 Horizontal concrete surfaces intended to receive waterproofing membrane or applied floor finishes: Smooth, steel trowel finish. Floors to be finished flat, free from defects which would telegraph through finish material.

.3 Horizontal concrete surfaces intended to receive additional concrete toppings, quarry tile or ceramic tile: Screeded off to true lines and levels shown, roughened to an amplitude of 3/16" (5 mm), cleaned of laitance and loose concrete and left ready to receive finish. Depress slabs to accommodate finish where indicated.

.4 Broom Finish: After completion of floating and when excess moisture of surface sheen has disappeared, complete surface finishing by drawing a fine-hair broom across concrete surface, perpendicular to line of traffic. Repeat operation if required to provide a fine line texture acceptable to Consultant.

3.4 PLAIN FLOOR FINISH (TROWELLED)

.1 Roll or tamp concrete to force coarse aggregate into concrete mix and then screed.

.2 Float surface with wood or metal floats or with power finishing machine and bring surface to true grade.

.3 Steel trowel to smooth and even surface.

.4 Follow with second steel trowelling to produces smooth burnished surface to within tolerance described in CAN/CSA-A23.1-M90, Cause 22.1.2-Straight-Edge Method for Very Flat Classification Finish 1/8” (3 mm) in 10’-0” (3000 mm) to all floors receiving carpet, resilient flooring, liquid applied flooring, thin-set ceramic tile. All other floors shall be finished to Flat Classification Finish 3/16” (5 mm) in 10’-0” (3000 mm). Floors shall be true to plane as determined by a 10’-0” (3.0 meter) straight-edge placed anywhere on the surfaces in any direction. Check conformance to tolerance limits at any time after the curing period. Where this Section conflicts with other Sections in Division 3, this Section shall govern.

.5 Sprinkling of dry cement or dry cement and sand mixture over concrete surfaces is not acceptable.

.6 Apply curing compound in accordance with manufacturer’s instructions to all areas not scheduled to receive further floor finish.

.7 Protect surfaces which will be exposed to direct sunlight during the curing period in accordance with manufacturer’s instructions.

3.5 HARDENED FLOOR FINISH

.1 Roll or tamp concrete to force coarse aggregate into concrete mix and then screed and apply non-metallic hardener to manufacturer’s instructions.

.2 Apply first shake of aggregate (one half of amount) after floating.

.3 Float first shake and apply second shake.

.4 Float second shake.

.5 Flat steel trowel to produce fine texture non-slip finish.

.6 Apply two coats of curing and sealing compound in accordance with manufacturer’s directions.

3.6 BONDING AGENT

.1 Apply bonding agent to all concrete when new concrete will be applied against it under the following conditions:
- .1 Patching.
- .2 Feathering.
- .3 Construction joints.
- .4 Bonding of topping slabs.

3.7 EXPOSED AGGREGATE CONCRETE

.1 The seeding operation shall start immediately after placement of concrete. The select aggregate shall be carefully and uniformly seeded by suitable means so that the entire surface is completely covered with one layer of stone. Stacked stone as well as slivery particles shall be removed. The aggregate shall be embedded by suitable means. When the concrete is hard enough to retain the embedded aggregate and the mortar is still soft enough to be removed by brushing, the surface shall be brushed and flushed out with water. The exposing operation of washing and brushing with stiff bristle broom is continued until the surface matches the approved sample panel. The final washing operation shall cease when the flush water runs clear and there is no noticeable cement film on the aggregate.

3.8 DEFECTIVE WORK

.1 Repair honeycombing, rock packets, chips, spalls and other voids in exposed concrete surfaces, using patching materials as specified to provide a smooth surface. Remove fins and other protrusions in concrete surfaces. Maximum allowable depth of grinding to be 1/16".

.2 Consult with Departmental Representative on the repair of defective concrete surfaces prior to execution of the work.

.3 Patch form tie holes in all exposed concrete surfaces and surfaces designated to receive waterproofing unless otherwise directed.

.4 Where in the opinion of Departmental Representative, material or workmanship fails to meet the requirements of the specification, such work may be rejected. Work rejected shall be replaced or repaired to the approval of the consultant at no additional cost to the owner.

3.9 PROTECTION

.1 Take every precaution to protect finished surfaces from stains and abrasions. Surfaces and edges likely to be damaged during the construction period shall be especially protected.

.2 Protect work of other sections from damage resulting from work of this Section.

.3 Provide suitable enclosures for collecting grit and dust from sandblasting operation.

.4 Erect barricades to prevent traffic on newly finished surfaces.

.5 Suggested protection in high traffic areas after the sealer has been applied is as follows:

.1 Place cheap colourfast carpet that is breathable (not rubber backed), fuzzy side down or Protect CP board.

.2 Masonite or plywood may then be applied over the carpet/cardboard for further protection.

3.10 ADJUSTING & CLEANING

.1 Progress Cleaning: Clean during progress of the Work in accordance with Section 01 74 11- Cleaning.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11- Cleaning.

.3 Repair, remove and clean all drips or smears resulting from the work of this section on exposed, finished surfaces or surfaces to be subsequently finished.

.4 Engage a concrete finish manufacturer's authorized representative to train Owner's maintenance personnel on proper maintenance procedures

END OF SECTION 03 35 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Masonry Mortar and Grout Section 04 05 12

.2 Masonry Anchorage Reinforcing Section 04 05 19

.3 Masonry Accessories Section 04 05 23

.4 Brick Masonry Section 04 21 13

.5 Concrete Unit Masonry. Section 04 22 00

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)
- .1 CSA-A165 Series-04, Standards on Concrete Masonry Units.
- .2 CSA A179-04, Mortar and Grout for Unit Masonry.
- .3 CSA-A371-04, Masonry Construction for Buildings.

.2 International Masonry Industry All-Weather Council (IMIAC)
- .1 Recommended Practices and Guide Specification for Hot and Cold Weather Masonry Construction.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation meetings: comply with Section 01 31 19 - Project Meetings. Conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to:
- .1 Verify project requirements, including mock-up requirements.
- .2 Verify substrate conditions.
- .3 Co-ordinate products, installation methods and techniques.
- .4 Sequence work of related sections.
- .5 Co-ordinate with other building subtrades.
- .6 Review manufacturer's installation instructions.
- .7 Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.
- .8 Review warranty requirements.

.2 Sequencing: sequence with other work in accordance with 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart. Comply with manufacturer's written recommendations for sequencing construction operations.

.3 Scheduling: schedule with other work in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.

1.4 ACTION & SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Provide manufacturer's printed product td literature, specifications and datasheet and include product characteristics, performance criteria, limitations and colours.
- .2 Provide two copies of Workplace Hazardous Materials Information System (WHMIS) – Material Safety Data Sheets (MSDS) in accordance with Section 01 35 43 -

Environmental Procedures.

1.5 INFORMATION & SUBMITTALS

.1 Certificates: provide manufacturer's product certificates certifying materials comply with specified requirements.

.2 Test and Evaluation Reports:
- .1 Provide certified test reports in accordance with Section 01 45 00 Quality Control
- .2 Test reports to certify compliance of masonry units and mortar ingredient with specified performance characteristics and physical properties.
- .3 Provide data for masonry units, in addition to requirements set out in referenced CSA and ASTM Standards, indicating initial rates of absorption.

.3 Installer Instructions: provide manufacturer's installation instructions, including storage, handling, safety and cleaning.

.4 Manufacturer's Reports: provide written reports prepared by manufacturer's on-site personnel to include:
- .1 Verification of compliance of work with Contract.
- .2 Site visit reports providing detailed review of installation of work, and installed work.

.5 Submit shop drawings for temporary bracing according to Section 01 33 00 Submittal Procedures.

1.6 CLOSEOUT SUBMITTALS

.1 Provide manufacturer's instructions for care, cleaning and maintenance of prefaced masonry units for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.7 EXTRA MATERIALS

.1 Provide manufacturer's instructions in accordance with Section 01 78 00 - Closeout Submittals covering maintenance requirements and parts catalogue, with cuts and identifying numbers.

1.8 QUALITY ASSURANCE

.1 Qualifications:
- .1 Manufacturer: capable of providing field service representation during construction and approving application method.
- .2 Ensure manufacturer has minimum 5 years experience in manufacturing components similar to or exceeding requirements of project.
- .3 Installer: experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
- .4 Masons: company or person specializing in masonry installations with 5 years experience with masonry work similar to this project.
  - .1 Masons employed on this project must demonstrate ability to reproduce mock-up standards.

.2 Mock-ups:
- .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
- .2 Construction mock-up panel of exterior and interior masonry wall 2000 mm long x 1800 mm high showing masonry colours and textures, use of reinforcement, mortar, grout and workmanship.
- .3 Mock-up used:
  - .1 To judge workmanship, substrate preparation, operation of equipment and material application.
- .4 Construct mock-up where directed by Departmental Representative.
- .5 Allow 24 hours for inspection of mock-up by Departmental Representative before

proceeding with work.

.6 When accepted by Departmental Representative, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of finished work.

.7 Start work only upon receipt of written acceptance of mock-up by Departmental Representative.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in accordance with Section 01 61 00 - Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Storage and Handling Protection:

.1 Keep materials dry until use.

.2 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

.3 Packaging Waste Management:

.1 Remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management And Disposal.

1.10 SITE CONDITIONS

.1 Ambient Conditions: assemble and erect components when temperatures are above 4 degrees C.

.2 Weather Requirements: to CSA-A371 to IMIAC - Recommended Practices and Guide Specifications for Hot and Cold Weather Masonry Construction.

.3 Cold weather requirements:

.1 To CSA-A371 with following requirements.

.1 Maintain temperature of mortar between 5 degrees C and 50 degrees C until batch is used or becomes stable.

.2 Maintain ambient temperature of masonry work and it's constituent materials between 5 degrees C and 50 degrees C and protect site from windchill.

.3 Maintain temperature of masonry above 0 degrees C for minimum of 3 days, after mortar is installed.

.4 Preheat unheated wall sections in enclosure for minimum 72 hours above 10 degrees C, before applying mortar.

.2 Hot weather requirements:

.1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

.2 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.

.3 Spray mortar surface at intervals and keep moist for maximum of three days after installation.

1.11 WARRANTY

.1 For Work in this Section 04 05 00 - Common Work Results for Masonry, Provide 12 months warranty period for concrete masonry.

2.0 PRODUCTS

2.1 MATERIALS

.1 Masonry materials are specified elsewhere in related Sections:
- .1 Section 04 22 00 Concrete Unit Masonry.
- .2 Section 04 21 13 Brick Masonry

3.0 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 EXAMINATION

.1 Examine conditions, substrates and work to receive work of this Section.
- .1 Co-ordinate with Section 01 71 00 - Examination and Preparation.

.2 Examine openings to receive masonry units. Verify opening size, location, and that opening is square and plumb, and ready to receive work of this Section.
- .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .2 Proceed with installation after unacceptable conditions have been remedied and after receipt of written approval from Departmental Representative.

.3 Verification of Conditions:
- .1 Verify that:
  - .1 Substrate conditions which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of concrete block and glass block.
  - .2 Field conditions are acceptable and are ready to receive work.
  - .3 Built-in items are in proper location, and ready for roughing into masonry work.
- .2 Commencing installation means acceptance of existing substrates.

3.3 PREPARATION

.1 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations and co-ordinate with Section 01 71 00 - Examination and Preparation.

.2 Establish and protect lines, levels, and coursing.

.3 Protect adjacent materials from damage and disfiguration.

3.4 INSTALLATION

.1 Do masonry work in accordance with CSA-A371 except where specified otherwise.

.2 Build masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CSA-A371.

.3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.5 CONSTRUCTION

.1 Exposed masonry:

.1 Remove chipped, cracked, and otherwise damaged units, in accordance with CSA A-165, in exposed masonry and replace with undamaged units.

.2 Jointing:

.1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints where concave joints are indicated.

.2 Allow joints to set just enough to remove excess water, then rake joints uniformly to 6 mm depth and compress with square tool to provide smooth, compressed, raked joints of uniform depth where raked joints are indicated.

.3 Strike flush joints concealed in walls and joints in walls to receive plaster, tile, insulation, self-adhered water/vapour/air barrier membrane, or other applied material except paint or similar thin finish coating.

.3 Cutting:

.1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.

.2 Make cuts straight, clean, and free from uneven edges.

.4 Building-In:

.1 Build in items required to be built into masonry.

.2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.

.3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.

.5 Wetting of bricks:

.1 Except in cold weather, wet bricks having initial rate of absorption exceeding 1 g/minute/1000 mm^2: wet to uniform degree of saturation, 3 to 24 hours before laying, and do not lay until surface dry.

.2 Wet tops of walls built of bricks qualifying for wetting, when recommencing work on such walls.

.6 Support of loads:

.1 Use 25 MPa concrete to Section 03 30 00 - Cast-in-Place Concrete, where concrete fill is used in lieu of solid units.

.7 Provision for movement:

.1 Leave 25MM space between top of non-load bearing walls and partitions and structural elements. Do not use wedges. Refer to structural drawings for details.

.8 Interface with other work:

.1 Cut openings in existing work as indicated.

.2 Openings in walls: reviewed by Departmental Representative.

.3 Make good existing work. Use materials to match existing.

3.6 SITE TOLERANCES

.1 Tolerances in notes to CSA-A371 apply.

3.7 FIELD QUALITY CONTROL

.1 Site Tests, Inspection:
.1 Perform field inspection and testing in accordance with Section 01 45 00 - Quality Control.
.2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.

3.8 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.2 Progress Cleaning: in accordance with related masonry sections.

.3 Final Cleaning:
.1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
.2 Upon completion of installation and verification of performance of installation, remove surplus materials, rubbish, tools and equipment barriers.

.4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal
.1 Divert unused or damaged masonry units from landfill as specified in Section 01 74 19 - Waste Management and Disposal.

3.9 PROTECTION

.1 Temporary Bracing:
.1 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.
.2 Brace masonry walls as necessary to resist wind pressure and lateral forces during construction.

.2 Moisture Protection:
.1 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until completed and protected by flashing or other permanent construction.
.2 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.
Air Temperature Protection: protect completed masonry as recommended in 1.10 SITE CONDITIONS.

END OF SECTION 04 05 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Common Work Results for Masonry — Section 04 05 00

.2 Masonry Accessories — Section 04 05 23

.3 Concrete Unit Masonry — Section 04 22 00

1.2 REFERENCES

..` Canadian Standards Association (CSA International)

.1 CAN/CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CAN/CSA A179-04, Mortar and Grout for Unit Masonry.

.3 CAN/CSA A371-04, Masonry Construction for Buildings.

.4 CAN/CSA-A3000-08, Cementitious Materials Compendium

.2 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)

.1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

1.3 ACTION AND INFORMAL SUBMITTALS

.1 Product Data:

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Provide manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.

.3 Provide two copies of Workplace Hazardous Materials Information System (WHMIS) - Material Safety Data Sheets (MSDS) in accordance with Section 01 35 33 - Health and Safety Requirements and 01 35 43 - Environmental Procedures. Indicate VOC's mortar, grout, parging, colour additives and admixtures. Express as grams per litre (g/L).

.2 Samples:

.1 Samples: provide unit samples in accordance with Section 04 05 00 - Common Work Results for Masonry, supplemented as follows:

.1 Provide two size samples of mortar coloured mortar.

.2 Provide samples and confirmation of source or product data sheet, prior to mixing or preparation of mortars, to Departmental Representative.

.1 Aggregate: course aggregate and sand.

.2 Cement.

.3 Lime.

.4 Colour pigment samples.

.3 Manufacturer's Instructions:

.1 Provide manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

.1 Test Reports: certified test reports including sand gradation tests in accordance with CAN/CSA A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - Common Work Results for Masonry supplemented as follows:

.1 Submit laboratory test reports in accordance with Section 01 45 00 - Quality Control

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified

performance characteristics and criteria and physical requirements.

.3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Section 01 31 19 Project Meetings.

.4 Mock-ups:

.1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry supplemented as follows:

.1 Construction mock-up panel of 2000mm long x 1800mm high using proposed procedures, colors, texture, finish and workmanship.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handles masonry mortar and grout materials in accordance with Section 01 61 00 - Product Requirements, supplemented as follows:

.1 Deliver prepackaged, dry-blended mortar mix to project site in labelled plastic-lined bags each bearing name and address of manufacturer, production codes or batch numbers, and colour or formula numbers.

.2 Maintain mortar, grout and packaged materials clean, dry, and protected against dampness, freezing, traffic and contamination by foreign materials.

.2 Packaging Waste Management: remove for reuse and return by manufacturer of packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

1.6 SITE CONDITIONS

.1 Weather Requirements: CAN/CSA A371 International Masonry Industry All-Weather Council (IMIAC) - Recommended Practices and Guide Specifications for Hot and Cold Weather Masonry Construction.

2.0 PRODUCTS

2.1 MATERIALS

.1 Use same brands of materials and source of aggregate for entire project.

.2 Cement:

.1 Portland Cement: to CAN/CSA-A3000, Type GU - General use hydraulic cement Type 10 gray colour.

.1 Use low VOC products in compliance with SCAQMD Rule 1168.

.2 Masonry Cement: to CAN/CSA-A3002 and CAN/CSA A179.

.3 Mortar Cement: to CAN/CSA-A3002 and CAN/CSA A179.

.1 Use low VOC products in compliance with SCAQMD Rule 1168.

.4 Packaged Dry Combined Materials for mortar: to CAN/CSA A179, Type S, using gray colour cement.

.3 Aggregate: supplied by one supplier.

.1 Aggregate: to CAN/CSA A179, Table 3 10mm maximum size.

.4 Water: clean and potable.

.5 Lime:

.1 Quick Lime: to CAN/CSA A179, Type S.

.2 Hydrated Lime: to CAN/CSA A179, Type S.

.6 Bonding Agent: latex type.

.7 Polymer Latex: organic polymer latex admixture of butadiene-styrene type non-emulsifiable bonding admixture.

2.2 COLOUR ADDITIVES

.1 Use colouring admixture not exceeding 10% of cement content by mass, or integrally coloured masonry cement, to produce coloured mortar to match approved sample. Admixtures to be approved prior to use. Use in accordance with the specific manufacturer's recommendations.

.2 White mortar: use white Portland cement, and lime to produce mortar type specified.

2.3 MORTAR MIXES

.1 Mortar for interior masonry:

.1 Loadbearing: type S based on property specifications.

.2 Non-Loadbearing: N based on property specifications.

2.4 MORTAR MIXING

.1 Use pre-blended, pre-coloured mortar prepackaged under controlled factory conditions. Ingredients batching limitations to be within 1% accuracy.

.2 Mix mortar ingredients in accordance with CAN/CSA A179 in quantities needed for immediate use.

.3 Maintain sand uniformly damp immediately before mixing process.

.4 Add mortar colour and admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and colouration.

.5 Do not use anti-freeze compounds including calcium chloride or chloride based compounds.

.6 Do not add air entraining admixture to mortar mix.

.7 Use a batch type mixer in accordance with CAN/CSA A179.

.8 Pointing mortar: prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour no more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.

.9 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.

.10 Use mortar within 2 hours after mixing at temperatures of 32 degrees C, or 2-1/2 hours at temperatures under 10 degrees C.

3.0 EXECUTION

3.1 EXAMINATION

.1 Request inspection of spaces to be grouted.

3.2 PREPARATION

.1 Apply bonding agent to existing concrete surfaces.

.2 Plug clean-out holes with block masonry units. Brace masonry for wet grout pressure.

3.3 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.4 CONSTRUCTION

.1 Do masonry mortar and grout work in accordance with CAN/CSA A179 except where specified otherwise.

3.5 MIXING

.1 All pointing mortar can be mixed using a regular paddle mixer. Only electric motor mixers are permissible. Mixers run on hydrocarbons are not permitted, due to fumes, Mixing by hand must be pre-approved by the Departmental Representative.

.2 Clean all mixing boards and mechanical mixing machine between batches.

.3 Mortar must be weaker than the units it is binding.

.4 Contractor to appoint one individual to mix mortar, for duration of project. In the event that this individual must be changed, mortar mixing must cease until the new individual is trained, and mortar mix is tested.

3.6 MORTAR PLACEMENT

.1 Install mortar to manufacturer's instructions.

.2 Remove excess mortar from grout spaces.

3.7 GROUT PLACEMENT

.1 Install grout in accordance with manufacturer's instructions.

.2 Install grout in accordance with CAN/CSA A179.

.3 Work grout into masonry cores and cavities to eliminate voids.

.4 Do not install grout in lifts greater than 400 mm, without consolidating grout by rodding.

.5 Do not displace reinforcement while placing grout.

3.8 FIELD QUALITY CONTROL

.1 Site Tests, Inspection: in accordance with Section 04 05 00 - Common Work Results for Masonry supplemented as follows:

.1 Test and evaluate mortar prior to construction and during construction in accordance with CAN/CSA A179.

.2 Test and evaluate grout prior to construction and during construction to CAN/CSA A179; test in conjunction with masonry unit sections specified.

3.9 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

.2 Remove droppings and splashings using clean sponge and water.

.3 Clean masonry with low pressure clean water and soft natural bristle brush.

.4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal

3.10 PROTECTION OF COMPLETED WORK

.1 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

END OF SECTION 04 05 12

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Common Work Results for Masonry Section 04 05 00

.2 Masonry Accessories Section 04 05 23

.3 Brick Masonry Section 04 21 13

.4 Concrete Unit Masonry Section 04 22 00

1.2 REFERENCES

.1 ASTM International Inc.

- .1 ASTM A 36/A 36M- 12, Standard Specification for Carbon Structural Steel.
- .2 ASTM A 82/A 82M- 07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- .3 ASTM A 167- 99 (2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .4 ASTM A 307- 12, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
- .5 ASTM A 580/A 580M- 13a, Standard Specification for Stainless Steel Wire.
- .6 ASTM A 641/A 641M- 09a, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
- .7 ASTM-A666- 10, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

.2 Canadian Standards Association (CSA International)

- .1 CAN/CSA-A23.1/A23.2- 09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .2 CAN/CSA A179- 04, Mortar and Grout for Unit Masonry.
- .3 CAN/CSA A370- 04, Connectors for Masonry.
- .4 CAN/CSA A371- 04, Masonry Construction for Buildings.
- .5 CAN/CSA G30.18- M92 (R2007), Billet-Steel Bars for Concrete Reinforcement.
- .6 CSA-S304.1- 04, Design of Masonry Structures.
- .7 CSA W186- M1990 (R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.3 ACTION AND INFORMAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and datasheets illustrating products to be incorporated into project for specified products.
- .2 Provide two copies of Workplace Hazardous Materials Information System (WHMIS) - Material Safety Data Sheets (MSDS) in accordance with Section 01 35 33 - Health and Safety Requirements.

.3 Manufacturer's Instructions:

- .1 Provide manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

.1 Test Reports: certified test reports showing compliance with specified performance characteristics

and physical properties.

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Section 04 05 00 - Common Work Results for Masonry.

.4 Mock-ups:

.1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry supplemented as follows:

.1 Construct mock-ups pame;s pf reinforcement installation and anchorage installation.

.2 Sample panel: 2000mm long x 1800mm high using proposed procedures, anchorage material, connectors, reinforcement material, and workmanship.

1.5 FIELD MEASUREMENTS

.1 Make field measurements necessary to ensure proper fit of members.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle masonry anchorage and reinforcing materials in accordance with Section 01 61 00 - Product Requirements, supplemented as follows:

.1 Deliver reinforcement and connectors, identified in shop and placement drawings.

.2 Packaging Waste Management:

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

2.0 PRODUCTS

2.1 MATERIALS

.1 Bar reinforcement: Steel to CAN/CSA A371 and CAN/CSA G30.18, Grade 400.

.2 Connectors: to CAN/CSA A370 and CSA-S304.1.

.3 Corrosion protection: to CSA-S304.1, galvanized to CSA-S304.1 and CAN/CSA A370.

.4 Fasteners: installed post-construction:

.1 Bolts and Screws: size and type to suit application, locate where indicated.

.2 Nails: case-hardened cut or spiral nails, size and type to suit fastening application.

.3 Powder-Driven Fasteners: pin styles and lengths to suit fastening application in accordance with manufacturers use, load and hold recommendations.

.4 Adhesives: epoxies, mastics and contact cements for fastening applications, use in accordance with manufacturers' recommendations.

.5 Ties: Stainless Steel conforming to ASTM A580, Type 304, 4.8mm siderods with 3mm cross ties.

.1 Unit ties, to CAN/CSA A370: wire stainless steel, size to suit application.

.2 Adjustable Unit Ties: to CAN/CSA A370: proprietary type ties, type, style and size to suit application in accordance with manufacturer's recommendations.

.3 Joint Reinforcement Ties: to CAN/CSA A370:

.1 Single Wythe Joint Reinforcement: ladder type:

.1 Steel wire, hot dip galvanized: to ASTM A 641, Class 3 after fabrication.
.2 Cold drawn steel wire conforming to ASTM A 82.
.3 Stainless steel conforming to ASTM A 580, Type 304, 4.8 mm side rods with 3 mm cross ties.

.2 Multiple Wythe Joint Reinforcement: ladder type: without moisture drip; adjustable:
.1 Steel wire, hot dip galvanized: to ASTM A 641 Class 3 after fabrication.
.2 Cold drawn steel wire conforming to ASTM A 82.
.3 Stainless steel conforming to ASTM A 580 Type 304, 4.8 mm side rods with 3 mm cross rods.

.4 Anchors: to CAN/CSA A370:
.1 Conventional Anchors: type steel bolts with bent bar anchors; plate anchors; through bolts, shape, J or L, sized to suite application.
.2 Wedge Anchors: expansion anchors type; wedge and bolt sized to suit application.
.3 Sleeve Anchors: type sleeve and bolt, sized to suit application.
.4 Self-Contained Anchors: type double glass/plastic vial system, with epoxy resin and hardener
.5 Dovetail Anchors: bent steel strap, galavanized to CAN/CSA A370 Table 5.2 coated finish.
.6 Spiral Anchors: 8 mm stainless steel spiral anchors to Grade 304.
.7 Stone Anchors: series 300 stainless steel conforming to ASTM A 666. Anchors to be manufactured.
.8 Anchor Bolts: conventional unpatented anchors, steel, uncoated finish.

.5 Conventional Bolts:
.1 Bolts: to ASTM A 36, bar stock shop threaded, straight bolts with square or hex-headed nuts; bent bar anchors, J or L shaped.
.2 Plate anchors: steel to ASTM A 36, weld square of circular steel plate perpendicular to axis of steel bar threaded on opposite end.
.3 Through bolt rods: to ASTM A 307 threaded rod or threaded ASTM A 36 bar stock.

.6 Adhesive Anchors: proprietary systems, pre-mixed, self-contained system with double glass vial system to contain epoxy, consisting of resin, hardener and aggregate.

2.2 FABRICATION

.1 Fabricate reinforcing in accordance with CAN/CSA-A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

.2 Fabricate connectors in accordance with CAN/CSA A370.

.3 Obtain Departmental Representative's approval for locations of reinforcement splices other than shown on placing drawings.

.4 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.

.5 Ship reinforcement and connectors clearly identified in accordance with drawings.

2.3 SOURCE QUALITY CONTROL

.1 Provide Departmental Representative certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis, minimum 2 weeks prior to commencing reinforcement work.

.2 Inform Departmental Representative of proposed source of material to be supplied.

3.0 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PREPARATION

.1 Direct and coordinate placement of metal anchors for masonry supplied to other Sections.

3.3 INSTALLATION

.1 Supply and install masonry connectors and reinforcement in accordance with CAN/CSA A370, CAN/CSA A371, CAN/CSA-A23.1 and CSA-S304.1 unless indicated otherwise.

.2 Prior to placing mortar, obtain Departmental Representative's approval of placement of reinforcement and connectors.

.3 Supply and install additional reinforcement to masonry as indicated.

3.4 BONDING AND TYING

.1 Bond walls of two or more wythes using metal connectors in accordance with CSA-S304.1, CAN/CSA A371 and as indicated.

.2 Tie masonry veneer to backing in accordance with NBC, CSA-S304.1, CAN/CSA A371 and as indicated.

.3 Install unit, adjustable, single wythe and multiple wythe joint reinforcement where indicated and in accordance with CAN/CSA A370 and CAN/CSA A371 manufacturer's instructions.

- .1 Bond walls of two or more wythes using metal connectors in accordance with CAN/CSA A371 and as indicated.
- .2 Install horizontal joint reinforcement 400 mm on centre.
- .3 Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
- .4 Place joint reinforcement continuous in first and second joint below top of walls.
- .5 Lap joint reinforcement ends minimum 150 mm.
- .6 Connect stack bonded unit joint corners and intersections with strap anchors 400 mm on centre.

3.5 REINFORCED LINTELS AND BOND BEAMS

.1 Reinforce masonry beams, masonry lintels and bond beams as indicated.

.2 Place and grout reinforcement in accordance with CSA-S304.1, CAN/CSA A371, and CAN/CSA A179.

.3 Support and position reinforcing bars in accordance with CAN/CSA A371.

3.6 GROUTING

.1 Grout masonry in accordance with CSA-S304.1, CAN/CSA A371 and CAN/CSA A179 and as indicated.

3.7 ANCHORS

.1 Supply and install metal anchors in accordance with CAN/CSA A370 and CAN/CSA A371 as indicated.

3.8 LATERAL SUPPORT AND ANCHORAGE

.1 Supply and install lateral support and anchorage in accordance with CSA-S304.1 and as indicated.

3.9 MOVEMENT JOINTS

.1 Reinforcement will not be continuous across movement joints unless otherwise indicated.

3.10 FIELD BENDING

.1 Do not field bend reinforcement and connectors except where indicated or authorized by Departmental Representative.

.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.

.3 Replace bars and connectors which develop cracks or splits.

3.11 FIELD QUALITY CONTROL

.1 Site inspections in accordance with Section 04 05 00 - Common Work Results for Masonry.

.2 Obtain Departmental Representative approval of placement of reinforcement and connectors, prior to placing mortar.

3.12 FIELD TOUCH-UP

.1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcement steel and connectors with compatible finish to provide continuous coating.

3.13 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION 04 05 19

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1	Common Work Results for Masonry	Section 04 05 00
.2	Masonry and Mortar Grout	Section 04 05 12
.3	Masonry Anchorage Reinforcing	Section 04 05 19
.4	Brick Masonry	Section 04 21 13
.5	Concrete Unit Masonry	Section 04 22 00

1.2 REFERENCES

.1 ASTM International Inc.
- .1 ASTM D 2240-05, Standard Test Method for Rubber Property - Durometer Hardness.

.2 Canadian Standards Association (CSA International)
- .1 CAN/CSA A371-04, Masonry Construction for Buildings.
- .2 CAN/CSA-ISO 14021-00(R2204), Environmental Labels and Declarations - Self Declared Environmental Claims (Type II Environmental Labelling).

.3 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
- .1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Provide manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.

.3 Shop Drawings:
- .1 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings consist of flashing and installation details. Indicate sizes, spacing, location and quantities of fasteners.

.4 Samples:
- .1 Provide masonry accessory samples in accordance with Section01 33 00 - Submittal Procedures, supplemented as follows:
  - .1 Materials: two, cured, and coloured samples, illustrating colour and colour range. Include:
    - .1 Movement joint filler.
    - .2 Lap adhesive.
    - .3 Mechanical fasteners.
    - .4 Reglets.
    - .5 Brick vents.
  - .2 Two moisture control material samples, illustrating colour and colour range, size, and shape. Include:
    - .1 Weep hole vents.
    - .2 Mortar diverters.

.3 Grout screens.

.3 Two flashing material samples, illustrating colour and colour range, size, shape, and profile. Include as specified:

.1 Sheet metal flashings.

.5 Quality Assurance Submittals:

.1 Test reports: submit certified test reports in accordance with Section 04 05 00 - Common Work Results for Masonry:

.2 Certificates: submit in accordance with Section 04 05 00 - Common Work Results for Masonry.

.3 Manufacturer's Instructions: submit in accordance with Section 04 05 00 - Common Work Results for Masonry, supplemented as follows:

.1 Submit installation instructions for fillers adhesives reglets brick vents weeps vents diverters screens flashings.

.6 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.7 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.8 Pre-installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Section 04 05 00 - Common Work Results for Masonry.

1.4 FIELD MEASUREMENTS

.1 Make field measurements necessary to ensure proper fit of members.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle masonry accessories in accordance with, Section 01 61 00 - Product Requirements supplemented as follows:

.1 Keep fillers and adhesives dry, protected against dampness, and freezing.

.2 Store packaged materials off ground and in accordance with manufacturer's written instructions.

.2 Packaging Waste Management:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

2.0 PRODUCTS

2.1 MATERIALS

.1 Movement joint filler: purpose-made durometer hardness to ASTM D 2240 of size and shape indicated.

.1 Use low VOC products in compliance with the SCAQMD Rule 1168.

.2 Material type: fibre board expanded polyethylene rubber cork self-expanding cork closed cell neoprene.

.2 Lap adhesive: recommended by masonry flashing manufacturer. Use low VOC products in compliance with the SCAQMD Rule 1168.

.3 Weep hole vents: purpose-made PVC galvanized steel polypropylene fibre filter, colour beige.

.4 Mechanical fasteners: recommended by flashing manufacturer to suit project requirements.

.5 Brick vents:
- .1 Material: aluminum, 38 mm deep frame.
- .2 Blades: aluminum, overlapping, 45 degree angle opposed blade damper with maximum free area 39%.
- .3 Size: height of brick x grout width.
- .4 Provide 458 x 356 mm mesh aluminum insect screen, single blade flap damper straight duct connection exterior operator.

2.2 MOISTURE CONTROL

.1 Weep Hole Vents: PVC galvanized steel polypropylene fibre filter.

.2 Cell vents: polypropylene plastic, honeycomb design.
- .1 Size: 9.5 mm x 63.5 mm x 85.7 mm.

.3 Colour: brown.

.4 Mortar diverters: shaped and sized to suit cavity spaces.
- .1 Cavity space size: 25 mm.
- .2 Manufactures from recycled material.

.5 Grout Screens: 6 mm square monofilament screen is fabricated form high-strength, non-corrosive polypropylene polymers to isolate flow of grout in designated areas.
- .1 Size: 100 mm wide x 30 m.

2.3 FLASHINGS

.1 Sheet metal: galvanized steel.
- .1 Thickness: 22 gauge.
- .2 Finish: to be selected by Departmental Representative.

.2 Aluminum flashings: aluminum foil, 0.004 mm thick, asphalt laminated between two sheets of creped kraft paper with one exposed paper surface coated with asphalt-wax treatment.

3.0 EXECUTION

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION: MATERIALS

.1 Install continuous movement joint fillers in movement joints at locations indicated on drawings.

.2 Lap adhesive: apply adhesive to flashing lap joints.

.3 Mechanical fasteners: install fasteners to suit application and in accordance with manufacturer's written installation instructions.

.4 Brick vents: install brick vents at locations indicated on drawings.

3.3 INSTALLATION: MOISTURE CONTROL

.1 Install weep hole vents in vertical joints immediately over flashings, in exterior wythes of cavity wall and masonry veneer wall construction, at maximum horizontal spacing of 600 mm on centre.

.2 Mortar diverters: install purpose made diverters in cavities where indicated and as directed, size and shape to suit purpose and function.

.3 Grout screens: install purpose made diverters in cavities where indicated and as directed, size and shape to suit purpose and function.

3.4 INSTALLATION: FLASHINGS

.1 Build in flashings in masonry in accordance with CAN/CSA A371.

.1 Install flashings under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings, and at base of cavity wall and where cavity is interrupted by horizontal members or supports and as shown on drawings. Install flashings under weep hole courses and as indicated.

.2 In cavity walls and veneered walls, carry flashings from front edge of exterior masonry, under outer wythe, then up backing not less than 150 mm, and as follows:

.1 For masonry backing embed or bond flashing 25 mm in joint.

.2 For concrete backing, insert or bond flashing into reglets.

.3 Lap joints 150 mm and seal with adhesive.

.2 Form flashing (end dams) at lintels, sills and wall ends to prevent water from travelling horizontally past flashing ends.

.3 Install vertical flashing where outer veneer returns at window or door jambs, to prevent contact of veneer with inner wall.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION 04 05 23

1.0 GENERAL

1.1 RELATED REQUIRMENTS

.1	Common Work Results for Masonry	Section 04 05 00
.2	Masonry Mortar & Grout	Section 04 05 12
.3	Masonry Anchorage & Reinforcing	Section 04 05 19
.4	Masonry Accessories	Section 04 05 23
.5	Concrete Unit Masonry	Section 04 22 00

1.2 REFERENCES

.1 ASTM International Inc.
- .1 ASTM C 73-05, Standard Specification for Calcium Silicate Brick (Sand-Lime Brick).

.2 Brick Industry Association (BIA)
- .1 Technical Note No. 20-2006, Cleaning Brick Work.

.3 Canadian Standards Association (CSA International)
- .1 CAN/CSA A82-06, Fired Masonry Brick Made From Clay or Shale).
- .2 CAN/CSA-A165 Series-2004, CSA Standards on Concrete Masonry Units.
- .3 CAN/CSA A371-04, Masonry Construction for Buildings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Provide manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.

.3 Manufacturer's Instructions:
- .1 Provide manufacturer's installation instructions in accordance with Section 04 05 00 - Common Work Results for Masonry.

.4 Samples:
- .1 Provide unit samples in accordance with Section 01 33 00 - Submittal Procedures.

1.4 QUALITY ASSURANCE SUBMITTALS

.1 Provide Certificates: in accordance with Section 04 05 00 - Common Work Results for Masonry.

.2 Test and Evaluation Reports: submit certified test reports in accordance with Section 04 05 00 - Common Work Results for Masonry, supplemented as follows:

.3 Pre-Installation Meetings: conduct pre-installation meeting in accordance with Section 04 05 00 – Common Work Results for Masonry to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

.4 Mock-ups:
- .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry supplemented as

follows:
.1 Construct mock-up panel of exterior brick construction 1200 x 1800 mm.

.5 Delivery, Storage, and Handling:
.1 Deliver, store and handle brick unit masonry in accordance with Section 01 61 00 - Product Requirements.

.6 Packaging Waste Management:
.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

1.5 SITE CONDITIONS
.1 Ambient Conditions: assemble and erect components only when temperature is above 4 degrees C.

2.0 PRODUCTS

2.1 MANUFACTURED UNITS
.1 Face brick:
.1 Fired clay brick: to CAN/CSA A82.1 M87
.1 Type: FBS
.2 Grade: SW
.3 Size: 90mm($3\ ^5/_8$") x 57mm (2 ¼") x 194mm ($7\ ^5/_8$")
.4 Colour and texture: Smooth face, colour to match Golden Buff by Interstate or approved equivlant.
.5 Hollow.

.2 Reinforcement:
.1 Reinforcement in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

.3 Connectors:
.1 Connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

.4 Flashings:
.1 Flashing: in accordance with Section 04 05 23 - Masonry Accessories.

.5 Mortar Mixes:
.1 Mortar and mortar mixes in accordance with Section 04 05 12 - Masonry Mortar and Grout.

.6 Grout Mixes:
.1 Grout and grout mixes in accordance with Section 04 05 12 - Masonry Mortar and Grout.

.7 Cleaning Compounds:
.1 Compatible with substrate and acceptable to masonry manufacturer for use on products.
.2 Cleaning compounds compatible with brick masonry units and in accordance with manufacturer's written recommendations and instructions.

3.0 EXECUTION

3.1 EXAMINATION
.1 Verify surfaces and conditions are ready to accept work of this Section.

.2 Commencing installation means acceptance of existing substrates.

3.2 PREPARATION

.1 Protect adjacent finished materials from damage due to masonry work.

3.3 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.4 INSTALLATION

.1 Construction to conform to CAN/CSA A371.

.2 Bond: Running (Stretcher).

.3 Coursing height: 203mm (8") for three bricks and three joints

.4 Jointing: concave raked where exposed or where paint or similar thin finish coating is specified.

.1 Mixing and blending: mix units within each pallet and with other pallets to ensure uniform blend of colour and texture.

.2 Clean unglazed clay masonry as work progresses.

.3 Reinforcement:

.1 Install reinforcing in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

.4 Connectors:

.1 Install connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

.5 Flashings:

.1 Install flashings in accordance with Section 04 05 23 - Masonry Accessories.

.6 Mortar Placement:

.1 Place mortar in accordance with Section 04 05 12 - Masonry Mortar and Grout.

.7 Grout Placement:

.1 Place grout in accordance with Section 04 05 12 - Masonry Mortar and Grout.

.8 Repair/Restoration:

.1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.

.9 Field Quality Control:

.1 Site Tests, Inspection: in accordance with Section 04 05 00 - Common Work Results for Masonry,

.10 Tolerances:

.1 To CAN/CSA A371 unless noted below.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.2 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.

.3 Clean unglazed clay masonry: 10 m² area of wall designated by Departmental Representative mock up panel specified in Section 04 05 00 - Common Work Results for Masonry as directed below and leave for one week. If no harmful effects appear and after mortar has set and cured, protect windows, sills, doors, trim and other work, and clean brick masonry as follows.

.1 Remove large particles with wood paddles without damaging surface. Saturate masonry with clean water and flush off loose mortar and dirt.
.2 Scrub with solution of 25 mL trisodium phosphate and 25 mL household detergent dissolved in 1 L of clean water using stiff fibre brushes, then clean off immediately with clean water using hose. Alternatively, use proprietary compound recommended by brick masonry manufacturer in accordance with manufacturer's directions.
.3 Repeat cleaning process as often as necessary to remove mortar and other stains.
.4 Use acid solution treatment for difficult to clean masonry as described in Technical Note No.20 by the Brick Industry Association.

.4 Clean concrete brick masonry as work progresses.
.1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of brick and finally by brushing.

.5 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

.6 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

3.6 PROTECTION

.1 Brace and protect brick masonry in accordance with Section 04 05 00 - Common Work Results for Masonry.

END OF SECTION 04 21 13

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Common Work Results for Masonry Section 04 05 00.

.2 Masonry Mortar and Grout Section 04 05 12

.3 Masonry Anchorage Reinforcing Section 04 05 19

.4 Masonry Accessories Section 04 05 23

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-A165 Series-2004, CSA Standards on Concrete Masonry Units covers: A165.1, A165.2, A165.3.

.2 CAN/CSA A371-04, Masonry Construction for Buildings.

.3 CSA S304.1-04, Design of Masonry Structures.

.2 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)

.1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

.3 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S101-07, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.3 ACTION & INFORMAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Product Data: provide product data, including manufacturer's printed data sheets and catalog pages illustrating products to be incorporated into project for specified products.

.3 Manufacturer's Written Instructions: provide in accordance with Section 04 05 00 - Common Work Results for Masonry.

1.4 QUALITY ASSURANCE SUBMITTALS

.1 Certificates: provide in accordance with Section 04 05 00 - Common Work Results for Masonry.

.2 Test and Evaluation Reports: provide certified test reports in accordance with Section 04 05 00 - Common Work Results for Masonry.

.3 Pre-Installation Meetings: conduct pre-installation meeting in accordance with Section 04 05 00 - Common Work Results for Masonry to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

.4 Mock-ups:

.1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry supplemented as follows:

.1 Construct mock-up panel of interior concrete unit masonry construction 1200 x 1800 mm.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle concrete unit masonry in accordance with Section 04 05 00 - Common Work Results for Masonry.

.2 Packaging Waste Management:

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

2.0 PRODUCTS

2.1 MATERIALS

.1 Standard concrete block units Type : to CAN/CSA-A165.

.1 Classification: H/15/A/M.

.2 Dimensions - Nominal: 200 mm wide x200 mm high x 400 mm long or as specified.

.3 Special shapes: provide square units for exposed corners. Provide purpose-made shapes for lintels, beams and bond beams. Provide additional special shapes as indicated.

.4 Colour:

.1 Colour to be natural grey, smooth texture finish.

2.2 REINFORCEMENT

.1 Reinforcement in accordance with Section 04 05 19 - Masonry Anchorage Reinforcing.

2.3 CONNECTORS

.1 Connectors in accordance with Section 04 05 19 - Masonry Anchorage Reinforcing.

2.4 MORTAR MIXES

.1 Mortar and mortar mixes in accordance with Section 04 05 12 - Masonry Mortar and Grout.

2.5 GROUT MIXES

.1 Grout and grout mixes in accordance with Section 04 05 12 - Masonry Mortar and Grout.

2.6 CLEANING COMPOUNDS

.1 Use low VOC products in compliance with SCAQMD Rule 1168.

.2 Compatible with substrate and acceptable to masonry manufacturer for use on products.

.3 Cleaning compounds compatible with concrete unit masonry and in accordance with manufacturer's written recommendations and instructions.

2.7 TOLERANCES

.1 Tolerances for standard concrete unit masonry tolerances in accordance with CAN/CSA A165.1, supplemented as follows:

.1 Maximum variation between units within specific job not to exceed 2 mm.

.2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.

.3 Out of square tolerance not to exceed 2 mm.

3.0 EXECUTION

.1 Verify surfaces and conditions are ready to accept work of this Section.

.2 Commencing installation means acceptance of existing substrates.

3.2 PREPARATION

.1 Protect adjacent finished materials from damage due to masonry work.

3.3 INSTALLATION

.1 Concrete block units:

.1 Bond: running.

.2 Coursing height: 200mm for one block and one joint.

.3 Jointing: concave where exposed or where paint or other finish coating is specified.

.2 Special Shapes:

.1 Install special units to form corners, returns, offsets, reveals and indents without cut ends being exposed and without losing bond or module.

.2 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.

.3 End bearing: not less than 200 mm.

.4 Install special site cut shaped units.

3.4 REINFORCEMENT

.1 Install reinforcing in accordance with Section 04 05 19 - Masonry Anchorage Reinforcing.

3.5 CONNECTORS

.1 Install connectors in accordance with Section 04 05 19 - Masonry Anchorage Reinforcing.

3.6 MORTAR PLACEMENT

.1 Place mortar in accordance with Section 04 05 12 - Masonry Mortar and Grout.

3.7 GROUT PLACEMENT

.1 Place grout in accordance with Section 04 05 12 - Masonry Mortar and Grout.

3.8 CONSTRUCTION

.1 Cull out masonry units, in accordance with CAN/CSA A165 and reviewed range of colour samples, with chips, cracks, broken corners, excessive colour and texture variation.

.2 Build in miscellaneous items such as bearing plates, steel angles, bolts, anchors, inserts, sleeves and conduits.

.3 Construct masonry walls using running bond unless otherwise noted.

.4 Build around frames previously set and braced. Fill behind hollow frames within masonry walls with mortar or grout and embed anchors.

.5 Fit masonry closely against electrical and plumbing outlets so collars, plates and covers overlap and conceal cuts.

.6 Install movement joints and keep free of mortar where indicated.

.7 Hollow Units: spread mortar setting bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness. Avoid excess mortar.

.8 Ensure compacted head joints. Use full or face-shell joint as indicated.

.9 Tamp units firmly into place.

.10 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean and reset units in new mortar.

.11 Tool exposed joints concave raked for interior work; strike concealed joints flush.

.12 After mortar has achieved initial set up, tool joints.

.13 Do not interrupt bond below or above openings.

3.10 REPAIR/RESTORATION

.1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.

3.11 FIELD QUALITY CONTROL

.1 Site Tests, Inspection: in accordance with Section 04 05 00 - Common Work Results for Masonry supplemented as follows:

.1 Concrete masonry units will be sampled and tested by independent testing agency appointed and paid by Departmental Representative in accordance with CSA S304.1.

3.12 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning, supplemented as follows.

.1 Progress Cleaning:

.1 Standard Concrete Unit Masonry:

.1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

3.13 PROTECTION

.1 Brace and protect concrete unit masonry in accordance with Section 04 05 00 - Common Work Results for Masonry.

END OF SECTION 04 22 00

1.0 GENERAL

1.1 RELATED SECTIONS

.1 Section 05 21 00 –Steel Joists.

.2 Section 05 31 00 – Steel Decking.

.3 Section 05 50 00 – Metal Fabrication.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

- .1 ASTM A 36/A 36M-12, Specification for Carbon Structural Steel.
- .2 ASTM A 307-12, Specification for Carbon Steel Bolts and Studs, 60,000psi Tensile.
- .3 ASTM A 325-10e1, Specification for Structural Bolts, Steel, Heat Treated,120/105 ksi Minimum Tensile Strength.
- .4 ASTM A 325M-13, Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength Metric.

.2 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA).

- .1 CISC/CPMA 1-73a, Quick-Drying, One-Coat Paint for Use on Structural Steel.
- .2 CISC/CPMA 2-75, Quick-Drying, Primer for Use on Structural Steel.

.3 Canadian Standards Association (CSA International)

- .1 CAN/CSA-G40.20-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel.
- .2 CAN/CSA-G40.21-04 (R2009), Structural Quality Steels.
- .3 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .4 CAN/CSA-S16-09, Design of Steel Structures.
- .5 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.
- .6 CSA W48-06 (R2011), Electrodes.
- .7 CSA W55.3-08, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
- .8 CSA W59-03 R(2008), Welded Steel Construction (Metal Arc Welding)

1.3 DESIGN OF DETAILS AND CONNECTIONS

.1 Design details and connections in accordance with requirements of CAN/CSA-S16-09 to resist forces, moments, shears and allow for movements indicated.

.2 If connection for shear only (standard connection) is required:

- .1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction".

.3 If shears are not indicated, select or design connections to support reaction from 120% maximum uniformly distributed load that can be safely supported by beam in bending (60% each end), provided no point loads act on beam.

.4 At the Departmental Representative’s request, submit sketches and design calculations for non standard connections, stamped and signed by qualified professional engineer licensed in the Province of British Columbia, Canada.

1.4 SHOP DRAWINGS

.1 Submit shop drawings including fabrication and erection documents and materials list in accordance with Section 01 33 00 – Submittal Procedures.

.2 On erection drawings, indicate all details and information necessary for assembly and erection purposes such as, description of methods, sequence of erection, type of equipment used in erection and temporary bracings.

.3 All shop drawings to be signed, sealed by professional engineer licensed in British Columbia, Canada.

.4 The Professional Engineer responsible for the shop drawings shall inspect the installation of the work for conformance with the design and the shop drawings, and shall upon completion of the work submit to the Consultant a completed Schedule S-B: Assurance of Professional Design and Commitment for Field Review by Supporting Registered Professional, and Schedule S-C: Assurance of Professional Field Review and Compliance by Supporting Registered Professional.

1.5 QUALITY ASSURANCE

.1 Submit 2 copies of mill test reports showing chemical and physical properties and other details of steel to be incorporated into work at least 2 weeks prior to fabrication of structural steel. Mill test reports shall be certified by metallurgists qualified to practice in British Columbia, Canada.

.2 Fabricator of structural steel shall, in addition, provide an affidavit stating that materials and products used in fabrication conform to applicable material and products standards called for by design drawings and specifications.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 –Waste Management and Disposal.

2.0 PRODUCTS

2.1 MATERIALS

.1 Structural steel: to CAN/CSA-G40.21 Grade as indicated on drawings.

.2 Anchor bolts: ASTM A307 unless noted otherwise on drawings.

.3 Bolts, nuts and washers: to ASTM A325.

.4 Welding materials: to CSA W48 Series and CSA W59 and certified by Canadian Welding Bureau.

.5 Shop paint primer: to CISC/CPMA 1.

.6 Hot dip galvanizing: galvanize steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 600 g/m^2.

.7 Galvanize touch-up primer: to CISC/CPMA 1.

.8 Shear studs: to CSA W59, Appendix H.

2.2 FABRICATION

.1 Fabricate structural steel in accordance with CAN/CSA-S16 and in accordance with reviewed shop drawings.

.2 Install shear studs in accordance with CSA W59..

.3 Continuously seal members that required by remediation with continuous field welds where appropriate. Grind smooth.

1.7 SHOP PAINTING

.1 Clean, prepare surfaces and field prime structural steel in accordance with CAN/CSA-S16 except where members to be encased in concrete.

.2 Clean members, remove loose mill scale, rust, oil, dirt and other foreign matter. Prepare surface according to SSPC SP7 brush off blast.

.3 Apply one coat of CISC/CMPD2-75 primer in shop to steel surfaces to achieve minimum dry film thickness of 3 to 4 mils, except:

.1 Surfaces to be encased in concrete.

.2 Surfaces to receive field installed stud shear connections.

.3 Surfaces and edges to be field welded.

.4 Faying surfaces of friction-type connections.

.5 Below grade surfaces in contact with soil.

.4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.

.5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.

.6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

3.0 EXECUTION

3.1 GENERAL

.1 Structural steel work: in accordance with CAN/CSA-S16.

.2 Welding: in accordance with CSA W59.

.3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.2 CONNECTION TO EXISTING WORK

.1 Verify dimensions and condition of existing work, report discrepancies and potential problem areas to Departmental Representative for direction before commencing fabrication.

3.3 MARKING

.1 Mark materials in accordance with CAN/CSA G40.20/G40.21. Do not use die stamping. If steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.

.2 Match marking: shop mark, bearing assemblies and splices for fit and match.

3.4 ERECTION

.1 Erect structural steel, as indicated and in accordance with CAN/CSA-S16 and in accordance with reviewed erection drawings.

.2 Field cutting or altering structural members: to approval of Departmental Representative.

.3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.

.4 Continuously seal members by continuous welds where indicated. Grind smooth.

2.5 FIELD QUALITY CONTROL

.1 The Departmental Representative will not be responsible for inspection of the Contractor's work as described in Clause 7.12 of the CISC Code of Standard Practice for Structural Steel. The Contractor is responsible for the accuracy and completeness of his own work and shall verify that the structural steel has been fabricated, erected and finished in accordance with the contract specifications.

.2 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Departmental Representative.

.3 Testing requirements are as follows:

.1 Visual Field Inspection and Bolt Torque Testing (Random 10% of Bolts) of all bolted connections.

.2 Non Destructive Testing of Welds:

- 100% of all welds to be visually inspected
- 10% of all moment connections to be ultrasonically tested.
- 10% of all full strength splice connections to be ultrasonically tested.

.3 Verify the certification and conformance of the steel fabricator and erector to any relevant CSA Standards.

.4 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Departmental Representative.

.5 Submit test reports to Departmental Representative within 1 week of completion of inspection.

.6 Costs of tests will be borne by Contractor as specified in Section 01 11 00 – General Instructions.

2.6 FIELD PAINTING

.1 Paint in accordance with Section 09 91 13 – Exterior Painting and Section 09 91 23 – Interior Painting.

.1 Touch up all damaged surfaces and surfaces without shop coat with primer to MPI Product #76 except as specified otherwise. Apply in accordance with MPI system INT5.1A.

END OF SECTION 05 12 23

1.0 GENERAL

1.1 RELATED WORK

.1	Structural Steel for Buildings	Section 05 12 23
.2	Steel Decking	Section 05 31 00
.3	Metal Fabrications	Section 05 50 00
.4	Interior Painting	Section 09 91 23

1.1 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM)
- .1 ASTM A 36/A 36M-12, Specification for Carbon Structural Steel.
- .2 ASTM A325M-12 Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength Metric.
- .3 ASTM A 325-10e1, Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

.2 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA).
- .1 CISC/CPMA1-73b, Quick-Drying, One-Coat Paint for Use on Structural Steel.
- .2 CISC/CPMA2 -75, Quick-Drying, Primer for use on Structural Steel.

.3 Canadian Standards Association (CSA)
- .1 CAN/CSA-G40.20-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel.
- .2 CAN/CSA-G40.21-04 (R2009), Structural Quality Steels.
- .3 CAN/CSA-S16-09, Design of Steel Structures.
- .4 CAN/CSA-S136-07, North American Specification for the design of Cold Formed Steel Structural Members.
- .5 CSA-W47.1-09 Certification of Companies for Fusion Welding of Steel Structures.
- .6 CSA-W59-03 (R2008), Welded Steel Construction (Metal Arc Welding).

1.2 QUALITY ASSURANCE

.1 At least 4 weeks prior to fabrication of steel joists and accessories, submit 2 copies of mill test reports showing chemical and physical properties and other details of steel to be incorporated into work. Such mill test reports shall be certified by qualified metallurgists confirming that tests conform to requirements of CAN/CSA G40.20 and CAN/CSA G40.21.

.2 Fabricator of structural steel joists shall, in addition, provide an affidavit stating that materials and products used in fabrication conform to applicable material and products standards called for by design drawings and specifications.

1.3 DESIGN OF STEEL JOISTS AND BRIDGING

.1 Design steel joists, their connections, diagonal bracing and bridging and other associated components to carry loads as shown on drawings in accordance with CAN/CSA-S16-09, CSA-S136.

.2 Design joists and anchorages for uplift forces and snow built-up forces as per Building Code requirements unless otherwise indicated on the drawings.

.3 Ensure joists are manufactured to consider load effects due to fabrication, erection and handling.

.4 Limit roof joist deflection due to specified live load to 1/360 of span and camber all open web steel joists for full dead load and 25% live load unless specified otherwise.

.5 No drilling or cutting for hanger or support devised is permitted unless approved by the design engineer of the OWSJ supplier.

.6 Diagonal bracing shall be used.

.7 Joist fabricator shall coordinate duct runs with Mechanical Engineer and Architect. Openings in joists must line up to allow passage of mechanical ducting and other equipment.

.8 Joist shall bear on center lines of supporting members, unless noted otherwise on drawings or approved by departmental representative.

.9 Submit 5 copies of calculations and joist design drawings for typical joists for Departmental Representative review at least 4 weeks prior to fabrication and/or delivery.

1.4 SUBMITTALS

.1 Submit shop details and erection drawings in accordance with Section 01 33 00 - Submittals Procedures

.2 Submit drawings stamped and signed by qualified professional engineer registered or licensed in province of British Columbia, Canada.

.3 On erection drawings, indicate relevant details such as joist mark, depth, spacing, bridging lines, bearing, anchorage and details.

.4 Provide particulars, on shop drawings, relative to joist geometry, framed openings, splicing details, bearing and anchorage. Include member size, properties, specified and factored member loads, and stresses under various loadings, deflection and camber.

.5 The Professional Engineer responsible for the shop drawings shall inspect the installation of the work for conformance with the design and the shop drawings, and shall upon completion of the work, provide to the Departmental Representative a completed Schedules S-B: Assurance of Professional Design and Commitment for Field Review by Supporting Registered Professional, and Schedule S-C: Assurance of Professional Filed Review and Compliance by Supporting Registered Professional.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

2.0 PRODUCTS

2.1 MATERIALS

.1 Structural steel: to CAN/CSA-G40.21 and CAN/CSA –S136.

.2 Welding materials: to CSA W59 and certified by the Canadian Welding Bureau.

.3 Shop paint primer: to CISC/CPMA 2.

.4 Shear studs: to CSA W59, Appendix H.

2.2 FABRICATION

.1 Fabricate steel joists and accessories as indicated in accordance with CAN/CSA-S16-09, CAN/CSA –S136 and in accordance with reviewed shop drawings.

.2 Weld in accordance with CSA_W59.

.3 Provide chord extensions where indicated.

.4 Provide diagonal and horizontal bridgings and anchorages in accordance with. CAN/CSA –S16-09.

2.3 SHOP PAINTING

.1 Clean, prepare and shop prime all surfaces of steel joists to CAN/CSA-S16-01.

.2 Clean all members of loose mill scale, rust, oil, dirt and other foreign matter. Prepare surfaces in accordance with SSPC SP 1 brush off blast.

.3 Apply one coat of CISC/CMPA-2 primer to all steel surfaces to achieve maximum dry film thickness of 3 mil to 4 mil except:

.1 Surfaces to be encased in concrete.
.2 Surfaces to receive field installed stud shear connectors.
.3 Surfaces and edges to be field welded.
.4 Faying surfaces of friction-type connections.
.5 Below grade surfaces in contact with soil.

.4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.

.5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.

.6 Strip paint bolts, nuts, sharp edges and corners before prime coat is dry.

3.0 EXECUTION

3.1 GENERAL

.1 Structural steel work: in accordance with CAN/CSA-S16, CAN/CSA –S136.

.2 Welding: in accordance with CSA W59.

.3 Companies to be certified under Division 2.1 of CSA W47.1 for fusion welding of steel structures.

.4 Provide certification that welded joints are qualified by Canadian Welding Bureau.

3.2 FIELD QUALITY CONTROL

.1 Inspection and testing of materials and workmanship will be carried out by testing laboratory approved by Departmental Representative.

.2 Testing laboratory will inspect representative joists for integrity, accuracy of fabrication and soundness of welds. Testing laboratory will also monitor test loading of joists used by manufacturer to verify design and check representative field connections. Departmental Representative will determine extent of and identify all inspections.

.3 Submit test report to Departmental Representative within 5 days after completion of inspection.

.4 Costs of tests will be borne by Contractor as specified in Section 01 11 55 – General Instructions.

3.3 ERECTION

.1 Erect steel joists and bridging as indicated in accordance with CAN/CSA-S16 and in accordance with reviewed erection drawings.

.2 Complete installation of all bridging and anchorages before placing construction loads on joists.

.3 Field cutting or altering joists or bridging that are not shown on shop drawings: to approval of Departmental Representative.

.4 Clean and touch up shop primer to bolts, welds, burned or scratched surfaces at completion of erection.

3.4 FIELD PAINTING

.1 Paint in accordance with Section 09 91 13 – Exterior Painting and Section 09 91 23 – Interior Painting.

.1 Touch up all damaged surfaces and surfaces without shop coat with primer to MPI Product #76 except as specified otherwise. Apply in accordance with MPI system INT5.1A.

END OF SECTION 05 21 00

1.0 GENERAL

1.1 RELATED WORK

.1 Structural Steel for Buildings Section 05 12 23

.2 Steel Joist Section 05 21 00

.3 Fire stopping Section 07 84 00

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA)
- .1 CAN/CSA-S136-07, North American Specification for the design of Cold Formed Steel Structural Members.
- .2

.2 Canadian Sheet Steel Building Institute (CSSBI)
- .1 CSSBI 10M-08, Standard for Steel Roof Deck.

.3 American Society for Testing and Materials International, (ASTM)
- .1 ASTM A 653/A653M-11, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM A792/A 792M-05, Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

1.3 DESIGN REQUIREMENTS

.1 Design steel deck using limit states design in accordance with CSA S136 and, CSSBI 10M and CSSBI 12M.

.2 Steel deck and connections to steel framing to carry dead, live and other loads including lateral loads, diaphragm action and uplift as indicated.

.3 Deflection under specified live load not to exceed 1/240 of span, except that when gypsum board ceilings are hung directly from deck, live load deflection not to exceed 1/360 of span.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

- .1 Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacings, projections, openings, reinforcement details and accessories.
- .2 Submit drawings stamped and signed by qualified professional engineer registered or licensed in Provinces of British Columbia, Canada.
- .3 Submit design calculations if requested by Departmental Representative.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 –Waste Management and Disposal.

2.0 PRODUCTS

2.1 MATERIALS

.1 Zinc-iron Alloy (ZF) coated steel sheet: to ASTMA653/A653M structural quality Grade 230, with ZF75 coating, for interior surfaces not exposed to weather, unpainted finish, 1.22mm minimum base steel thickness and as indicated on drawing 5606.

.2 Decks to be painted: zinc-iron alloy coated decks suitable for finish painting.

.3 Zinc (Z) coated steel sheet: to ASTMA653/A653M structural quality Grade 230, with Z275, coating, regular spangle surface, not chemically treated for paint finish, for exterior surfaces exposed to weather, 0.91mm minimum base steel thickness.

.4 Aluminum-zinc alloy (AZ) coated steel sheet: to ASTMA 792/A 792M structural quality grade 230, with AZ 150 coating, surface not chemically treated for paint finish, for exterior surfaces exposed to weather, 0.91mm minimum base steel thickness.

.5 Closures: as indicated.

.6 Coverplates, deck flute closures and flashings: steel sheet with minimum base steel thickness of 0.91 mm. Metallic coating same as deck material.

.7 Primer: zinc rich, ready mix to MPI #200.

.8 Caulking: to Section 07 92 00 Joint Sealants.

.9 Fire stopping: to Section 07 84 00 Fire stopping.

2.2 TYPES OF DECKING

.1 Roof deck: 1.22 mm minimum base steel thickness or as indicated on drawing, 38 mm deep profile, non-cellular interlocking side laps.

3.0 EXECUTION

3.1 GENERAL

.1 Structural steel work: in accordance with CAN/CSA-S136 and CSSBI 10M.

.2 Mechanical Fastener to be Hilti- X-EDNK 19 or X-EDNK 22 fasteners or approved alternative spaced at maximum 300mm on center to structural members and edge angles and side laps with 1-#10 self drilling screws at maximum 300mm on center or approved alternative and as shown on plans

.

3.2 ERECTION

.1 Erect steel deck as indicated and in accordance with CSSBI 10M and in accordance with reviewed erection drawings.

.2 Where possible, supply and install decking in length that will permit continuity over a minimum of three spans.

.3 Butt ends: to 1.5 to 3 mm gap. Install steel cover plates over gaps wider than 3 mm.

.4 Lap ends: to 50 mm minimum.

.5 Provide minimum mechanical fasteners for roof deck base thicknesses as indicated on structural drawings and as listed below with side laps screw #10 spaced @ minimum

150mm or approved equal for steel deck to steel beams and inserts:

.1 1.22mm base thickness: Hilti ENP2K, EX-EDNK22 connection pattern of 914/7 or approved equal.
.2 1.52mm base thickness: Hilti ENP2K, EX-EDNK22 connection pattern of 914/9 or approved equal.

.6 Deck edge and chord members:
All edges of steel decking shall be supported by edge angles fastened to main structural members, unless noted otherwise, use L150x100x5 at roofs.

.7 Unless noted otherwise, all members designated as diaphragm chord members and all perimeter edge angles shall be connected by full strength grove welds or by full strength splice plates on each leg to form continuous compression and tension members. Weld edge angles and chords to Beams, joists and shear connectors and weld deck to angles chords and structural members as shown on drawings or as detailed by decking contractor.

3.3 OPENINGS AND AREAS OF CONCENTRATED LOADS

.1 No reinforcement required for openings cut in deck which are smaller than 150 mm square.

.2 For larger openings, detail framing as follows:

Location	Opening Size (In any direction)	Reinforcing
Roof/Floor	<150mm but < 500mm	L51x51x6.4 running perpendicular to Flutes and welded to minimum two flutes Each side of opening
Roof/Floor	>500mm but < 1000mm	L76x76x6.4 all around and extending to Structural members
Roof/Floor	>1000mm	See special details.

3.4 CONNECTIONS

.1 Install connections in accordance with CSSB1-10M.

END OF SECTION 05 31 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Cast-in-Place Concrete Section 03 30 00

.2 Rough Carpentry for Minor Works Section 06 08 99

.3 Exterior Painting Section 09 91 13

.4 Interior Painting Section 09 91 23

1.2 REFERENCES

1 ASTM International

.1 ASTM A 53/A 53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A 269 08, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.3 ASTM A 307-07v, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.4 ASTM B 209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.5 ASTM B 221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.

.2 CSA International

.1 CSA G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CAN/CSA G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CSA S16-09, Design of Steel Structures.

.4 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).

.5 CSA W59-M03(R2008), Welded Steel Construction (Metal Arc Welding) [Metric].

.1 GS-11-2008, 2nd Edition], Paints and Coatings.

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - current edition.

.5 Green Seal Environmental Standard GS 03 (anti-corrosive primer).

1.3 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, pipe, tubing, bolts and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements

.1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.

.3 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada. Submit Model Schedule B and C.
.2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.4 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 DELIVERY, STORAGE & HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 19 Waste Management and Disposal.

.5 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 Waste Management and Disposal.

2.0 PRODUCTS

2.1 MATERIALS

.1 Steel sections and plates: to CSA G40.20/G40.21, Grade 350W.

.2 Exterior Steel, stair stringers and pipe rails: to ASTM A 53/A 53M standard weight galvanized finish.

.3 Welding materials: to CSA W59.

.4 Welding electrodes: to CSA W48 Series.

.5 Bolts and anchor bolts: to ASTM A 307.

.6 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

.7 Aluminum: to ASTM B209, clear anodized finish.

.8 Unistrut: unistrut P1100 or similar profile embedded in concrete, 1.9mm (14ga) hot-dipped

galvanized finish conforming to ASTM A123.

.9 Grout: non-shrink, non-metallic flowable, 15MPC at 24 hours.

.10 Stainless Steel Sheet: Conforming to ASTM A167, Type 304, #4 Satin Finish.12 Gauge for use in seismic joint cover plate.

.11 Security fasteners: screws and bolts with spanner type heads to prevent removal except with special tools; non-corrosive type.

.12 Shop coat primer: to CAN/CGSB-1.40M.

.13 Galvanize touch-up primer: zinc rich, read mix to CGSB-1-GP-181M.

.14 Stair treads- Galvanized welded steel stair tread with checkered plate noising maximum spacing between bearing bars to be 13mm, cross bar spacing to be about 100mm, serrated.

.15 Stair Landing Bar Grating- Galvanized welded steel bar grating for stair landing, maximum spacing between bearing bars to be 13mm, cross bar spacing to be about 100mm, serrated.

.16 Aluminum Trench Covers at PHS – ASTM 209 Aluminum 3003-H22 tread plate 6mm minimum thickness, checker pattern; Frames – 6061-T6 aluminum flat bar, 19mm minimum thickness, run flat bars in both direction. Edge of cover to be reinforced with 40x40x6mm thick Aluminum angle.

2.2 FABRICATION

.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.

.3 Where possible, fit and shop assemble work, ready for erection.

.4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

.1 Galvanizing: hot dipped galvanizing with zinc coating 610 g/m² to CAN/CSA-G164, for all exposed exterior structural steel and metal fabrication.

.2 Shop coat primer: CGSB 1GP 40M in accordance with chemical component limits and restrictions requirements and VOC limits of GC-03. Prepare surface to an abrasive blast specification SSPC-SP10.

.3 Zinc primer: To CGSB 1GP 48, CISC/CPMA 1-73A, CISC/CPMA 2-75 in accordance with chemical component limits and restrictions requirements and VOC limits of GC-03. Prepare surface to an abrasive blast SSPC-SP10.

2.4 ISOLATION COATING

.1 Isolate 2 different metals from following components, by means of bituminous paint:
- .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
- .2 Concrete, mortar and masonry.
- .3 Wood.

2.5 SHOP PAINTING

.1 Primer: VOC limit 250 g/L maximum to GC-03.

.2 Apply one shop coat of primer to metal items, with exception of aluminum, galvanized or concrete encased items.

.3 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.

.4 Clean surfaces to be field welded; do not paint.

2.6 RAILINGS AND GUARDRAILS

.1 Steel fabrications: formed to shapes and sizes as indicated.

.2 Galvanize exterior pipe railings after fabrication. Shop coat prime all interior steel work after fabrication.

3.0 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

.4 Contractor shall verify field measurements are as shown on shop drawings prior to fabrication.

3.2 ERECTION

.1 Do welding work in accordance with CSA W59 unless specified otherwise.

.2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.3 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.4 Exposed fastening devices to match finish and be compatible with material through which they pass.

.5 Supply components for work by other trades in accordance with shop drawings and schedule.

.6 Weld field connection.

.7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.

.8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:

.1 Primer: maximum VOC limit 250 g/L to GC-03.

.9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
.1 Primer: maximum VOC limit 250 g/L to GC-03.

3.3 RAILINGS & GUARDRAILS

.1 Install steel railings and guardrails and locations as indicated.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal fabrications installation.

END OF SECTION 05 50 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Finish Carpentry Section 06 20 00

.2 Modified Bituminous Membrane Roofing Section 07 52 00

.3 Non-Structural Metal Framing Section 09 22 16

1.2 REFERENCES

.1 CSA International
- .1 CSA B111- 1974 (R2003), Wire Nails, Spikes and Staples.
- .2 CSA O121- 08, Douglas Fir Plywood.
- .3 CAN/CSA-O141- 05, Softwood Lumber.
- .4 CSA O151- 09, Canadian Softwood Plywood.
- .5 CAN/CSA-O325.0- 07, Construction Sheathing.

.2 Forest Stewardship Council (FSC)
- .1 FSC-STD-01-001- 2004, FSC Principle and Criteria for Forest Stewardship.
- .2 FSC-STD-20-002- 2004, Structure and Content of Forest Stewardship Standards V2-1.
- .3 FSC Accredited Certified Bodies.

.3 Green Seal Environmental Standards (GS)
- .1 GS-11- 2008, 2nd Edition, Paints and Coatings.

.4 National Lumber Grades Authority (NLGA)
- .1 Standard Grading Rules for Canadian Lumber 2000.

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
- .1 SCAQMD Rule 1113- A2007, Architectural Coatings.

1.3 ACTION & INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for rough carpentry work and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Wood Certification: submit vendor's Chain-of-Custody Certificate number for FSC certified wood.

.4 Low-Emitting Materials:
- .1 Submit listing of paints and coatings used in building, comply with VOC and chemical component limits or restriction requirements.
- .2 Submit listing of composite wood products used in building, stating that they contain no added urea-formaldehyde resins, and laminate adhesives used in building, stating that they contain no urea-formaldehyde.

1.4 QUALITY ASSURANCE

.1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards

Accreditation Board.

.2 Plywood identification: by grade mark in accordance with applicable CSA standards.

.3 Plywood, OSB and wood based composite panel construction sheathing identification: by grademark in accordance with applicable CSA standards.

.4 Sustainable Standards Certification:
- .1 Certified Wood: submit listing of wood products and materials used in accordance with FSC-STD-01-001.

1.5 DELIVERY, STORAGE & HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect wood from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 19 Waste Management and Disposal.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

2 .0 PRODUCTS

2.1 MATERIALS

.1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with following standards:
- .1 CAN/CSA-O141.
- .2 NLGA Standard Grading Rules for Canadian Lumber.
- .3 FSC certified.

.2 Furring, blocking, nailing strips, grounds, rough bucks, curbs, fascia backing and sleepers:
- .1 Board sizes: "Standard" or better grade.
- .2 Dimension sizes: "Standard" light framing or better grade.
- .3 Post and timbers sizes: "Standard" or better grade.

.3 Panel Materials:
- .1 Douglas fir plywood (DFP): to CSA O121, standard construction.
  - .1 Urea-formaldehyde free.
- .2 Canadian softwood plywood (CSP): to CSA O151, standard construction.
  - .1 Urea-formaldehyde free.
- .3 Plywood, OSB and wood based composite panels: to CAN/CSA-O325.
  - .1 Urea-formaldehyde free.

.4 Wood Preservative:
- .1 Surface-applied wood preservative: clear coloured, or 5% pentachlorophenol solution, water repellent preservative.
- .2 Pentachlorophenol use is restricted to building components that are in ground contact and subject to decay or insect attack only. Where used, pentachlorophenol-treated wood must be covered with two coats of an appropriate sealer.
- .3 Structures built with wood treated with pentachlorophenol and inorganic arsenicals must not be used for storing food nor should the wood come in contact with drinking water.

.5 Primers: in accordance with manufacturer's recommendations for surface conditions:
- .1 Interior Flat coating or Primer, Green Seal GS-11, VOC limit 50 g/l.
- .2 Interior Non-Flat Coating or Primer, Green Seal GS-11, VOC limit 150 g/l.
- .3 Sealers and undercoaters, SCAQMD Rule 1113, VOC limit 200 g/l.

2.2 ACCESSORIES

.1 Fasteners: hot dipped galvanized to CAN/CSA-G164, for interior highly humid areas, pressure-preservative, fire-retardant treated lumber.

.2 Nails, spikes and staples: to CSA B111.

.3 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.

.4 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs recommended for purpose by manufacturer.

3.0 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for rough carpentry installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

.1 Treat surfaces of all exterior use timber or wood in contact with concrete, metal and masonry with wood preservative before installation.

.2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and 1 minute soak on plywood.

.3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.

3.3 INSTALLATION

.1 Comply with requirements of NBC 2010, and BCBC 2012, supplemented by the following paragraphs.

.2 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding and other work as required.

.3 Align and plumb faces of furring and blocking to tolerance of 1:600.

.4 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

.5 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.

.6 Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation for roof hopper.

.7 Install sleepers as indicated.

.8 Use caution when working with particle board. Use dust collectors and high quality respirator masks.

.9 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.10 Countersink bolts where necessary to provide clearance for other work.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

END OF SECTION 06 08 99

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Rough Carpentry for Minor Works Section 06 08 99

.2 Door Hardware Section 08 71 00

1.2 REFERENCES

.1 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
- .1 Architectural Woodwork Quality Standards, 1st edition, 2009 (AWS).

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-11.3-M87, Hardboard.

.3 CSA International
- .1 CSA B111-74 (R2003), Wire Nails, Spikes and Staples.
- .2 CAN/CSA G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CSA O121-08, Douglas Fir Plywood.
- .4 CSA O141-05, Softwood Lumber.
- .5 CSA O151-09, Canadian Softwood Plywood.
- .6 CSA O153-13 Poplar Plywood.

.4 Forest Stewardship Council (FSC)
- .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .2 FSC-STD-20-002-2004, Structure and Content of Forest Stewardship Standards V2-1.
- .3 FSC Accredited Certified Bodies.

.5 National Lumber Grades Authority (NLGA)
- .1 NLGA Standard Grading Rules for Canadian Lumber 2008.

.6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
- .1 SCAQMD Rule 1168 2005, Adhesives and Sealants Applications.

.7 Underwriters Laboratories of Canada (ULC)
- .1 CAN4-S104-10 Standard Method for Fire Tests of Door Assemblies.
- .2 CAN/ULC-S105-09, Standard Specification for Fire Door Frames.

1.3 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for plywood MDF and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements.

.3 Shop Drawings:
- .1 Submit drawings in accordance with Section 01 33 00 Submittal Procedures.
- .2 Indicate details of construction, profiles, jointing, fastening and other related details.

.3 Indicate materials, thicknesses, finishes and hardware.

.4 Samples:
.1 Submit for review and acceptance of each unit.
.2 Samples will be returned for inclusion into work.

.5 Certifications: submit certificates signed by manufacturer certifying materials comply with specified performance characteristics and physical properties.

.6 Test and Evaluation Reports: submit certified test reports for composite wood from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

1.4 QUALITY ASSURANCE

.1 Lumber by grade stamp of agency certified by Canadian Lumber Standards Accreditation Board (CLSAB).

.2 Plywood, particleboard, OSB and wood based composite panels to CSA and ANSI standards.

.3 Wood fire rated frames and panels: listed and labelled by an organization accredited by Standards Council of Canada to CAN4-S104 and CAN/ULC-S105.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect wood products from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan Waste Reduction Workplan related to Work of this Section

.5 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal

2.0 PRODUCTS

2.1 MATERIALS

.1 Softwood lumber: S4S, moisture content 19% or less in accordance with following standards:
.1 CSA O141.
.2 NLGA Standard Grading Rules for Canadian Lumber
.3 AWMAC custom or premium grade, where noted, moisture content as specified.
.4 Machine stress-rated lumber is acceptable.

.2 Hardwood lumber: moisture content 10% or less in accordance:

.1 AWMAC custom grade, moisture content as specified.

.3 Panel Material: Urea-formaldehyde free
- .1 Recycled content: provide information indicating recycled content on a % (Post-Consumer + ½ Post-Industrial)
- .2 FSC certified.
- .3 Douglas fir plywood (DFP): to CSA O121, standard construction. 6.1.5 and 6.2.5 where both sides exposed to view.
- .4 Hardwood plywood: to ANSI/HPVA HP-1.
- .5 Medium density fibreboard (MDF): to ANSI A208.2, density 640-800 kg/m³.
- .6 Decorative overlaid composite panels.
  - .1 Decorative overlay, heat and pressure laminated with suitable resin to thickness indicated MDF urea-formaldehyde free core.
  - .2 Overlay bonded to both faces where exposed two sides, and when panel material require surface on one side only, reverse side to be overlaid with a plain (buff) balancing sheet.
  - .3 Furniture finish: stain wood grain pattern selected by Departmental Representative.
  - .4 Edge finishing: edges dadoed or saw kerfed to take plastic "T" moulding in width and colour to match melamine finish.

2.2 ACCESSORIES

.1 Nails and staples: to CSA B111; galvanized to CAN/CSA-G164 for exterior work, interior humid areas and for treated lumber; plain finish elsewhere.

.2 Wood screws: plain, type and size to suit application.

.3 Splines: wood

.4 Adhesive and Sealants: in accordance with Section 07 92 00 - Joint Sealants.

3 .0 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for wood products installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Do finish carpentry to AWS Custom Grade.

.2 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate piping, columns, fixtures, outlets, or other projecting, intersecting or penetrating objects.

.3 Form joints to conceal shrinkage.

3.3 CONSTRUCTION

.1 Fastening:

.1 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.

.2 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.

.3 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round smooth cut hole and plug with wood plug to match material being secured.

.4 Replace items of finish carpentry with damage to wood surfaces including hammer and other bruises.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by finish carpentry installation.

END OF SECTION 06 20 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Rough Carpentry — Section 06 08 99

.2 Thermal Insulation — Section 07 21 00

.3 Air Barriers — Section 07 27 00.01

1.2 REFERENCES

.1 ASTM International Inc.

.1 ASTM D 6164- 05, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 37-GP-56M- 80b (A1985), Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Convene pre-installation meeting one week prior to beginning waterproofing Work, with waterproofing contractor's representative and Departmental Representative in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart to:

.1 Verify project requirements.
.2 Review installation and substrate conditions.
.3 Co-ordination with other building subtrades.
.4 Review manufacturer’s installation instructions and warranty requirements.

1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide for review by Departmental Representative prior to commencing work, two copies of most recent technical waterproofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide two copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements for: Primers.

.3 Provide shop drawings and indicate:

.1 Flashing, control joints, details, transitions and lapping details according to construction sequencing.

.4 Manufacturer's Certificate: certify that products meet or exceed specified requirements.

.5 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.

.6 Manufacturer's field report: in accordance with Section 01 45 00 - Quality Control.

1.5 QUALITY ASSURANCE

.1 For each type of work, obtain primary materials from single manufacturer, which has produced that type of product successfully for not less than 10-Years. Provide ancillary materials only as

recommended by manufacturer of membrane materials for use with roofing system specified.

.2 Installer shall be approved by the manufacturer of the materials prior to tender; shall be experienced in the application of the materials and shall supply job references to show similar installations in satisfactory waterproof condition at least 5 years of age.

.3 Successful Contractors shall not sub contract any work unless special approval is received from the Consultant. Sub-contracting of work without approval shall be considered a violation of the contract.

.4 Mock-ups
- .1 Construct mock-up in accordance with Section 01 45 00 Quality Control.
- .2 Mock-up may be part of finished work if acceptable to Departmental Representative.
- .3 Provide a minimum of 3 days' notice to Departmental Representative to review installation of slab membrane prior to raft slab pour.

1.6 DELIVERY, STORAGE & HANDLING

.1 Provide and maintain dry, off-ground weatherproof storage.

.2 Store rolls of membrane in upright position.

.3 Remove only in quantities required for same day use.

.4 Handle waterproofing materials in accordance with manufacturer's written directives, to prevent damage or loss of performance.

.5 Store and manage hazardous materials in accordance with Section 01 35 33 - Health and Safety Requirements

.6 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

1.7 SITE CONDITIONS

.1 Ambient Conditions in accordance with manufacturer's requirements.

1.8 WARRANTY

.1 The product manufacturer shall issue a written and signed document in the name of the owner, certifying the product will meet all the physical characteristic published by the manufacturer, for a period of 5 years, starting from the date of completion of installation of membranes. No letter amending the manufacturer's standard warranty will be accepted and the warranty certificate must reflect these requirements.

1.9 INSPECTION AUTHORITY

.1 Arrange manufacturer's representative to inspect the work on site.

.2 The presence of an Inspector shall in no way excuse the Contractor from performing the Work in accordance with the contract Documents and keeping with the best practices of the trades.

.3 The Contractor shall inform the Inspection Agency seven (7) days prior to commencement of work.

2.0 PRODUCTS

2.1 MEMBRANE

.1 Non-woven polyester reinforced SBS modified bitumen membrane, specifically designed for blind side waterproofing, with a sanded under face with a four inch self-adhered selvage edge covered by a silicone release film. The top face, against which the concrete is poured, has a polyester fleece with a four inch self-adhered selvage edge covered by a silicone release film.

.2 Properties Standards:

Thickness	ASTM D 3767	108 mils (2.70 mm)
Tensile strength	ASTM D 412	23.7/18.5 MPa
Ultimate elongation	ASTM D 412	67/74 %
Flexibility at cold temperature	ASTM D1970	Unaffected at -23 °C
Puncture resistance	ASTM E154	1210 N
Tear resistance	ASTM D 5601	125 N
Lap peel adhesion	ASTM D1876	1360 N/m
Water absorption	ASTM D 570	0.5 %
Adhesion of poured concrete	ASTM D 903	(Mod.) 2880 N/m
Water Vapor Permeance	ASTM E96	(Procedure B) 0.21 ng/Pa.s.m²

2.2 SURFACE PRIMER

.1 Primer used specifically for self-adhered membranes to substrates such as wood, metal or concrete. Primer is composed of a blend of natural resins and synthetic rubber; may be spray or roller applied (if required by construction conditions or detailing).

2.3 REINFORCEMENT MEMBRANE

.1 Self-adhered waterproofing membrane composed of SBS modified bitumen and a Tri-Laminate Woven Polyethylene Facer. The self-adhesive underside is covered by a silicone release sheet.

2.4 PREFABRICATED DRAINAGE BOARD

.1 Composite drainage board consisting of a post-industrial recycled polypropylene drainage core of fused entangled filaments and a geocomposite fabric bonded to one side.

Properties	**Standards**	**Values**
Thickness	ASTM D-1777	0.45 in.
Compressive Strength	ASTM D-1621	30,000 psf
Flow@ 3000 psf & 1.0 Gradient	ASTM D-4716	16 gpm/ft
Puncture Strength	ASTM D-4833	70 lbs.
Flow Rate	ASTM D-4491	120 gpm/ft²
Grab Tensile Strength	ASTM D-4632	120 lbs
Apparent Opening Size (AOS)	ASTM D-4751	70 sieve
Roll Dimensions		39” x 100’ (324 sf)

2.5 PROTECTION BOARD

.1 Asphaltic Hardboard: pre-molded, semi-rigid asphaltic protection board composed of bitumen, mineral core and reinforcement. Provide 3 mm (0.125 in.) thick hardboard on horizontal surfaces not receiving steel reinforced slab. Where steel reinforcing bars are to be used, apply two layers of 3 mm (0.125 in.) thick hardboard or one layer of 6 mm (0.25 in.) thick hardboard.

2.6 ACCESSORIES

.1 Waterproofing Mastic : one part urethane mastic containing SBS modified bitumen, fibers and

mineral fillers.

.2 Waterproofing Liquid Membrane for conduits and piping penetrations: high performance, two component, rapid curing PMMA (poly methyl methacrylate) acrylic resin formulation for use at end laps only. Acceptable products: Alsan RS 230 Flash or Siplat's Parapro 123.

.3 Protection Board:
- .1 A semi-rigid protection board composed of a mineral fortified asphaltic core formed between two saturated fibreglass felts.
- .2 Characteristics:
  - .1 Thickness: 3mm
  - .2 Board Size: Width: 1.22m Length: 1.52m

.4 Termination Bar:
- .1 Hexagonal Stainless Steel plate and Stainless Steel fasteners for outboard waterproofing. Standard of Acceptance to meet Factory Mutual.

.5 Drainage Layer:
- .1 To be double dimpled sheeting with integral geo-textile made of high density polyethylene. Filter mat to be polyethylene. Compressive strength of approximately 90 kg/m^2. Drainage capacity of approximately 72 l/min-m. Resistance to root penetration and rotproof.

.6 Protection Layer:
- .1 Provide protection sheet over horizontal underslab membrane as per manufacturer's recommendation.

3.0 EXECUTION

3.1 EXAMINATION AND PREPARATION OF SURFACES

.1 Surface examination and preparation must be completed in conformance with manufacturer's recommendations.

.2 Before waterproofing work begins, the Departmental Representative and the contractor will inspect and approve substrate condition and ensure that related work has been properly executed. If necessary, a non-conformity notice will be issued to the contractor so that required corrections can be made. The start of the membrane application will mean that substrate conditions are acceptable for work completion.

.3 Before commencing work, all surfaces must be smooth, dry with no standing water affecting raftslab membrane, clean and free of ice and debris as per manufacturer's recommendations.

.4 No materials will be installed during rain or snowfall.

.5 Concrete must be cured a minimum of fourteen (14) days and an adhesion test is recommended before membrane application.

.6 Verify the compatibility of all membrane components with curing compounds, coatings or other materials which are already installed on the surfaces to be treated.

.7 Any cracks over 3 mm wide should be reported to the Departmental Representative. After review, the crack should be filled in with waterproofing mastic. A 150 mm (6 inches) wide strip of membrane should be installed, centered over the crack.

3.2 METHOD OF EXECUTION

.1 Work shall be performed on a continuous basis as surface and weather conditions allow.

.2 Adjoining surfaces shall be protected against any damage that could result from the waterproofing installation.

3.3 EQUIPMENT

.1 Maintain all equipment and tools in good working order.

3.4 PRIMER APPLICATION

.1 Surface where heat-welded membrane is applied shall receive an asphalt primer coating at the rate of 0.15 to 0.20 l/m2. Application rate may vary depending on surface condition.

3.5 WATERPROOFING MEMBRANE INSTALLATION

.1 To begin application, align the first roll of membrane to a previously drawn chalk line.

.2 All inside and outside corners must be pre-stripped with a 300 mm (12 in.) wide strip of membrane centered over the corner. This membrane must be installed in direct contact with the substrate not leaving any voids under the membrane strip. Outside corners should be double lapped.

.3 Weld the membrane using a propane gas torch.

.4 Subsequent rolls must be installed in the same manner and should be aligned with the preceding roll with a side lap of at least 75 mm. End laps must be overlapped at least 100 mm.

.5 Holes and tears in the membrane must be repaired with the appropriate membrane material. The repair must exceed the affected surface area by at least 100 mm.

.6 Prior to backfilling, it is recommended to protect waterproofing system with protection boards. Backfilling should commence immediately after installation of protection boards.

.7 The uppermost edge of the membrane is to be mechanically fastened to the concrete substrate using termination bars. The termination bar should surpass the top edge of the membrane.

.8 Apply mastic on the top edge of termination bar to prevent water accumulation and infiltration.

.9 Any waterproofing membrane left exposed after backfilling shall be protected from ultra violet and mechanical damages.

.10 All membrane lap joints to be torched and reinforced.

.11 For horizontal underslab membrane, install loose lay membrane, torch and weld seams, install protection sheet on top of membrane.

.12 Mechanically fasten stainless steel termination bar with gumlip edge to receive termination caulking.

3.6 DRAINAGE BOARD INSTALLATION

.1 Adhere the drainage panels directly on the exposed insulation surface by applying a uniform pressure on the entire surface.

.2 Backfill as soon as possible after drainage board installation within 72 hours maximum.

3.7 DRAINAGE LAYER INSTALLATION

.1 Install drainage layer according to manufacturer's recommendation by mechanical fastening.

.2 Install dimpled sheet and geo-textile so they overlap at the edges.

.3 Geo-textile to face outward – towards backfill side.

.4 Wrap the top edge of the drainage mat with the filter fabric facer to prevent soil from getting into dimples. Provide stainless steel mechanical fasteners to clamp drainage mat in place. Do not use mechanical fastener through waterproofing membrane. Use only intermittent fasteners that do not penetrate through the insulation layer into the membrane.

3.8 FIELD QUALITY CONTROL

.1 Inspection and testing of roofing systems and application will be carried out by testing laboratory designated by Owner and paid for by the Contractor.

.2 Field Review will be carried out on a daily basis during the entire roof installation procedure.

.3 Written "Daily" inspection reports to be distributed to Departmental Representative.

3.9 CLEANING

.1 Remove bituminous markings from finished surfaces.

.2 Repair or replace defaced or disfigured finishes caused by work of this section.

END OF SECTION 07 13 52

1.0 GENERAL

1.1 SECTION INCLUDED

.1 Furnishing of all labor, materials, services and equipment necessary for the supply and installation of crystalline waterproofing additive to concrete structures of the new concrete driveway and supporting structure at the south side of the new southside substation. The crystalline waterproofing material shall be added to concrete during the mixing cycle, and shall be used in below-grade walls and slabs.

1.2 RELATED REQUIREMENTS

.1 Section 03 10 00 – Concrete Forming and Accessories

.2 Section 03 20 00 – Concrete Reinforcing

.3 Section 03 30 00 – Cast-in-Place Concrete

.4 Section 07 95 20 – Below Grade Expansion Joint

1.3 REFERENCES

.1 Applicable Standards. The following standards are referenced herein.

- .1 American Society for Testing and Materials (ASTM)
- .2 Army Corps of Engineers (CRD)
- .3 American Concrete Institute (ACI)
- .4 NSF International (NSF)

1.4 SYSTEM DESCRIPTION

.1 Crystalline Waterproofing Additive: Concrete waterproofing system shall be of the crystalline type, defined by the ACI 212.3R – 10 Report on Chemical Admixtures for Concrete as a “PRAH” type hydrophilic admixture. It shall react such that it chemically controls and permanently fixes a non-soluble crystalline structure throughout the capillary voids of the concrete. The system shall cause the concrete to become sealed against the penetration of liquids from any direction, and shall protect the concrete from deterioration due to harsh environmental conditions.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

.1 Testing Requirements: Crystalline waterproofing system shall be tested in accordance with the following standards and conditions, and the testing results shall meet or exceed the performance requirements as specified herein. Independent tests verifying these results shall be submitted prior to approval.

.2 Independent Laboratory: Testing shall be performed by an independent laboratory meeting the requirements of the recognized specifying body of the country in which the testing is performed. Testing laboratory shall obtain all concrete samples and waterproofing product samples.

.3 Crystalline Formation: Crystallizing capability of waterproofing system shall be evidenced by independent SEM (Scanning Electron Microscope) photographs showing crystalline formations within the concrete matrix at a magnification no greater than 2000 times.

.4 Permeability: Independent testing shall be performed according to U.S. Army Corps of Engineers CRD-C48 - Mod “Permeability of Concrete”. Under CRD-C48 treated concrete samples shall be pressure tested to 150 psi (350 foot head of water) or 1.05 MPa (106 m

head of water). The treated samples shall exhibit no measurable leakage against control samples which shall exhibit full saturation and measurable leakage.

.5 Acid Resistance: Independent testing shall be performed to determine “Sulfuric Acid Resistance of Concrete Specimens”. Treated concrete samples (dosage rates of 3%, 5% and 7%) shall be tested against untreated control samples. All samples shall be immersed in 7% sulfuric acid and weighed daily until a control sample reaches a weight loss of 50%. On final weighing the percentage weight loss of the 3% treated samples shall be 20% or lower than the control samples.

.6 Sulfate Resistance: Testing for weight loss and length change when samples exposed to Ammonium Sulfate solution for 25 weeks shall show a weight loss of at least 25% less than the control concrete and a length change of - 0.01% or less than the control.

.7 Compressive Strength: Independent testing shall be performed according to ASTM C39 “Compressive Strength of Cylindrical Concrete Specimens”. Concrete samples containing the crystalline waterproofing additive shall be tested against untreated control sample. At 28 days, the treated samples shall exhibit a minimum of 10% increase in compressive strength over the control sample.

.8 Portable Water Approval: Independent testing shall be performed according to NSF Standard 61, and approval for use of waterproofing material on structures holding potable water shall be evidenced by NSF certification.

1.6 SUBMITTALS

.1 General: Submit listed submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data: Submit product data, including manufacturer's specifications, installation instructions, and general recommendations for waterproofing applications. Also include manufacturer's certification or other data substantiating that products comply with requirements of Contract Documents.

.3 Test Reports: Submit, for acceptance, complete test reports from approved independent testing laboratories certifying that waterproofing system conforms to performance characteristics and testing requirements specified herein.

.4 Manufacturer’s Certification: Provide certificate signed by manufacturer or manufacturer's representative certifying that the materials to be installed comply in all respects with the requirements of this specification.

1.7 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Manufacturer to have no less than 3 years experience in manufacturing the crystalline waterproofing additive for the required work, and be capable of providing field service representation during construction phase. Manufacturers that cannot provide the performance test data specified herein will not be considered for the project.

.2 Applicator: Installer of crystalline waterproofing additive shall be approved by the manufacturer or manufacturer's representative in writing.

.3 Pre-Installation Conference: Prior to installation of waterproofing, conduct meeting with departmental, owner's representative, applicator (concrete supplier), concrete placer and waterproofing manufacturer's representative to verify and review the following:
.1 Project requirements for waterproofing as set out in Contract Document.
.2 Manufacturer’s product data including application instrucitons.

.4 Technical Consultation: The waterproofing manufacturer's representative shall provide technical consultation on waterproofing application.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

.2 Delivery: Deliver packaged waterproofing materials to project site in original undamaged containers, with manufacturer’s labels and seals intact.

.3 Storage: Store waterproofing materials in dry, enclosed location, at temperature and humidity conditions recommended by manufacturer.

1.9 WARRANTY

.1 Project Warranty: Refer to conditions of the Contract for project warranty provisions.

.2 Manufacturer’s Warranty: Manufacturer shall provide standard product warranty executed by authorized company official. Term of warranty shall be ten(10) years from Date of Substantial Completion.

2.0 PRODUCTS

2.1 MATERIALS

.1 Source Quality: Obtain proprietary crystalline waterproofing products from a single manufacturer.

2.2 DOSAGE AND MIXING

.1 General: CrystallineAdmix must be added to concrete mix at time of batching.

.2 Dosage Rate: Under normal conditions, the crystalline waterproofing powder shall be added to the concrete mix at a rate of 2% - 3% by weight of Portland cement content. For enhanced chemical protection or meeting specific project requirements, consult with manufacturer or its authorized representative to determine appropriate dosage rates.

.3 Waterproofing Construction Joints and Cold Joints Between Pours: Crystalline Waterproofing Powder , single coat crystalline waterproofing; proprietary compound of Portland cement, silica sand and active chemicals, mixed with water at 3 parts powder to 1 part water or in proportions recommended by manufacturer to achieve full coverage with application method used. Application rate: 2.0 lb/sq yd (1.09 kg/sq m).

.4 Dry Pack Joint Compound: Dry pack consistency mixture of Crystalline Waterproofing Powder ; proprietary compound of Portland cement, silica sand and active chemicals; and water at 6 parts powder to 1 part water or in proportions recommended by manufacturer.

3.0 EXECUTION

3.1 MANUFACTURERS INSTRUCTIONS

.1 Compliance: Comply with manufacturer's product data regarding installation, including technical bulletins, product catalogue, installation instructions and product packaging labels.

3.2 PRODUCT CONDITIONS

.1 Reinforcement: All reinforcement shall be rib deformed bar in accordance with applicable standards. Exposed concrete decks (joint free) shall contain sufficient reinforcement to minimize thermal movement and control cracking.

.2 Setting Time and Strength: Some retardation of set may occur when using admix product.The amount of retardation will depend upon the concrete mix design, the particular Admix product used, dosage rate of the Admix, temperature of the concrete and climatic conditions. Concrete containing a admix product may develop higher ultimate stengths than plain concrete. Conduct trial mixes under project conditions to determine setting time and strength of concrete. Consult with manufacturer or manufacturer’s representative regarding concrete mix design, project conditions and proper dosage rate.

.3 Weather Conditions: For mixing, transporting and placing concrete under conditions of high temperature or low temperature follow concrete practices as referred to in ACI 305R-77 (Hot Weather Concreting) and ACI 306R-78 (Cold Weather Concreting). For flatwork being placed in either hot, dry or windy conditions use of monomolecular film (evaporation retardant) is recommended to control loss of bleed water.

3.3 APPLICATION

.1 General: Crystalline Admix shall be added to the concrete mix at time of batching. Thorough blending of the Crystalline Admix throughout the concrete mix is essential for correct performance of the product and, therefore, care should be taken to ensure that a homogeneous mixture is obtained.

.2 Concrete Batching & Mixing: Procedures for mixing will vary according to type of batch plant operation and equipment.

- .1 Ready Mix Plant-Dry Batching Operation: Add Crystalline Admix powder to drum of ready-mix truck, then add 60% - 70% of required water along with 300 - 500 lb. (136- 227 kg) of aggregate. Mix the materials for 2 - 3 minutes to ensure that the Admix is distributed evenly throughout the mix water. Add balance of materials to the ready-mix truck and mix in accordance with standard batch practices.
- .2 Ready Mix Plant Central Mix Operation: Mix Crystalline Admix with water to form a very thin slurry (e.g. 15 - 20 lb. or 6.75 - 9 kg of powder mixed with 3 gal. or 13.6 liters of water). Pour the required amount of material in drum of ready-mix truck. The aggregate, cement and water should be batched and mixed in the plant in accordance with standard practices (taking into account the quantity of water that has already been placed in the ready-mix truck). Pour the concrete into the truck and mix for at least 5 minutes to ensure even distribution of the Crystalline Admix throughout the concrete.
- .3 Precast Batch Plant- Pan Type Mixer: Add Crystalline Admix to the rock and sand, then mix thoroughly for 2 - 3 minutes before adding the cement and water. The total concrete mass should be blended using standard practices.

.3 Construction and Cold Joints: One coat of Crystalline Waterproofing Powder slurry at a rate of 2 lb/sq yard is to be applied to the entire concrete substrate surface where the existing and new concrete will interface. Allow slurry to set or dry. No curing is required.

.4 For hydrostatic conditions also apply sealing strips at each construction joint by filling grooves coinciding with construction joint.
- .1 If grooves have not been preformed, at least 3/4 inch (19 mm) wide and minimum 1 inch (25 mm) deep, saw cut and chip grooves to that dimension.
- .2 Apply specified slurry coat to slot at rate recommended by manufacturer.
- .3 Fill and form surfaces using specified dry pack repair compound while slurry coat is still green, but after slurry coat has reached initial set.
- .4 Compact tightly using pneumatic packer or hammer and block.

3.4 CURING

.1 General: Concrete containing Crystalline Admix shall be moist cured in accordance with ACI Reference 308, “Standard Practice for Curing Concrete”.

.2 Curing Compounds: Curing compounds may be used in the event that project requirements or conditions prevent moist curing. Curing compounds shall comply with ASTM C-309.

3.5 PROTECTION

.1 Protection: Protect installed product and finished surfaces from damage during construction.

3.6 FIELD QUALITY CONTROL

.1 Examination for Defects : Do not conceal Crystalline Admix treated concrete before it has been observed by Departmental Representative, waterproofing manufacturer's representative and other designated entities. Concrete shall be examined for structural defects such as honeycombing, rock pockets, tie holes, faulty construction joints, cold joints and cracks. Such defects to be repaired in accordance with manufacturer's repair procedures.

.2 Flood Testing for Suspended Slabs:
- .1 Perform flood test on completed waterproofing installation before placement of other construction.
- .2 Plug or dam drains and fill area with water to a depth of two inches (50 mm) or to within 0.5 inch (12.5 mm) of top of waterproofing treatment.
- .3 Let water stand for 24 hours.
- .4 If leaks are discovered, make repairs and repeat test until no leaks are observed.

3.7 INTERACTION WITH OTHER MATERIALS

.1 Backfilling: Normal backfilling procedures may be used after concrete has been cured for at least seven days. If backfill takes place within seven days after concrete placement, then backfill material shall be moist so as not to draw moisture from the concrete. In no event shall backfilling take place before concrete has gained sufficient strength to withstand the applied load.

.2 Grout, Cement Parge Coat, Plaster or Stucco: Because concrete containing Crystalline Admix forms a relatively smooth surface and the resulting crystalline formation fills the concrete pores thereby reducing suction characteristics of the concrete, it may be necessary to use a suitable bonding agent for proper bonding of cementitious systems.

.3 Responsibility to Ensure Compatability: The manufacturer makes no representations or warranties regarding compatibility of Crystalline treated concrete with coatings, plasters, stuccos, tiles or other surface-applied materials. It shall be the responsibility of the installer of the surface-applied material that is to be applied over the Crystalline treated concrete, to take whatever measures are necessary, including testing, to ensure acceptance by or adhesion to the waterproofing treatment.

END OF SECTION 07 16 16

1.0 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 ASTM C957, “Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with Intergral Wearing Surface”.

1.3 SCOPE OF WORK

.1 Furnish all labour, material, equipment and services for the complete supply and installation of waterproof traffic deck coating on stop of stair landing.

.2 The work of this section shall include the supply and installation of a new waterproof traffic deck coating to rooms as shown on the Drawings and room finish schedule including:

- All necessary preparation of the deck surface to receive the coating including epoxy mortar repairs of voids and rough surfaces in the concrete deck.
- Levelling rough surfaces prior to membrane application.
- Treating all cracks and construction joints; cold pour joints, panel joints, edge joints and other joints as may be deemed necessary, after inspection of concrete substrate, prior to full application of deck coating system.
- Supply and application of deck coating, including primer, reinforcement (if required), elastomeric waterproof membrane, wearing course and top seal coat.

1.4 TRAFFIC CONTROL

.1 Provide adequate signage to route pedestrians and traffic around the designated work area.

1.5 QUALITY ASSURANCE

.1 All materials used in this contract shall be of the highest quality and of the type specified.

.2 All deck coating work shall be carried out by a specialist applicator, trained and licensed by the coating manufacturer, who can substantiate with documented evidence, successful installation of similar deck coating system over a minimum period of five (5) years prior to award of this subcontract. Such evidence and manufacturer’s statement of approval shall be submitted to the Consultant.

1.6 SAMPLES

.1 On the Consultant’s request, samples of materials shall be submitted for approval, prior to commencing work concerned.

.2 Submit two (2) samples, minimum 300 mm x 300 mm that are representative of finished work.

1.7 SUBMITTALS

.1 Submit to the Consultant the coating manufacturers' product literature indicating product information related to the specified requirements and the manufacturer's detailed installation specifications.

.2 Submit written confirmation from the applicator and membrane manufacturer, attesting that all surfaces have been inspected and found satisfactory to receive the coating.

.3 Submit to the Consultant, at completion of installation, recommended maintenance instructions for the waterproof traffic deck coating, for use by the Owner's maintenance staff. In particular, provide information on snow removal procedures (if applicable) which will not invalidate the warranty.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Deliver and store all materials in their original packaging in undamaged condition, sealed with labels intact, having manufacturer's name, brand, weight, CSA and other references to accepted standards clearly shown.

.2 Make all necessary arrangements with regard to delivery and storage on the site with the Contractor and schedule deliveries accordingly. In general, deliver material as required for installation and keep site storage to a minimum.

.3 Protect materials from damage, weather and store in a dry place.

.4 Handle materials and equipment in strict accordance with manufacturer's recommendations. Damaged or deteriorated materials shall be promptly removed from the site by the Contractor.

1.9 JOB CONDITIONS

.1 Conform to coating manufacturer's requirements for minimum application temperatures and humidity or to the requirements of this specification, whichever is more stringent. Check surfaces and areas specified and shown to receive deck coating. Ensure environmental and site conditions are suitable for application. Inspect surfaces for acceptability of level, texture, moisture content, etc.

.2 Report any unsatisfactory conditions and/or surface to the Consultant in writing. Starting work shall imply acceptance of surfaces and conditions.

.3 The work shall be laid out in a grid pattern to monitor application rate.

1.10 INSPECTION

.1 The Consultant may carry out inspection and testing of waterproof traffic deck coating installations. The cost of this inspection will be borne by the Owner and shall not be included in this section. Inspections and testing by the Consultant are for the sole benefit of the Owner and shall not relieve the Contractor of their responsibility to maintain their own quality assurance of the membrane supply and installation.

.2 A water leakage test may be carried out by the Consultant on the coating system installation.

1.11 GUARANTEE

.1 Submit a joint guarantee by the manufacturer and installer, in writing, in the name of the Owner, that the waterproof traffic deck coating furnished and installed under this contract

shall remain fully watertight and that the wearing surface and membrane layers shall remain free from loss of bond, slip resistance and all defects for a period of five (5) years from the date of certified Substantial Performance of the Project.

.2 This written guarantee shall jointly and severally cover the performance of the coating system, including immediate correction, at no expense to the Owner and at such time as the Owner may designate, of any defects due to faulty materials or workmanship appearing within five (5) years from the date of certified substantial performance of the project.

2.0 PRODUCTS

2.1 MATERIALS

.1 The deck coating shall be a modified epoxy, modified epoxy-urethane or urethane system designed for use on vehicular traffic decks. The full system shall provide a complete waterproof membrane in accordance with CAN/CSA-S413 and as specified herein. The wearing surface shall be slip resistant, resistant to abrasion due to vehicular traffic and shall be ultra-violet light resistant. The coating shall be tear resistant and chemical resistant to spillage of oil, gasoline, anti-freeze, battery acid, alkalis and salt water.

.2 Pre-approved manufacturers and systems include:

- Kelmar TE FWC II or Kelmar TE Traffic Deck System, by Technical Barrier Systems Autogard II system – Low Odor, by Neogard.
- Qualideck Qualipur by Advanced Polymer Technology
- The membrane shall have the following minium dry mil thickness excluding aggregate:

Area	Primer	Membrane	Intermediate Coat	Topcoat	Total Thickness *
Room Areas	4-6	25	0	20	45

* The primer thickness shall not be included as part of the total membrane dry mil thickness.

.3 Primer, elastomeric waterproof membrane, sealants, wearing course, aggregate, top coat and other associated materials shall be supplied or approved by the manufacturers for the deck coating systems specified.

.4 Caulking for cracks in concrete surface and joints to be two component self-levelling or non-sag polyurethane sealant suitable for use on trafficked surfaces and compatible with the membrane material. Select appropriate grade of caulking for application on sloped and horizontal surfaces.

.5 Patching materials for filling voids and rough surfaces shall be a premium grade, epoxy mortar patching material. Approved products include:

- SikaPronto 11 as manufactured by Sika
- Concresive 1470 or 2020 Polymer Concrete System as manufactured by Master Builders.

For large rain damaged areas where deteriorated surfaces may be up to 0 to ¼" deep, prepackaged rapid hardening cementitious products may be used. Approved products include:

- Planitop 21 as manufactured by Mapei
- Emaco R300 CI as manufactured by Masterbuilders

The membrane manufacturer shall provide confirmation of the compatibility of the membrane material and the materials proposed to level the slab surface.

3.0 EXECUTION

3.1 PROTECTION

.1 No work by other trades is to be conducted in the prepared work area until the deck coating is completed.

.2 Protect adjacent surfaces from damage resulting from work of this trade. If necessary, mask and/or cover adjacent surfaces, fixtures, equipment, etc. by suitable means.

.3 Apply temporary protection on completed deck coating as required.

.4 Provide and maintain all legal and necessary guards, railings and warning signs during the execution of the work to fully protect all persons and Owner from loss, damage, death or injury through the neglect or carelessness of the Contractor or the condition or handling of equipment. Ensure that employees have WHMIS training for materials being handled on site and that material safety data sheets for all materials being used are available for use and inspection on site.

3.2 PREPARATION

.1 Prepare all surfaces to receive deck membrane, including substrate joints, cracks, coves, vents, pipes, etc. in accordance with manufacturer's directions or as outlined in this specification whichever is more stringent. Preparation of cracks and joints in the concrete substrate shall be in accordance with manufacturer's printed Contractor's Application Manual.

.2 Surface preparation is required both before applying the epoxy and cementitious mortar repairs, crack repairs, sealant application **and** before installing the waterproof membrane. Prepare **all** concrete surfaces to receive traffic deck membrane by shot blast methods. Remove all laitance, loosely adhered surface mortar, and contaminants to the satisfaction of the Consultant and the deck membrane manufacturer. Prepare surfaces inaccessible to the shot blast equipment by sandblasting.

.3 Provide a smooth surface satisfactory for application of deck membrane in accordance with membrane manufacturer's direction or this specification whichever is more stringent. Ensure that concrete surfaces are free from excessive surface pitting and honeycombing. The prepared surface shall be sufficiently smooth to provide a uniform thickness of membrane base coat without leaving visual high points in the base coat surface.

.4 Remove fins, rough projections and any other irregularities which could puncture the membrane or which exceed 1/8" (3 mm) in height. Repair all rough surfaces, voids, pitting, honeycombing and depressions equal to or greater than 1/8" (3 mm) deep with an epoxy mortar or pre-approved rapid setting cementitious mortar as described in Section

2.1.5. Heavy broom finish or rough surfaces less than 1/8" (3 mm) in depth must be smoothed by grinding or filled with epoxy mortar prior to applying the membrane base coat. Rebuild joint nosings where required with epoxy mortar to provide uniform joint width and alignment of joint.

.5 Fill all voids and honeycombing at the base of perimeter walls with epoxy mortar prior to applying cove bead sealant and waterproofing membrane.

.6 Apply epoxy patching materials in accordance with manufacturers instructions. Prior to placing patching material, prepare the base concrete by sand blast or shot blast methods. Remove all laitance, loosely adhered surface mortar and contaminants to the satisfaction of the Consultant.

.7 Install ½" x ½" (13 mm x 13 mm) cove bead at the junction of horizontal and vertical surfaces (i.e., perimeter walls, curbs and columns). Use caulking materials which are fully compatible with the selected membrane system.

.8 Ensure that all substrate surfaces are smooth, dry and firm. Remove any loose particles, ridges, laitance, cracks, grease, asphalt, oil and other foreign matter which could prevent adhesion of the deck membrane to the substrate or induce premature membrane failure.

.9 Clean all exposed metal surface (pipes, sleeves, drains, vents, etc.). Remove paint, rust, scale or any other foreign matter.

.10 Immediately prior to application of repair mortar or membrane remove all dust using oil free compressed air.

3.3 INSTALLATION/APPLICATION

.1 Complete all work to Manufacturer's written Contractor's Application Manual and the Contract Documents. Where a conflict exists between the Contract Documents and the Manufacturer's instructions the more stringent criteria will apply.

.2 Comply with the following environmental conditions or the Manufacturer's specifications whichever are more stringent.

- Do not schedule work if the forecast temperature is below 10 □C or above 30□C the time of application.
- Allow a minimum of 48 hours following rain for the deck to dry prior to the application of the primer (exterior applications or interior decks that become wet).
- Provide ventilation as necessary to minimize concentration of fumes during membrane application and curing.

.3 Prime the entire deck surface in accordance with the manufacturers' guidelines.

.4 Apply the membrane base coat to a height of 4" (100 mm) above the deck surface on the walls, columns and upstands.

.5 Inspect the finished dry base coat. Grind fins or localized projection through the base coat membrane. Remove all particles trapped in the base coat prior to installing the wear

coats. Install an additional 25 mils of base coat over rough areas where high points in the deck surface are visible.

.6 Immediately prior to application of wear coats remove all dust using oil free compressed air.

.7 Install wear coat over the entire deck. The wear coat thickness and finish shall be in accordance with Section 2.1.2 of this specification or in accordance with the manufacturer's application guidelines for minimum dry film thickness, whichever is more stringent. Apply membrane wear coat to a height of 4" (100 mm) above the deck surface on the walls, columns and upstands. Use masking tape to define top edge where necessary.

.8 Install membrane thickness in accordance with the manufacturer's printed specifications for membrane subject to vehicular traffic. In no instance shall the total dry mil thickness of the completed membrane, excluding aggregate, be less than specified.

.9 Finished work shall match approved samples, be uniform in thickness, sheen, colour and texture and be free from defects detrimental to appearance or performance.

.10 Install corners, pipe seals and flashing protrusions in membrane in accordance with manufacturer's details. Ensure that membrane terminations are completed in accordance with manufacturer's details. As a minimum requirement, provide a ¼" wide x ¼" (6 mm x 6mm) deep saw cut where the membrane is terminated on a horizontal surface. Use manufacturer's recommended procedures for installation in corners, drains and for flashing protrusions.

3.4 FIELD QUALITY CONTROL

.1 Contractor shall perform measurements (cut test) in the presence of Engineer to measure the specified dry film thickness of deck coating. The wet film thickness shall be measured on a regular basis during the membrane application.

.2 The completed installation shall have a minimum direct tensile bond strength to the substrate and inter-layer adhesion of 1.55 MPa (225 psi) when 100 mm x 100 mm cured areas are tested in accordance with CAN/CSA A23.2-6B. Testing of the membrane for adhesion will be conducted by the Owner's Consultant and paid for by the Owner. The cost of repairing the bond test areas will be borne by the Contractor. Testing by the Consultant will not relieve the Contractor of his responsibility to meet the requirements of the Contract Documents. Repair all cut patches taken for inspection and testing purposes.

3.5 ADJUST AND CLEAN

.1 Repair, remove and clean all drips or smears on exposed finished surfaces or surfaces to be subsequently finished.

.2 Protect all adjacent surfaces from damage due to deck coating operations.

.3 As work proceeds and on completion, clean up and remove from the premises all rubbish and surplus materials resulting from this work. Dispose of all waste materials in strict accordance with all laws, bylaws and regulations governing the work.

END OF SECTION 07 18 16

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Architectural Concrete Section 03 33 00

1.2 ACTION AND INFORMAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheets illustrating products to be incorporated into project for specified products.

.2 Provide two copies of Workplace Hazardous Materials Information System (WHMIS) - Material Safety Data Sheets (MSDS) in accordance with Section 01 35 33 - Health and Safety Requirements.

.3 Manufacturer's Instructions:

.1 Provide manufacturer's installation instructions.

1.3 QUALITY ASSURANCE

.1 Do work in strict accordance with the manufacturer’s latest printed specifications and directions.

.2 Perform coating work by an applicator approved by the coating manufacturer and experienced in the specific type of water repellent coating installation. Submit proof of such experience and manufacturer’s approval on the request of the Consultant.

.3 Provide a sample panel of the coating application to the Consultant for both appearance and water repellent acceptance. The approved sample shall form a standard for this project and work of an inferior quality will be rejected. Start no large scale coating application until written approval of this sample is given by the Consultant.

.4 Sealer manufacturer: Inspect the substrate prior to commencement of Work and regularly thereafter during application. Submit reports to the Consultant.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Deliver and store material undamaged in original containers, with manufacturer labels and seals intact.

.2 Prevent damage to materials during handling and storage. Provide adequate protection against freezing and excessive heat.

1.5 PROJECT CONDITIONS

.1 Review and examine the actual concrete masonry units specified for the project. Confirm application rates, coverage and run-down with sealer manufacturer prior to bid submission.

.2 Examine surfaces shown to receive treatment and report, in writing to the Consultant any defects which might impair the application of the water repellent coating.

.3 Commencement of work shall imply acceptance of surfaces and conditions.

2.0 PRODUCTS

2.1 MATERIALS

.1 Water Repellent Coating:

.1 clear penetrating water repellent for above grade concrete protection

.2 low VOC (< 250 g/l)

.3 water-borne silane modified siloxane solutions
.4 not to alter shade of the treated surface
.5 solid concentration – as recommended by manufacturer based on desnity of concrete.

3.0 EXECUTION

3.1 PREPARATION

.1 Clean all surfaces to receive the coating thoroughly so as to have removed mortar spatter, job dirt, laitance, or any other substance which would inhibit the penetration, adhesion, and long term performance of the coating.

3.2 APPLICATION

.1 Allow a minimum drying time of 2 - 3 days after cleaning of the concrete before applying the water repellent coating.

.2 Try a small area in an inconspicuous area prior to application. Apply an initial light “mist” coat to break surface tension.

.3 Follow mist coat immediately with a uniform flood coat which allows just enough material to carry a 4 inches run-down from the contact point.

.4 Apply material in an overlapping pattern.

.5 Apply a second coat of material if the specified run-down cannot be achieved with the first coat.

3.3 ADJUSTING AND CLEANING

.1 Remove waste and excess material off site both during and at completion of coating Work. Repair and make good any defects to this application or any defects to any other Work caused by this application.

END OF SECTION 07 19 00

1.0 GENERAL

1.1 SECTION INCLUDES

.1 Insulation and moisture protection as indicated on the drawings and specified herein.

1.2 RELATED SECTIONS

.1	Rough Carpentry Minor Works	Section 06 08 99
.2	Finish Carpentry	Section 06 20 00
.3	Metal Wall Panels	Section 07 42 13
.4	Modified Bituminous Membrane Roofing	Section 07 52 00
.5	Gypsum Board Assemblies	Section 09 21 16

1.3 PRODUCT DELIVERY, STORAGE & HANDLING

.1 Materials shall be stored in a dry and protected area, off the ground, in original undamaged, sealed container with manufacturer's labels and seals in tact. Avoid freezing.

1.4 PROJECT CONDITIONS

.1 Review manufacturer's recommendations for ambient temperatures during and after application.

.2 Report to general contractor in writing, defects of work prepared by other trades and unsatisfactory site or environmental conditions.

.3 Examine surfaces to ensure they are dry, clean, free of oil, grease, dirt, paint, mull scale or other deleterious material that would impair bonding.

.4 Commencement of work shall imply acceptance of surfaces and conditions.

2.0 PRODUCTS

.1 Roof Insulation Polyisocyanurate: Thermal Resistance of R28 minimum of any point of the roof. Shall conform to CAN/CGSB-51.26-M86 factory finished both sides with a nominal 2 lb./ft^3 density, compressive strength of 140 Kpa (20 psi) minimum and meet ULC S704. Facers must not have organic matter.

.2 Wall Cladding Exterior Insulation: Mineral Wool Insulation, non-combustible to ULC CAN 4-S114, zero falme spread and smoke development to ULC S102, 50 mm thick thermal resistance of R8x minimum.

.3 Wall Assembly Batt: Mineral Wool Insulation. Comply Type 1 CAN/ULC - S702.

.4 Exterior insulation to foundations and underslab: below grade shall be closed cell Type 4 polystyrene insulation. Exterior insulation above grade shall either be protected with an asphalt impregnated protection board.

3.0 EXECUTION

3.1 INSPECTION

.1 Ensure that surfaces to receive insulation are clean and free of obstructions.

.2 Do not install insulation in framing until roofing is complete and the building is enclosed.

3.2 WORKMANSHIP

.1 Install insulation to maintain continuity of thermal protection to building elements and spaces.

.2 Install batt and rigid insulation to all other areas indicated on drawings to thickness shown.

.3 Fit closely around electrical boxes, pipes, ducts, frames, joists, and other objects in or passing through insulation.

3.3 INSTALLATION

.1 Batt insulation installation for interior wall

.1 Install batt insulation for acoustic separations so as to press on drywall over entire surface area.

.2 Cut and trim insulation neatly, to fit spaces. Use batts free of ripped backs and/or edges. Butt edges and ends tightly.

.2 Perimeter footing rigid installation

.1 Install insulation boards by mechanical fasteners to concrete footing.

.2 Fasteners: Impale type, non-corrosive, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, fused to membrane, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self locking type.

.3 For insulation over waterproofing membrane, use only adhesion method. Do not penetrate any below grade waterproofing.

.4 Extend insulation under floor slab for a minimum of 610 mm wide.

.3 Semi-Rigid insulation installation for exterior wall

.1 Apply semi-rigid insulation at all other areas indicated on drawings to thickness shown. Fasteners: mechanical fastened.

.2 Fasteners: Impale type, non-corrosive, perforated 50 X 50 mm cold rolled carbon steel 0.8 mm thick, fused to membrane, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25mm diameter washers of self locking type.

.3 Butt joints tightly, offset vertical joints. Use insulation boards free from chipped or broken edges.

.4 Install material in accordance with manufacturer’s instructions.

.4 Roof insulation installation

.1 Apply adhesive to rigid insulation board at applied thickness as recommended by manufacturer at all areas indicated on drawings.

.2 Butt joints tightly, offset vertical joints. Use insulation boards free from chipped or broken edges.

.3 Install material in accordance with manufacturer's instructions.

3.5 CLEANING

.1 Remove waste and excess material off site at completion of application. Repair and make good any defects to this application or any defects caused by this application.

END OF SECTION 07 21 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Modified Bituminous Membrane Roofing — Section 07 52 00

.2 Thermal Insulation — Section 07 21 00

.3 Sheet Metal Flashing & Trim — Section 07 62 00

.4 Metal Doors and Frames — Section 08 11 00

.5 Windows — Section 08 50 00

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-19.13M-M87, Sealing Compound, One Component, Elastomeric Chemical Curing.
- .2 CAN/CGSB-19.24M-M90, Multi-Component, Chemical Curing Sealing Compound.
- .3 CGSB 19-GP-14M-84, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.

.2 Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 33 – Health Safety Requirements.

.3 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.
- .1 Existing Substrate Condition: report deviations, as described in PART 3 -EXAMINATION in writing to Departmental Representative.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Qualifications:
- .1 Applicator: company specializing in performing work of this section with minimum 5 years documented experience with installation of air/vapour barrier systems.

.2 Mock-Up:
- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 Construct typical exterior wall panel, incorporating louvre and door frame, insulation, illustrating materials interface and seals.
- .3 Locate in location as agreed to with Departmental Representative.
- .4 Mock-up may remain as part of finished work.

.5 Allow 72 hours for inspection of mock-up by Departmental Representative before proceeding with air/vapour barrier Work.

.3 Schedule site visits with Departmental Representative, to review Work, at stages listed:
- .1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.
- .2 Minimum twice during progress of Work at 25% and 60% complete.
- .3 Upon completion of Work, after cleaning is carried out, prior to cover up by other building component.

1.5 DELIVERY STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Avoid spillage: immediately notify Departmental Representative if spillage occurs and start clean up procedures.

.4 Clean spills and leave area as it was prior to spill.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.7 AMBIENT CONDITIONS

.1 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.

.2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.

.3 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

1.8 SEQUENCING

.1 Sequence work in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Charts.

.2 Sequence work to permit installation of materials in conjunction with related materials and seals.

1.9 WARRANTY

.1 For sealant and sheet materials the 12 months warranty period is extended to 24 months.

2.0 PRODUCTS

2.1 SELF ADHESIVE MEMBRANE

.1 Membrane composed of high temperature grade SBS modified bitumen and a Tri-laminate woven polyethylene face on the top surface. The self-adhesive bottom surface is protected by a silicone release sheet.

- .1 Water Vapour transmission 202 g/m² /24 hours/ASTM E96/B (Dessicant).
- .2 Dry Tensile Strength 41 lbf/182N MD, 29 lbf/129N CD, ASTM D 828.
- .3 Average Dry Breaking Force 127 lbf/565N MD, 91 lbf/405N CD, ASTM D 5034.
- .4 Accelerated Aging, Pass, ICC-ES AC 48, 25 cycles.
- .5 Cycling and Elongation, Pass, ICC-ES AC48, 100 cycles at -29°C (20°F).
- .6 Application Temperature Minimum 5°C (41°F).
- .7 Flame Spread Index 0, Class A, ASTM E-84.
- .8 Smoke Developed 105, Class A, ASTM E-84.
- .9 Membrane thickness, Minimum 40 mil.
- .10 Air Permeance, Pass, ASTM E 2178 (Maximum 0.02 L/m²s @ 75Pa or 0.004 cfm/ft² @ 1.57pcf) ASTM E 2357 – assembly, Pass.
- .11 Criteria for Water Resistive Barriers, Pass, ICC-ES AV 38.
- .12 Low Temp Flexibility, Pass, ICC-AC38/3.3.4.
- .13 Peel-adhesion to Unprimed Plywood, PASS, ICC-ES AC48, Control 62 lbf/ft-905N/m, After 7 day water immersion 54 lbf/ft-788N/m, After accelerated aging 72 lbf/ft-1051N/m, After UV exposure 77 lbf/ft-1124N/m
- .14 Water Penetration Resistance around Nails, PASS, AAMA 711-05 and ASTM D 1970 modified.

2.2 SEALANTS

.1 Sealants in accordance with Section 07 92 10 - Joint Sealing.

.2 Sealant compatible with membrane as recommended by the manufacturer:

- .1 Silicone Sealant specifically for use with self-adhered membrane.

.3 Primer: recommended by sealant manufacturer as appropriate to application.

.4 Substrate Cleaner: non-corrosive type recommended by sealant manufacturer and compatible with adjacent materials.

2.3 PRIMER

.1 Apply primer to gypsum wall board and concrete masonry unit according to manufacturer’s specification. Ensure proper adhesion and compatibility to the membrane.

2.4 ACCESSORIES

.1 Provide mechanically fastened stainless steel termination bar with gumlip edge.

3.0 EXECUTION

3.1 MANUFACTURER’S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 GENERAL

.1 Perform Work in accordance with Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification requirements for materials.

3.3 EXAMINATION

.1 Verify that surfaces and conditions are ready to accept work of this section.

.2 Ensure surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.

.3 Report unsatisfactory conditions to Departmental Representative in writing.

.4 Do not start work until deficiencies have been corrected.

.1 Beginning of Work implies acceptance of conditions.

3.4 PREPARATION

.1 All surfaces to receive the membrane must be thoroughly cleaned so as to have removed all concrete spatter, job dirt, laitance, from release agents, curing compounds, or any other substance which could inhibit the adhesion, and long term performance of the membrane.

.2 All honeycombing in concrete shall be grouted flush prior to application of primer.

.3 Apply primer as per manufacturer’s recommendation to all surfaces to receive the membrane on gypsum board or concrete masonry block substrate.

.4 Prepare in accordance with manufacturer’s instructions.

.5 Apply a horizontal membrane strip over vertical leg and fasteners of all horizontal cladding supports. Seal top with mastic regular.

.6 Fill all joints or gaps wider than ¼” with galvanized steel sheet steel or wood backing and apply 12” strip of membrane over joints prior to application of the field membrane. Seal all side laps without factory bitumen self-adhering edge and all top laps with mastic.

3.5 APPLICATIONS

.1 Apply in accordance with manufacturer’s instructions.

.2 All joints within and between back up walls and window frames shall be sealed according to detail drawings.

.3 Ensure continuity of air barrier. Co-ordinate construction of roof/wall junction to maintain continuity of air barrier from wall to roof. Co-ordinate with construction of exterior walls to maintain continuity of air barrier between various exterior wall construction types.

.4 Shingle laps to drain. Minimum side and end laps as per manufacturer’s recommendation with a minimum of 75mm.

.5 Membrane should be adhered onto window frame section as per detail drawings.

.6 Lap and seal air barrier membrane over through-wall flashing at base of wall and at all horizontal wall flashings.

.7 Lap roof membrane flashing over air/vapour barrier membrane at parapets and seal.

.8 Seal all through-wall equipment flanges with air barrier membrane flashing strips; apply mastic to edges.

.9 Seal all metal fabrication flanges with air/vapour barrier membrane flashing strips; apply mastic to edges.

.10 Seal all horizontal drip flashings to air/vapour barrier membrane with minimum 150 mm strips of membrane flashing applied horizontally; apply mastic to edges of flashing membrane.

3.6 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.7 PROTECTION OF WORK

.1 Protect finished work in accordance with Section 01 61 00 - Common Product Requirements.

.2 Do not permit adjacent work to damage work of this section.

.3 Ensure finished work is protected from climatic conditions.

END OF SECTION 07 27 00.01

1.0 GENERAL

1.1 SECTION INCLUDES

.1 Supply and install preformed metal cladding panels, including all necessary supporting structure, girts, clips, flashings, sealants, gaskets, caulking and accessories to full extent shown on drawings and as specified herein.

1.2 RELATED SECTIONS

.1	Rough Carpentry for Minor Works	Section 06 08 99
.2	Thermal Insulation	Section 07 21 00
.3	Air Barriers	Section 07 27 00.01
.4	Sheet Metal Flashing and Trims	Section 07 62 00
.5	Joint Sealants	Section 07 92 00
.6	Metal Doors & Frames	Section 08 11 00
.7	Windows	Section 08 50 00
.8	Gypsum Board Assemblies	Section 09 21 16

1.4 SUBMITTALS

.1 Submit 300 x 300 mm size sample of wall cladding material, of color and profile specified, in accordance with Section 01 33 00 Submittal Procedures.

.2 Submit product data or shop drawings in accordance with Section 01 33 00 showing the profiles of preformed metal cladding units, and the detail of forming, jointing (gaskets if any), internal supports, anchorages, trim, flashing and accessories. Show details of weatherproofing at edges, terminations and penetrations of the metal cladding work. Show small scale layout and elevations of entire work.

.3 Shop drawings to be designed and prepared under the supervision of a registered Professional Engineer registered in British Columbia. All submitted shop drawings shall be sealed and signed by the said Professional Engineer. The same Professional Engineer shall provide Model Schedule B and Schedule C confirming the work is designed and installed in conformance with the structural design criteria.

1.5 EXISTING CONDITIONS

.1 Before commencing erection, examine the structure carefully. Notify the Consultant of any defects and have the base surfaces corrected as required. Do not work until corrective measures are taken.

.2 Commencement of work signifies acceptance of all base surfaces.

1.6 WARRANTY

.1 The metal cladding installation and material shall be warranted against the penetration of rain, snow, ice or environmental elements, to be rigid and safely able to withstand all wind and snow loads, not to deflect, buckle, twist or pull away from fastenings over a period of two (2) years from the date of Substantial Performance. Defects occurring within the two year warranty period shall be rectified at no cost to the Owner.

2.0 PRODUCTS

2.1 MATERIALS

.1 Exterior Cladding and Trim Materials

.1 Minimum 0.759mm (22ga) sheet steel.

.2 Minimum 0.912mm (20ga) for flat stock sheet metal installed behind fixtuers or wall penetration.

.3 All exposed sheet metal or cladding material to be PVDF/Kynar finish or galvalume Plus finish to match adjoining profile metal cladding.

.2 Profile:

.1 MC1 – 102mm x 40mm Profiled Metal Cladding, Slate Blue (to match existing EGD Administration Building), PVDF/Kynar finish.

.2 MC2 – 2 2/3" x 7/8" Corrugated Metal Cladding Galvalume Plus AZ 180.

.3 Assembly and Installation Accessories: Provide manufacturer's standard fasteners, brackets, clips, anchoring devices, furring strips, spacers, flashings, closures, adhesives, joint sealers, expansion joints and other components needed for a complete permanently weather proof installation. Use materials which are non-corrosive, non-deteriorating, and compatible with the panel faces. All exposed fasteners shall be painted to match siding panels.

.4 Trims and Custom Break Shapes: Provide trim components as part of the preformed metal cladding work, including all flashing and collars, capping, seam covers, end stops and filler pieces, etc. Match the material and finish of the exterior panels, thickness minimum 0.61 mm (22 ga).

.5 Flashings: shall be of the same material and finish as metal cladding, thickness minimum 0.759 mm.

.6 Closure Strips: shall be of same material and finish as metal cladding, thickness minimum 0.759 mm.

.7 Sealant: for metal cladding system with the colour to match adjoining surfaces, field applied around all openings, and to side of all cladding. Sealant shall comply with Section 07 92 00.

.8 Z-Girt: Stainless steel, Thermally broken, adjustable with PVC spacers, composed of inner short sections of angle and a continuous angle to the outside, tie together with a screw fastener.

.9 Fasteners to have a minimum 2000hr salt spray rating.

2.2 PANEL FABRICATION

.1 Determine the section properties of the metal cladding panel systems in strict accordance with the requirements of the National Building Code, BC Building Code; Canadian Structural Design Manual including CSA S136, Design of Light Gauge Steel Structured Members.

.2 Metal cladding panel systems shall withstand all live loads resulting from wind or a combination of wind and temperature as defined in the National Building Code, BC Building Code without exceeding the maximum working stress of 20,000 psi for steel members or the maximum deflection of 1/180th of the span.

.3 Form sections square, true and accurate to size, free of distortion and other defects detrimental to appearance or performance.

.4 Provide resilient gaskets or spacers between metal components of panel assemblies, and between panels, as required to eliminate metal-to-metal contact and movement noises in the completed work, which might result from thermal or structural movements.

3.0 EXECUTION

3.1 PREPARATION

.1 Wherever possible, take field measurements prior to completion of shop fabrication and finishing of preformed metal cladding. Do not delay job progress; allow for trimming where final dimensions cannot be established before fabrication.

3.2 INSTALLATION

.1 Comply with panel manufacturer's instructions and approved Engineered shop drawing for assembly, installation and erection of preformed metal cladding.

.2 Apply a coat of bituminous paint, concealed, on one or both surfaces wherever dissimilar metals would otherwise be in contact. Use gasket fasteners where needed to eliminate the possibility of corrosive or electrolytic action between metals.

.3 Anchor component parts of the preformed metal cladding securely in place, providing for necessary thermal and structural movement as recommended by manufacturer and as indicated on Engineered Shop Drawings. Make corners square, surfaces true and straight in all planes and lines accurate to profiles.

.4 Tolerances: Erect the Work plumb, level and true to line with tolerances not exceeding 6 mm in runs of 6 m.

.5 Install exterior corners, fillers and closure strips with individually formed and profiled work using concealed fasteners.

.6 Install sealants for the preformed metal cladding work as indicated and as required for performance. Comply with sealant manufacturer's instructions for installation and curing.

.7 Install starter strips, backer plates, drip caps, outside custom corners and other trims and flashings, as indicated on the drawings and as required to provide a complete and finished product.

.8 All flashing in contact with steel preformed metal cladding as herein described shall be steel and by this trade, except as noted otherwise.

.9 Isolate all dissimilar materials.

.10 Apply waterproof membrane between all members/supports for metal cladding connecting to back-up structure and weather barrier. Ensure membrane projects 25 mm beyond all sides of every member to provide a complete seal around fastenings.

.11 Do not install cladding in direct contact with lead or copper or in areas where run off from these metals on to the cladding surface may occur.

3.3 CLEANING

.1 Clean exposed surfaces of preformed metal cladding work promptly after completion of installation. Comply with recommendations of both the panel and coating manufacturers.

.2 Clean up and remove from the site all surplus materials and rubbish resulting from the Work of this Section.

END OF SECTION 07 42 13

1.0 GENERAL

1.1 SUMMARY OF WORK

.1 Work of this section includes provision of a 2 ply torch applied SBS membrane over insulation sheathing over steel deck.

1.2 RELATED REQUIREMENTS

.1	Rough Carpentry for Minor Works	Section 06 08 99
.2	Thermal Insulation	Section 07 21 00
.3	Air Barriers	Section 07 27 00.01
.4	Sheet Metal Flashing and Trim	Section 07 62 00
.5	Joint Sealants	Section 07 92 00
.6	Gypsum Board Assemblies	Section 09 21 16

1.3 REFERENCES

.1 ASTM International Inc.
- .1 ASTM C1177/C1177M-08, Standard Specification for Glass Mat Gypsum Substrate for use as Sheathing.
- .2 ASTM D 6164-05 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.

.2 Canadian General Standards Board (CGSB)
- .1 CGSB 37-GP-9Ma-, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
- .2 CGSB 37-GP-56M-80b (A1985), Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.

.3 Roofing Contractors' Association of British Columbia R.C.A.B.C. RGC Roofing Practices Manual, guarantee standards.

.4 Canadian Standards Association (CSA International)
- .1 CSA-A123.3-05, Asphalt Saturated Organic Roofing Felt.
- .2 CSA-A123.4-04, Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.
- .3 CSA O121-08, Douglas Fir Plywood.
- .4 CSA O151-04, Canadian Softwood Plywood.

.5 Factory Mutual (FM Global)
- .1 FM Approvals - Roofing Products.

.6 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.7 Underwriters Laboratories' of Canada (ULC)
- .1 CAN/ULC-S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Convene pre-installation meeting two week prior to beginning waterproofing Work, with roofing contractor's representative, membrane manufacturer's representative, and Departmental Representative in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart to:
- .1 Verify project requirements.
- .2 Review installation and substrate conditions.
- .3 Co-ordination with other building subtrades.
- .4 Review installation instructions and warranty requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Provide two copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Provide two copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements, and indicate VOC content for primers.

.3 Provide shop drawings:
- .1 Indicate flashing, control joints and tapered insulation details.
- .2 Provide layout for tapered insulation.

1.6 QUALITY ASSURANCE

.1 Installer qualifications: company or person specializing in application of modified bituminous roofing systems with minimum 5 years' experience.

.2 Inspection Authority:
- .1 Selected from RCABC Approved list of Roofing Inspectors.
- .2 The presence of an Inspector shall in no way excuse the Contractor from performing the Work in accordance with the contract Documents and keeping with the best practices of the trades.
- .3 The Inspector will not be responsible for or have control or charge over safety precautions and programs required for the Work in accordance with the applicable construction safety legislation, other regulations or general construction practice, the acts or omissions of the contractor, his subcontractors or their agents, employees or other persons performing any of the Work.
- .4 The Contractor shall inform the Inspection Agency seven (7) days prior to commencement of work.

1.7 FIRE PROTECTION

.1 Fire Extinguishers:
- .1 Maintain one cartridge operated type with shut-off nozzle, on roof per torch applicator, within 6 m of torch applicator.
- .2 ULC labelled for A, B and C class protection.

.2 Maintain fire watch for 1 hour after each day's roofing operations cease.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Storage and Handling Requirements:

.1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.
.2 Provide and maintain dry, off-ground weatherproof storage.
.3 Store rolls of membrane in upright position. Store membrane rolls with salvage edge up.
.4 Remove only in quantities required for same day use.
.5 Place plywood runways over completed Work to enable movement of material and other traffic.
.6 Store sealants at +5 degrees C minimum.
.7 Store insulation protected from daylight and weather and deleterious materials.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

1.9 SITE CONDITIONS

.1 Ambient Conditions
.1 Do not install roofing when temperature remains below -18 degrees C for torch application, or -5 degrees C for mop application.
.2 Minimum temperature for solvent-based adhesive is -5 degrees C.

.2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

1.10 WARRANTY

.1 Upon completion of work, this Contractor shall furnish Owners with a 10-YEAR R.C.A.B.C. Roof Star Guarantee on all work of this section.

.2 Provide for inspection in accordance with specifications and with R.C.A.B.C. Standards. Inspection fees shall be included in this contract.

.3 Upon Total Performance of the Contract submit a Ten (10) year Labour and Materials Warranty issued by the manufacturer of the roofing membrane.

2.0 PRODUCTS

2.1 PERFORMANCE CRITERIA

.1 Compatibility between components of roofing system is essential. Provide written declaration to Departmental Representative stating that materials and components, as assembled in system, meet this requirement.

2.2 DECK COVERING

.1 Gypsum board sheathing: to ASTM C1177/C1177 M-08 Standard 15.9 mm thick Glass Mat Gypsum Sheathing.

2.3 DECK PRIMER

.1 Asphalt primer: to CGSB 37-GP-9Ma.

2.4 VAPOUR RETARDER

.1 Base sheet vapour retarder: to CGSB 37-GP-56M, Styrene-Butadiene-Styrene (SBS) elastomeric polymer, prefabricated sheet, polyester reinforcement, weighing 180 g/m².
.1 Top and bottom surfaces: sanded/thermofusible.

2.5 MEMBRANE

.1 Base sheet: to CGSB 37-GP-56M polyester fibres to ASTM D 6164.
- .1 Styrene-Butadiene-Styrene (SBS) elastomeric polymer prefabricated sheet, polyester reinforcement, having nominal weight of 180 g/m².
- .2 Type 1, torch on.
- .3 Grade 1 - standard service.
- .4 Top and bottom surfaces:
  - .1 Thermofusible.
- .5 Base sheet membrane properties: to CGSB 37-GP-56M.
  - .1 Strain energy (longitudinal/transversal): 9.0/7.0 kN/m.
  - .2 Breaking strength (longitudinal/transversal): 17.0/18.0 N/5 cm.
  - .3 Ultimate elongation (longitudinal/transversal): 60/70.
  - .4 Tear resistance: 85 N.
  - .5 Cold bending at -30 degrees C: no cracking.
  - .6 Softening point: ò 110 degrees C.
  - .7 Static puncture resistance: > 400.
  - .8 Dimensional Stability: -0.3 / 0.3 %.
- .6 ULC certification: Class A.

.2 Cap sheet membrane: to CGSB 37-GP-56M polyester fibres to ASTM D 6164.
- .1 Styrene-Butadiene-Styrene (SBS) elastomeric polymer, prefabricated sheet, polyester reinforcement, having nominal weight of 250 g/m².
- .2 Type 1, torched on.
- .3 Class A-granule surfaced.
  - .1 Colour for granular surface: red .
- .4 Grade 1-standard service .
- .5 Bottom surface: thermofusible.
- .6 Cap sheet membrane properties: to CGSB 37-GP-56M.
  - .1 Strain energy (longitudinal/transversal): 13.0/10.0kN/m.
  - .2 Breaking strength (longitudinal/transversal): 25.0/16.0 kN/m.
  - .3 Ultimate elongation (longitudinal/transversal): 63/73 60/65 %.
  - .4 Tear resistance: 80 N.
  - .5 Cold bending at -30 degrees C: No cracking.
  - .6 Softening point: ò 110 degrees C.
  - .7 Static puncture resistance: > 400 370 .
  - .8 Dimensional Stability: -0.2 / 0.2 %.
  - .7 ULC certification: Class A.

2.6 OVERLAY BOARD

.1 Overlay Board: 6mm thick asphalt impregnated fiberboard.
- .1 Install over insulation to provide torch safe surface.

2.7 BITUMEN

.1 Asphalt: to CAN/CSA A123.4 ASTM D 312 , Type 2 3 .

2.7 POLYISOCYANURATE INSULATION

.1 Typical flatboard polyisocyanurate foam to ULC S704, Minimum 4 ½" thick equivalent to thermal resistance of R28, at any point of the roof. Refer to Section 07 21 00 Thermal Consultation.

.2 Create cricket as shown on drawing.

.3 Tapered insulation to create slope as shown on drawing.

2.8 SEALERS

.1 Sealing compound: rubber asphalt type.

.2 Caulking - see Section 07 92 00 - Joint Sealants.

2.9 WALKWAYS

.1 Walkways to consist of one additional ply of cap sheet membrane. Colour to be different from field membrane as selected by Departmental Representative.

2.10 CARPENTRY

.1 Refer to Section 06 08 99 - Rough Carpentry – For Minor Works.

2.11 FASTENERS

.1 Covering to steel deck: No. 10 flat head, self-tapping, Type A or AB, cadmium plated screws. Recommend FM Approved screw and plate assemblies.

.2 Insulation to deck: coated insulation fasteners and galvanized plates must meet FM Approval for wind uplift and corrosion resistance, as recommended by insulation manufacturer.

3.0 EXECUTION

3.1 QUALITY OF WORK

.1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and RCABC Roofing Specification Manual to meet specified Guarantee standards, particularly for fire safety precautions.

.2 Do priming in accordance with manufacturers written recommendations.

.3 The interface of the walls and roof assemblies will be fitted with durable rigid material providing connection point for continuity of air barrier.

.4 Assembly, component and material connections will be made in consideration of appropriate design loads.

3.2 EXAMINATION OF ROOF DECKS

.1 Verification of Conditions:

.1 Inspect with Departmental Representative deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed.

.2 Evaluation and Assessment:

.1 Prior to beginning of work ensure:

.1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.

.2 Curbs have been built.

.3 Roof drains have been installed at proper elevations relative to finished roof surface.

.4 Plywood and lumber nailer plates have been installed to deck, walls and parapets

as indicated.

.3 Do not install roofing materials during rain or snowfall.

3.3 PROTECTION OF IN-PLACE CONDITIONS

.1 Cover walls, walks and adjacent work where materials hoisted or used.

.2 Use warning signs and barriers. Maintain in good order until completion of Work.

.3 Clean off drips and smears of bituminous material immediately.

.4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.

.5 Protect roof from traffic and damage. Comply with precautions deemed necessary by Departmental Representative.

.6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.

.7 Metal connectors and decking will be treated with rust proofing or galvanization.

3.4 DECK SHEATHING

.1 Mechanically fasten to steel deck Gypsum Board Sheathing with screws to steel deck's upper rib surfaces, spaced 400 mm on centre each way.

.2 Place with long axis of each sheet transverse to steel deck ribs, with end joints staggered and fully supported on ribs.

3.5 VAPOUR RETARDER

.1 Install peel and stick continuous over installed gypsum sheathing. Extend up vertical surfaces as shown and tie into air/vapour barrier as indicated or required.

3.6 CONVENTIONAL MEMBRANE ROOFING

.1 Insulation: Refer to Section 07 21 00

.2 Tapered insulation application:

.1 Install tapered insulation as second insulation layer, in accordance with shop drawings. Stagger joints between layers 150 mm minimum.

.3 Overlay Board:

.1 Place boards in parallel rows with end joints staggered, mechanically fastened as per manufacturer’s recommendation.

.4 Base sheet application:

.1 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and reroll from both ends.

.2 Unroll and torch base sheet onto substrate taking care not to burn membrane or its reinforcement or substrate.

.3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.

.4 Application to be free of blisters, wrinkles and fishmouths.

.5 Cap sheet application:
- .1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.
- .2 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.
- .3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.
- .4 Application to be free of blisters, fishmouths and wrinkles.
- .5 Do membrane application in accordance with manufacturer's recommendations.

.6 Flashings:
- .1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.
- .2 Torch base and cap sheet onto substrate in 1 metre wide strips.
- .3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal by mopping or torch welding.
- .4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.
- .5 Provide 75 mm minimum side lap and seal.
- .6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.
- .7 Do work in accordance with Section 07 62 00 - Sheet Metal Flashing and Trim.

.7 Roof penetrations:
- .1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.

3.7 WALKWAYS

.1 Install additional cap sheet in contrasting colour as walkway membrane in accordance with manufacturer's instructions and as indicated.
- .1 Apply primer to cap sheet membrane and torch apply, ensuring selvage edge is removed.

.2 Install concrete paver at cat ladder landing and foot path as indicated on roof plan. Level on insulation pads, as indicated.

3.8 FIELD QUALITY CONTROL

.1 Inspections:
- .1 Inspection and testing of roofing systems and application will be carried out by testing laboratory designated by Departmental Representative.
- .2 Inspection will be carried out during the entire roof installation procedure.
- .3 Manufacturer’s Representative to complete review of basesheet installation prior to cap sheet installation.
- .4 Manufacturer’s Representative to complete review of cap sheet installation.

3.9 CLEANING

.1 Remove bituminous markings from finished surfaces.

.2 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.

.3 Repair or replace defaced or disfigured finishes caused by work of this section.

.4 Waste Management: separate waste materials for reuse and recycling in accordance with Section

01 74 19 - Waste Management and Disposal.

.1 Place materials defined as hazardous or toxic in designated containers.

.2 Ensure emptied containers are sealed and stored safely.

.3 Unused adhesive, sealant and asphalt materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

.5 Dispose of unused sealant material at official hazardous material collections site approved by Departmental Representative.

.6 Divert unused gypsum materials from landfill to recycling facility as reviewed by Departmental Representative.

END OF SECTION 07 52 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1	Modified Bituminous Sheet Waterproofing	Section 07 13 52
.2	Air Barriers	Section 07 27 00.01.
.3	Metal Wall Panels	Section 07 42 13
.4	Modified Bituminous Membrane Roofing	Section 07 52 00

1.2 REFERENCES

.1 The Aluminum Association Inc. (AAI)
- .1 AAI-Aluminum Sheet Metal Work in Building Construction-2002.
- .2 AAI DAF45-03, Designation System for Aluminum Finishes.

.2 American Society for Testing and Materials International (ASTM)
- .1 ASTM A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM A 792/A 792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.3 Roofing Contractors Association of B.C. (RCABC)
- .1 RGC Roofing Practice Manual.

.4 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.

.5 Canadian Standards Association (CSA International)
- .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.

.7 Green Seal Environmental Standards
- .1 Standard GS-03-93, Anti-Corrosive Paints.
- .2 Standard GS-11-97, Architectural Paints.
- .3 Standard GS-36-00, Commercial Adhesives.

.8 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.9 British Columbia Sheet Metal Association (SMACNA-BC)
- .1 Architectural Sheet Metal Manual- 6th Edition 2003.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 33- - Health and Safety Requirements.

.3 Samples:
.1 Submit duplicate 50 x 50 mm samples of each type of sheet metal material, finishes and colours.

.4 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
.1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.4 QUALITY ASSURANCE
.1 Pre-Installation Meetings: convene pre-installation meeting [one] week prior to beginning work of this Section and, with contractor's representative , Departmental Representative in accordance with Section 01 32 16.07 - Construction Progress Schedule - Bar (GANTT) Chart to:
.1 Verify project requirements.
.2 Review installation and substrate conditions.
.3 Co-ordination with other building sub trades.
.4 Review manufacturer's installation instructions and warranty requirements.

.2 Upon completion of work, this Contractor shall furnish Owners with a 5 year R.C.A.B.C. guarantee work of this section.

.3 Provide for inspection in accordance with specifications and Consultant's Standards. Include inspection fees in this contract. Inspection agency to be selected from R.C.A.B.C. approved list of roofing inspectors.

1.5 DELIVERY, STORAGE AND HANDLING
.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Waste Management and Disposal:
.1 Separate waste materials for and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

2.0 PRODUCTS

2.1 PRE-FINISHED SHEET METAL
.1 Zinc coated steel sheet: 0.91 mm (20ga) thickness, commercial quality to ASTM A 792, with Z275 designation zinc coating, finish enamel coated factory applied coating to CGSB 93-GP-3m Class F29, color to match profiled metal panels as shown on drawing.

2.2 PREFINISHED ALUMINUM SHEET
.1 Prefinished aluminum sheet: 0.81mm (20 gauge).

2.3 ACCESSORIES
.1 Isolation coating: alkali resistant bituminous paint.

.2 Plastic cement: to CAN/CGSB 37.5.
.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168.

.3 Underlay for metal flashing: asphalt laminated 3.6 to 4.5 kg kraft paper.

.4 Sealants.

.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168.

.5 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.

.6 Fasteners: stainless steel, flat head roofing nails of length and thickness suitable for metal flashing application.

.7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

.8 Touch-up paint: as recommended by prefinished material manufacturer.
.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1113.

2.4 FABRICATION

.1 Fabricate metal flashings and other sheet metal work in accordance with applicable RCABC and SMACNA Standards. Guarantee standard as specified in 1.4 Quality Assurance.

.2 Form pieces in 2400 mm maximum lengths.
.1 Make allowance for expansion at joints.

.3 Hem exposed edges on underside 12 mm.
.1 Mitre and seal corners with sealant.

.4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.5 METAL FLASHINGS

.1 Form flashings, copings and fascias to profiles indicated of galvanized steel as indicated on drawings.

.2 Caulk perimeter flashings with specified sealant where necessary to make a proper seal.

.3 'S' Lock and caulk end joints in flashing. Provide standing seams with concealed clips at corners. Hem exposed edges of flashing a minimum of 12.5 mm for rigidity.

.4 Provide flashings with edges turned to form a drip. Make proper allowance for expansion and contraction. Face clip flashings with concealed clips (600 mm) on centres.

.5 Provide flashings at vents, chimneys and control joints.

.6 Carry face metal down exterior face a minimum of 100 mm or as indicated on drawings.

.7 Provide metal base and cap flashings to extend to within 25 mm of roof surface.

.8 At vent stacks, install aluminum vent stacks and include for aluminum metal caps.

3.0 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Install sheet metal work in accordance with R.C.A.B.C standards. Guarantee standard as per 1.4 Quality Assurance.

.2 Use concealed fastenings except where approved before installation.

.3 Provide underlay under sheet metal.
- .1 Secure in place and lap joints 100 mm.

.4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
- .1 Flash joints using S-lock forming tight fit over hook strips.

.5 Lock end joints and caulk with sealant.

.6 Install pans, where shown around items projecting through roof membrane.

3.3 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.3 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION 07 62 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Concrete Unit Masonry Section 04 22 00

.2 Gypsum Board Assemblies Section 09 21 16

.3 Non-Structural Metal Framing Section 09 22 16

.4 Mechanical Divisions 21-23

.5 Electrical Communications/Electronics/Security Divisions 25-28

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.2 Underwriter's Laboratories of Canada (CAN/ULC)
- .1 CAN/ULC-S101 Fire Endurance Tests of Building Construction and Materials.
- .2 CAN/ULC-S102 Surface Burning Characteristics of Building Materials and Assemblies.
- .3 CAN/ULC-S115-07, Fire Tests of Fire stop Systems.

1.3 DEFINITIONS

.1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.

.2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.

.3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.

.4 Tightly Fitted; (ref: NBC 2010): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.
- .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 33 - Health and Safety Requirements.

.3 Shop Drawings:
- .1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation for each type of firestop condition.
- .2 Construction details should accurately reflect actual job conditions.

.4 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
.1 Test reports: in accordance with CAN/ULC-S101 and CAN/ULC-S102.
.1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.
.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
.4 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.5 QUALITY ASSURANCE
.1 Qualifications:
.1 Installer: company specializing in fire stopping installations with 5 years documented experience and certified by manufacturer of firestop system.

.2 Pre-Installation Meetings: convene pre-installation meeting two weeks prior to beginning work of this Section, with contractor's representative and Departmental Representative in accordance with Section 01 32 16.07 - Construction Progress Schedule - Bar (GANTT) Chart to:
.1 Verify project requirements.
.2 Review installation and substrate conditions.
.3 Co-ordination with other building sub trades.
.4 Review manufacturer's installation instructions and warranty requirements.

.3 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
.1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.
.2 Twice during progress of Work at 25% and 60% complete.
.3 Upon completion of Work, after cleaning is carried out.

1.6 DELIVERY, STORAGE AND HANDLING
.1 Packing, shipping, handling and unloading:
.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
.3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.

.2 Storage and Protection:
.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Replace defective or damaged materials with new.

.3 Waste Management and Disposal:
.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

2.0 PRODUCTS

2.1 MATERIALS

.1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.

.1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN- ULC-S115 and not to exceed opening sizes for which they are intended and conforming to specified special requirements described in PART 3.

.2 Fire stop system rating: 1 hour FRR, F rating.

.2 Service penetration assemblies: systems tested to CAN-ULC-S115.

.3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.

.4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC and BCBC 2012.

.5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.

.6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.

.7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

.10 Sealants for vertical joints: non-sagging.

3.0 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PREPARATION

.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.

.1 Ensure that substrates and surfaces are clean, dry and frost free.

.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

.3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.

.4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

.1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.

.2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

.3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.4 Tool or trowel exposed surfaces to neat finish.

.5 Remove excess compound promptly as work progresses and upon completion.

3.4 SEQUENCES OF OPERATION

.1 Proceed with installation only when submittals have been reviewed by Departmental Representative.

.2 Install floor fire stopping before interior partition erections.

.3 Mechanical pipe insulation: fire stop system component.

.1 Ensure pipe insulation installation precedes fire stopping.

3.5 FIELD QUALITY CONTROL

.1 Inspections: notify Departmental Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.6 FIRE STOP LABEL

.1 All fire stop penetrations shall be labeled. Labels shall be secured to surface directly on both sides of fire stop penetration. Fire stop penetration labels shall include the following information.

.1 Name of installer.

.2 Date of installation.

.3 Type of sealing system.

.4 Time duration of sealant.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.8 SCHEDULE

.1 Fire stop and smoke seal at:

.1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.

.2 Top of fire-resistance rated masonry and gypsum board partitions.

.3 Intersection of fire-resistance rated masonry and gypsum board partitions.

.4 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.

.5 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.

.6 Openings and sleeves installed for future use through fire separations.

.7 Around mechanical and electrical assemblies penetrating fire separations.

.8 Rigid ducts: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

END OF SECTION 07 84 00

1 .0 GENERAL

1.1 RELATED REQUIREMENTS

.1	Brick Masonry	Section 04 21 13
.2	Finish Carpentry	Section 06 20 00
.3	Metal Wall Panels	Section 07 42 13
.4	Sheet Metal Flashing and Trim	Section 07 62 00
.5	Metal Doors and Frames	Section 08 11 00
.6	Windows	Section 08 50 00
.7	Glazing	Section 08 80 50
.8	Gypsum Board Assemblies	Section 09 21 16
.9	Resilient Floor for Minor Works	Section 09 65 99
.10	Exterior Painting	Section 09 91 13
.11	Interior Painting	Section 09 92 13
.12	Mechanical	Divisions 21-23
.13	Electrical Communications/Electronics/Security	Divisions 25-28

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)
- .1 ASTM C 919- 12, Standard Practice for Use of Sealants in Acoustical Applications.

.2 ASTM C920-11 Standard Specification for Elastomeric Joint Sealants

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Manufacturer's product to describe.
- .1 Caulking compound.
- .2 Primers.
- .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

.3 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.4 Submit duplicate samples of each type of material and colour.

.5 Cured samples of exposed sealants for each color where required to match adjacent material.

.6 Submit manufacturer's instructions in accordance with Section 01 33 00 - Submittal Procedures.
.1 Instructions to include installation instructions for each product used.

1.4 QUALITY ASSURANCE / MOCK-UPS

.1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.

.2 Construct mock-up to show location, size, shape and depth of joints complete with back-up material, primer, caulking and sealant.

.3 Mock-up will be used:
.1 To judge workmanship, substrate preparation, operation of equipment and material application.

.4 Location to be decided with Departmental Representative.

.5 Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with sealant work.

.6 When accepted, mock-up will demonstrate minimum standard of quality required for this Work. Approved mock-up may remain as part of finished Work.

1.5 DELIVERY, STORAGE & HANDLING

.1 Deliver, handle, store and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

.3 Upon completion of Work, after cleaning is carried out.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Environmental Limitations:
.1 Do not proceed with installation of joint sealants under following conditions:
.1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C.
.2 When joint substrates are wet.

.2 Joint-Width Conditions:
.1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

.3 Joint-Substrate Conditions:
.1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

.4 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada.

.5 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

.6 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.

2.0 PRODUCTS

2.1 SEALANT MATERIALS

.1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.

.2 When low toxicity caulks are not possible, confine usage to areas which offgas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize offgas time.

.3 Where sealants are qualified with primers use only these primers.

.4 Standard: For interior and exterior work unless otherwise specified, ensure compatibility of sealants being used and other materials in contact with them, meet VOC level of 250 g/L for architectural sealant.

2.2 SEALANT TYPE

.1 S-1:
- .1 ASTM C920, polyurethane or polysulfide.
- .2 Type M.
- .3 Class 25.
- .4 Grade NS.
- .5 Shore A hardness of 20-40.

.2 S-2:
- .1 ASTM C920, polyurethane or polysulfide.
- .2 Type M.
- .3 Class 25.
- .4 Grade P.
- .5 Shore A hardness of 25-40.

.3 S-3:
- .1 ASTM C920, polyurethane or polysulfide.
- .2 Type S.
- .3 Class 25, joint movement range of plus or minus 50 percent.
- .4 Grade NS.
- .5 Shore A hardness of 15-25.
- .6 Minimum elongation of 700 percent.

.4 S-4:
- .1 ASTM C920, polyurethane or polysulfide.
- .2 Type M.
- .3 Class 25,
- .4 Grade NS.
- .5 Shore A hardness of 25-40.

.5 S-5:
- .1 ASTM C920, polyurethane or polysulfide.

.2 Type M.
.3 Class 25.
.4 Grade P.
.5 Shore A hardness of 25-40.

.6 S-6:
.1 ASTM C920, silicone, neutral cure.
.2 Type S.
.3 Class: Joint movement range of plus 100 percent to minus 50 percent.
.4 Grade NS.
.5 Shore A hardness of 15-20.
.6 Minimum elongation of 1200 percent.

.7 S-7:
.1 ASTM C920, silicone, neutral cure.
.2 Type S.
.3 Class 25.
.4 Grade NS.
.5 Shore A hardness of 25-30.
.6 Structural glazing application.

.8 S-8:
.1 ASTM C920, silicone, acetoxy cure.
.2 Type S.
.3 Class 25.
.4 Grade NS.
.5 Shore A hardness of 25-30.
.6 Structural glazing application.

.9 S-9:
.1 ASTM C920, silicone.
.2 Type S.
.3 Class 25.
.4 Grade NS.
.5 Shore A hardness of 25-30.
.6 Non-yellowing, mildew resistant.

.10 S-10:
.1 ASTM C920, coal tar extended fuel resistance polyurethane.
.2 Type M/S.
.3 Class 25.
.4 Grade P/NS.
.5 Shore A hardness of 15-20.

.11 S-11:
.1 ASTM C920, polyurethane.
.2 Type M/S.
.3 Class 25.
.4 Grade P/NS.
.5 Shore A hardness of 35-50.
.6 Structural glazing application.

.12 S-12:
- .1 ASTM C920, polyurethane.
- .2 Type M/S.
- .3 Class 25, joint movement range of plus or minus 50 percent.
- .4 Grade P/NS.
- .5 Shore A hardness of 25-50.

2.3 CAULKING COMPOUND

.1 C-1: ASTM C834, acrylic latex.

.2 C-2: One component acoustical caulking, non-drying, non hardening, synthetic rubber.

2.4 JOINT CLEANER

.1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.

.2 Primer: as recommended by manufacturer.

3.0 EXECUTION

3.1 PROTECTION

.1 Protect installed Work of other trades from staining or contamination.

3.2 SURFACE PREPARATION

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

.1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.6 APPLICATION

.1 Sealant.

.1 Apply sealant in accordance with manufacturer's written instructions and ASTM C919.

.2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.

.3 Apply sealant in continuous beads.

.4 Apply sealant using gun with proper size nozzle.

.5 Use sufficient pressure to fill voids and joints solid.

.6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.7 Tool exposed surfaces before skinning begins to give slightly concave shape.

.8 Remove excess compound promptly as work progresses and upon completion.

.2 Curing.

.1 Cure sealants in accordance with sealant manufacturer's instructions.

.2 Do not cover up sealants until proper curing has taken place.

.3 Cleanup.

.1 Clean adjacent surfaces immediately and leave Work neat and clean.

.2 Remove excess and droppings, using recommended cleaners as work progresses.

.3 Remove masking tape after initial set of sealant.

3.7 CLEANING

.1 Clean adjacent surfaces immediately and leave work clean and neat. Remove excess sealant and droppings using recommended cleaners as work progresses. Remove masking after tooling of joints.

3.8 LOCATIONS

.1 Exterior Building Joints, Horizontal and Vertical:

.1 Metal to Metal: Type S-1, S-2.

.2 Metal to Masonry or Stone: Type S-1.

.3 Masonry to Masonry or Stone: Type S-1.

.4 Threshold Setting Bed: Type S-1, S-3, S-4.

.5 Masonry Expansion and Control Joints: Type S-6

.2 Metal Reglets and Flashings:

.1 Flashings to Wall: Type S-6.

.2 Metal to Metal: Type S-6.

.3 Sanitary Joints:

.1 Pipe Penetrations: Type S-12.

.4 Interior Caulking:

.1 Typical Narrow Joint 6mm, (1/4 inch) or less at Walls and Adjacent Components: Type C-1 and C-2.

.2 Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Exterior Walls: Types C-1 and C-2.

.3 Joints at Masonry Walls and Columns, Piers, Concrete Walls or Exterior Walls: Types C-1 and C-2.

.4 Expose Isolation Joints at Top of Full Height Walls: Types C-1 and C-2.

.5 Exposed Acoustical Joint at Sound Rated Partitions Type C-2.

.6 Concealed Acoustic Sealant Types S-4, C-1 and C-2.

END OF SECTION 07 92 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1	Cast in Place Concrete	Section 03 30 00
.2	Brick Masonry	Section 04 21 13
.3	Metal Fabrication	Section 05 50 00
.4	Sheet Metal and Trim	Section 07 62 00
.5	Joint Sealant	Section 07 92 00

1.2 WORK INCLUDED

.1 The work shall consist of furnishing and installing waterproof expansion joints in accordance with the details shown on the plans and the requirements of the specifications. Preformed sealant shall be silicone pre-coated, preformed, pre-compressed, self-expanding, sealant system.

1.3 SUBMITTALS

.1 Submit the following according to Section 01 33 00 – Submittal Procedures.

.2 Standard Submittal Package – Submit typical expansion joint drawing(s) indicating pertinent dimensions, general construction, expansion joint opening dimensions and product information.

.3 Submit 150mm long sample of each type of sealant system.

.4 All products must be certified by independent laboratory test report to exceed the requirements of curtain wall performance tests ASTM E330, E283-04, and E331. Product must meet or exceed hurricane-force wind loading with no deflection at both positive and negative pressures up to 4954 Pascals—equal to 200 mph winds (ASTM E330-02-procedure A).

.5 All products must be certified by independent laboratory test report to ASTM E90-09 and to meet or exceed an STC 52 in STC 56 wall and OITC 38 rating in an OITC 38 wall.

.6 All products must be certified by independent laboratory test report to be free in composition of any waxes or wax compounds using FTIR and DSC testing.

.7 All products shall be certified in writing to be: a) capable of withstanding 150°F (65°C) for 3 hours while compressed down to the minimum of movement capability dimension of the basis of design product (-50% of nominal material size) without evidence of any bleeding of impregnation medium from the material; and b) that the same material after the heat stability test and after first being cooled to room temperature will subsequently self-expand to the maximum of movement capability dimension of the basis-of-design product (+50% of nominal material size) within 24 hours at room temperature 68°F (20°C).

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Deliver products to site in Manufacturer's original, intact, labeled containers. Handle and protect as necessary to prevent damage or deterioration during shipment, handling and storage. Store in accordance with manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

.1 The General Contractor will conduct a pre-construction meeting with all parties and trades involved

in the treatment of work at and around expansion joints including, but not limited to, concrete, masonry, and other finish trade subcontractors. All superintendents and foremen with responsibility for oversight and setting of the joint gap must attend this meeting. The General Contractor is responsible to coordinate and schedule all trades and ensure that all subcontractors understand their responsibilities in relation to expansion joints and that their work cannot impede anticipated structural movement at the expansion joints, or compromise the achievement of watertighness or life safety at expansion joints in any way.

.2 Warranty- Manufacturer's standard warranty shall apply.

2.0 PRODUCTS

2.1 GENERAL

.1 Provide watertight, energy-efficient exterior joints in vertical-plane walls and above-grade horizontal concrete platform. Locations are interfaces between new and old buildings at seismic structural expansion joints.

.2 Preformed sealant shall be silicone pre-coated, preformed, pre-compressed, self-expanding, sealant system. Expanding foam to be cellular foam impregnated with a water-based, non-drying, 100% acrylic dispersion. Seal shall combine factory-applied, low-modulus silicone and a backing of acrylic-impregnated expanding foam into a unified hybrid sealant system.

.3 Material shall be capable of movements of +50%, -50% (100% total) of nominal material size

.4 Silicone external color facing to be factory-applied to the foam while it is partially pre-compressed to a width greater than maximum joint extension and cured before final compression. When compressed to final supplied dimension, a bellow(s) to handle movement must be created in the silicone coating. Silicone coating color to be coordinated with typical building materials. Color to be selected from manufacturer's standard color.

.5 Select the sealant system model appropriate to the movement and design requirements at each joint location that meet the specification and details in drawings.

.6 Manufacturer's Checklist must be completed by expansion joint subcontractor and returned to manufacturer at time of ordering material.

2.2 FABRICATION

.1 Sealant System must be supplied precompressed to less than the joint size, packaged in shrink-wrapped lengths (sticks) with a mounting adhesive on one face.

.2 Directional changes and terminations into horizontal plane surfaces to be provided by factory-manufactured universal-90-degree single units containing minimum 300mm long leg and 150mm long leg or custom leg on each side of the direction change or through field fabrication in strict accordance with installation instructions.

3.0 EXECUTION

3.1 INSTALLATION

.1 Preparation of the work area:

.1 The contractor shall provide a properly formed and prepared expansion joint openings constructed to the exact dimensions and elevations shown on manufacturer's standard system drawings or as shown on the contract drawings. Deviations from these dimensions

will not be allowed without the written consent of the engineer of record.

.2 The contractor shall clean the joint opening of all contaminants immediately prior to installation of expansion joint system. Repair spalled, irregular or unsound joint surfaces using accepted industry practices for repair of the substrates in question. Remove protruding roughness to ensure joint sides are smooth. Ensure that there is sufficient depth to receive the full depth of the size of the Sealant System being installed plus at least 6mm for the application of corner beads. Refer to Manufacturers Installation Guide for detailed step-by-step instructions.

.3 No drilling, or screwing, or fasteners of any type are permitted to anchor the sealant system into the substrate.

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION 07 95 10

1 .0 GENERAL

1.1 RELATED REQUIREMENTS

.1	Cast in Place Concrete	Section 03 30 00
.2	Modified Bituminous Sheet Waterproofing	Section 07 13 52
.3	Joint Sealants	Section 07 92 00

1.2 WORK INCLUDED

.1 The work shall consist of furnishing and installing waterproof expansion joints in accordance with the details shown on the plans and the requirements of the specifications. Preformed sealant shall be silicone pre-coated, pre-compressed, self-expanding, sealant system.

1.3 SUBMITTALS

.1 Submit the following according to Section 01 33 00 – Submittal Procedures.

.2 Standard Submittal Package – Submit typical expansion joint drawing(s) indicating pertinent dimensions, general construction, expansion joint opening dimensions and product information.

.3 Sample of material is required at time of submittal.

.4 All products must be certified by independent laboratory test report to be free in composition of any waxes or wax compounds using FTIR and DSC testing.

.5 All products must be certified by independent laboratory test report to ASTM E90-09 and to meet or exceed an STC 52 in STC 56 wall and OITC 38 rating in an OITC 38 wall.

.6 All products shall be certified in writing to be: a) capable of withstanding 150°F (65°C) for 3 hours while compressed down to the minimum of movement capability dimension of the basis of design product (-25% of nominal material size) without evidence of any bleeding of impregnation medium from the material; and b) that the same material after the heat stability test and after first being cooled to room temperature will subsequently self-expand to the maximum of movement capability dimension of the basis-of-design product (+30% of nominal material size) within 24 hours at room temperature 68°F (20°C).

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Deliver products to site in Manufacturer's original, intact, labeled containers. Handle and protect as necessary to prevent damage or deterioration during shipment, handling and storage. Store in accordance with manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

.1 The General Contractor will conduct a pre-construction meeting with all parties and trades involved in the treatment of work at and around expansion joints including, but not limited to, concrete, waterproofing and other finish trade subcontractors. All superintendents and foremen with responsibility for oversight and setting of the joint gap must attend this meeting. The General Contractor is responsible to coordinate and schedule all trades and ensure that all subcontractors understand their responsibilities in relation to expansion joints and that their work cannot impede anticipated structural movement at the expansion joints, or compromise the achievement of watertightness or life safety at expansion joints in any way.

.2 Warranty- Manufacturer's standard warranty shall apply.

2.0 PRODUCTS

2.1 GENERAL

.1 Provide watertight expansion joint by the Systems for the seismic separations in below grade wall, between the new building and existing basement or footings as indicated in drawings.

.2 Sealant system shall be comprised of three components: 1) cellular polyurethane foam impregnated with hydrophobic 100% acrylic, water-based emulsion, factory coated on both faces with water-resistant silicone; 2) field-applied epoxy adhesive primer, 3) field-injected silicone sealant bands.

.3 Material shall be capable as of movements of +30%, -25% (55% total) of nominal material size. Standard sizes from 12mm to 300mm. Depth of seal as recommended by manufacturer or customized as shown on details.

.4 Silicone coating to be water/moisture resistant silicone applied to the impregnated foam sealant at a width greater than maximum allowable joint extension and which when cured and compressed will form a bellows on two faces.

.5 Sealant System to be installed into manufacturer's standard field-applied epoxy adhesive.

.6 Sealant System is to be installed slightly recessed from the surface such that when the field-applied injection band of silicone is installed between the substrates and the foam-and-silicone-bellows, the system will be essentially flush with the substrate surface.

.7 Select the sealant system model appropriate to the movement and design requirements at each joint location that meet the project specification or as shown in drawing.

.8 Manufacturer's Checklist must be completed by expansion joint subcontractor and returned to manufacturer at time of ordering material.

2.2 FABRICATION

.1 Sealant System must be supplied precompressed to less than the joint size, packaged in shrink-wrapped lengths (sticks).

.2 Directional changes and terminations into horizontal plane surfaces to be provided by factory-manufactured universal-90-degree single units containing minimum 300mm long leg and 150mm long leg or custom leg on each side of the direction change or through field fabrication in strict accordance with installation instructions.

3.0 EXECUTION

3.1 INSTALLATION

.1 Preparation of the work area:

.1 The contractor shall provide properly formed and prepared expansion joint openings constructed to the exact dimensions and elevations shown on manufacturer's standard system drawings or as shown on the contract drawings. Deviations from these dimensions will not be allowed without the written consent of the engineer of record

.2 The contractor shall clean the joint opening of all contaminants immediately prior to installation of expansion joint system. Repair spalled, irregular or unsound joint surfaces using accepted industry practices for repair of the substrates in question. Remove protruding roughness to ensure joint sides are smooth. Ensure that there is sufficient depth to receive the full depth of the size of the Sealant System being installed. Refer to Manufacturers

Installation Guide for detailed step-by-step instructions.

.3 No drilling, or screwing, or fasteners of any type are permitted to anchor the sealant system into the substrate.

.4 System to be installed by qualified sub-contractors only according to detailed published installation procedures and/or in accordance with job-specific installation instructions of manufacturer's field technician.

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION 07 95 20

DOOR SCHEDULE

DOOR							FRAME				RATING	REMARKS	LOCATION
No.	Door W (mm)	Opening H (mm)	Type	Mat'l	Finish	Glass Type	Type	Mat'l	Finish	Glass Type			
100A	1220 + 1830	3050	D3	HM	PTD	-	F1	PSS	PTD	-	-	#1, #5,, #6, #7	ELECTRICAL ROOM
100B	915	2134	D1	HM	PTD	-	F1	PSS	PTD	-	1 hr	#1, #5, #7	ELECRICAL ROOM
101	915	2134	D1	HM	PTD	-	F1	PSS	PTD	-	45 min	#1, #5, #7	COMMUNICATION ROOM
102A	915	2134	D2	HM	PTD	WG	P1	PSS	PTD	-	-	-	STAIR 1
102B	915	2134	D1	HM	PTD	-	F1	PSS	PTD	-	-	#1, #5, #7	STAIR 1
200A	1220 + 1830	3050	D3	HM	PTD	-	F1	PSS	PTD	-	-	#1, #6, #7	ELECTRICAL ROOM
200B	915	2134	D1	HM	PTD	-	F1	PSS	PTD	-	45 min	#1, #4, #5	ELECRICAL ROOM
200C	915	2134	D1	HM	PTD	-	F1	PSS	PTD	-	-	#1, #5, #7	ELECTRICAL ROOM

LEGEND

AL	ALUMINUM
CG	CLEAR GLASS
FTG	FROST FILMED TEMPERED GLASS
ITG	INSULATED TEMPERED GLASS UNIT
HM	HOLLOW METAL
PSS	PRESSED STEEL FRAME
PTD	PAINT FINISH
TG	TEMPERED GLASS
WD	SOLID CORE WOOD
WG	GEORGIAN WIRED GLASS
STN	STAINED/CLEAR VARNISHED

Remarks

#1	Refer Exterior Elevation drawings
#2	Provide ¾" door undercut
#3	Refer detail drawings
#4	Insulated Acoustic Door with acoustic seal
#5	Card access
#6	Oversized door with door casters to support weight of door
#7	Insulated Exterior Door

END OF SECTION 08 06 10

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1	Rough Carpentry for Minor Works	Section 06 08 99
.2	Finish Carpentry	Section 06 20 00
.3	Door Hardware	Section 08 71 00
.4	Glazing	Section 08 80 50
.5	Interior Painting	Section 09 91 23

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.

.2 Canadian Standards Association (CSA International)
- .1 CSA-G40.20-04/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CSA W59-03, Welded Steel Construction (Metal Arc Welding).

.3 Canadian Steel Door Manufacturers' Association (CSDMA)
- .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000.
- .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990.

.4 National Fire Protection Association (NFPA)
- .1 NFPA 80-2007, Standard for Fire Doors and Fire Windows.
- .2 NFPA 252-2012, Standard Methods of Fire Tests of Door Assemblies.

.5 South Coast Air Quality Management District (SCAQMD), California State
- .1 SCAQMD Rule 1113-04, Architectural Coatings.
- .2 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

.6 Underwriters' Laboratories of Canada (ULC)
- .1 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .2 CAN/ULC-S702-09, Standard for Thermal Insulation, Mineral Fibre, for Buildings.
- .3 CAN/ULC-S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- .4 CAN4-S104-M80, Standard Method for Fire Tests of Door Assemblies.
- .5 CAN4-S105-M85, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104.

1.3 SYSTEM DESCRIPTION

.1 Design Requirements:
- .1 Provide fire labeled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104, and listed by nationally recognized agency having factory inspection services and to ULC fire protection rating.

1.4 SUBMITTALS

.1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

.1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, arrangement of hardware and fire rating and finishes.

.2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and finishes.

.3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

2.0 PRODUCTS

2.1 MATERIALS

.1 Hot dipped galvanized steel sheet: to ASTM A 653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.

.2 Reinforcement to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A 653M, ZF75.

.3 Exterior and Interior Door and Window Frames: 16ga typical, 12ga for oversized door frame

2.2 DOOR CORE MATERIALS

.1 Honeycomb construction:

.1 Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m³ minimum sanded to required thickness.

.2 Stiffened: doors to be reinforced with 0.8mm (20 gauge) hat shaped steel stiffeners welded to inside of face sheets. Stiffeners to be located a maximum 152mm (6”) on center and welded to face sheet on 100mm(4”) centers. Areas between stiffeners to be filled with fiberglass insulation.

.3 All exterior doors and acoustic doors are to be insulated.

4. Oversize double door at both SES and PHS to be constructed of hollow steel, vertically stiffened with minimum of 0.91mm galvanized steel interlocking “z” or “top hat” shaped stiffeners welded at 150mm O/C. Weld front skin stiffeners offset to allow for 3mm clearance of bottom stiffeners. Weld shaped stiffeners to back skin and mechanically interlock with top stiffeners. Form bottom stiffener to fill full thickness of door. Depth of stiffener to be 41mm. Offset stiffener in door core a mimimum of 75mm. Fill all voids with fibrous batt insulation.

2.3 ADHESIVES

.1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.

.1 Adhesive: maximum VOC content 50 g/L to SCAQMD Rule 1168.

.2 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, and

sealant/adhesive.

2.4 PRIMER

.1 Touch-up prime CAN/CGSB-1.181.

.1 Maximum VOC limit 50 g/L to GC-03.

2.5 PAINT

.1 Field paint steel doors and frames in accordance with Sections 09 91 13 – Exterior Painting and 09 91 23 - Interior Painting. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.

.1 Maximum VOC emission level 50 g/L to GS-11 to SCAQMD Rule 1113.

2.6 ACCESSORIES

.1 Door silencers: single stud rubber/neoprene type.

.2 Exterior and interior top and bottom caps: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.

.3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.

.4 Metallic paste filler: to manufacturer's standard.

.5 Fire labels: metal riveted.

.6 Sealant:

.1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.

.7 Glazing: Refer to Section 08 80 50.

.8 Make provisions for glazing as indicated and provide necessary glazing stops.

.1 Provide removable steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screws.

.2 Design exterior glazing stops to be tamperproof.

2.7 FRAMES FABRICATION GENERAL

.1 Fabricate frames in accordance with CSDMA specifications.

.2 Fabricate frames to profiles and maximum face sizes as indicated.

.3 Interior frames: 1.2 mm welded type construction.

.4 Blank, reinforce, drill and tap frames for mortised, templated hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.

.5 Prepare frame for door silencers, 3 for single door, 2 at head for double door.

.6 Manufacturer's nameplates on frames and screens are not permitted.

.7 Conceal fastenings except where exposed fastenings are indicated.

.8 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

2.8 FRAME ANCHORAGE

.1 Provide appropriate anchorage to floor and wall construction.

.2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.

.3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.

2.9 FRAMES: WELDED TYPE

.1 Welding in accordance with CSA W59.

.2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.

.3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.

.4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.

.5 Securely attach floor anchors to inside of each jamb profile.

.6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.10 DOOR FABRICATION GENERAL

.1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.

.2 Fabricate doors with longitudinal edges welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.

.3 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.

.4 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.

.5 Reinforce doors where required, for surface mounted hardware. Provide flush steel top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.

.6 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

.7 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

.8 Manufacturer's nameplates on doors are not permitted.

2.13 DOORS: HONEYCOMB CORE CONSTRUCTION

.1 Form face sheets for exterior and interior doors from 1.2 mm sheet steel with honeycomb or laminated under pressure to face sheets.

2.14 HOLLOW STEEL CONSTRUCTION

.1 Form face sheets for interior doors from 1.2mm sheet steel.

.2 Reinforce doors with vertical stiffeners, securely welded to face sheets at 150 mm on centre maximum.

.3 Fill voids between stiffeners of interior doors with honeycomb core.

3.0 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION GENERAL

.1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.

.2 Install doors and frames to CSDMA Installation Guide.

3.3 FRAME INSTALLATION

.1 Set frames plumb, square, level and at correct elevation.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.5 Caulk perimeter of frames between frame and adjacent material.

.6 Maintain continuity of air barrier and vapour retarder.

3.4 DOOR INSTALLATION

.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.

.2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.

.1 Hinge side: 1.0 mm.
.2 Latchside and head: 1.5 mm.
.3 Finished floor: 13 mm.

.3 Adjust operable parts for correct function.

.4 Install window.

3.5 FINISH REPAIRS

.1 Touch up with primer finishes damaged during installation.

.2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.6 GLAZING

.1 Install glazing for doors and frames in accordance with Section 08 80 50 - Glazing.

END OF SECTION 08 11 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1	Concrete Unit Masonry	Section 04 22 00
.2	Brick Masonry	Section 04 21 13
.3	Thermal Insulation	Section 07 21 00
.4	Air Barriers Descriptive or Proprietary	Section 07 27 00.01
.5	Metal Wall Panels	Section 07 42 13

1.2 REFERENCES

.1 Aluminum Association (AA)
- .1 Designation System for Aluminum Finishes (2003).

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.40-97, Anticorrosive Structural Steel Alkyd Primer.
- .2 CAN/CGSB-79.1-M91, Insect Screens.

.3 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
- .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
- .2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

.4 BC Energy Efficiency Act.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for windows and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada.
- .2 Indicate materials and details in full size scale for head, jamb and sill, profiles of components, interior and exterior trim junction between combination units elevations of unit, anchorage details,location of isolation coating, description of related components and exposed finishes fasteners, and caulking. Indicate location of manufacturer's nameplates.

.4 Samples:
- .1 AAMA/WDMA/CSA 101/I.S.2/A440.

.5 Performance Requirement:
- .1 Air Infiltration: The test specimen shall be tested in accordance with ASTM E 283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen. Air infiltration rate shall not exceed 0.06 cfm/ft^2 (0.3 l/s m^2) at a static air pressure differential of

6.24 psf (300Pa).

.2 Water Resistance (static): The test specimen shall be tested in accordance with ASTM E 331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference. There shall be no leakage at a static air pressure differential of 12 psf (575 Pa) as defined in AAMA 501.

.3 Uniform Load: ASTM E 330 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference. Requirements for this should be confirmed with the glazing systems structural engineer.

.6 Construction Waste Management:

.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

.7 Low-Emitting Materials:

.1 Submit listing of sealants used in building, comply with VOC and chemical component limits or restriction requirements.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for windows for incorporation into manual.

1.5 QUALITY ASSURANCE

.1 Certifications: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.2 Manufacturer qualifications: company specializing in manufacturing the products specified in this section with minimum 10 years documented experience.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect windows from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in 01 74 19 – Waste Management and Disposal.

2.0 PRODUCTS

2.1 MATERIALS

.1 Materials: to AAMA/WDMA/CSA 101/I.S.2/A440 supplemented as follows:

.2 All windows by same manufacturer.

.3 Sash: aluminum thermally broken.

.4 Main frame: aluminum thermally broken.

.5 Isolation coating: alkali resistant bituminous paint.

.6 Sealants: Refer to Section 07 92 00 Joint Sealants

2.2 WINDOW TYPE AND CLASSIFICATION

.1 Types:
.1 Fixed: with removable double glazing insulating glass.

.2 Classification rating: to CSA-A440/A440.1.
.1 Air tightness: A3.
.2 Water tightness: B7.
.3 Wind load resistance: C5.

2.3 FABRICATION

.1 Fabricate in accordance with CSA-A440/A440.1 supplemented as follows:

.2 Fabricate units square and true with maximum tolerance of plus or minus 1.5 mm for units with a diagonal measurement of 1800 mm or less and plus or minus 3 mm for units with a diagonal measurement over 1800 mm.

.3 Face dimensions detailed are maximum permissible sizes.

.4 Brace frames to maintain squareness and rigidity during shipment and installation.

.5 Finish steel clips and reinforcement with shop coat primer to CAN/CGSB-1.40 380 g/m² zinc coating to ASTM A 123/A 123M.

2.4 ALUMINUM FINISHES

.1 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes.
.1 Clear anodic finish: designation AA-MI2C22A1, class 1, minimum 14.

2.5 ISOLATION COATING

.1 Primers: in accordance with manufacturer's recommendations for surface conditions.
.1 Primer: VOC limit 100 g/L maximum.

.2 Isolate aluminum from following components, by means of isolation coating:
.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
.2 Concrete, mortar and masonry.
.3 Wood.

2.6 GLAZING

.1 Glaze windows in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.
.1 Refer to Section 08 80 50 for exterior insulated glass.

2.7 AIR BARRIER AND VAPOUR RETARDER

.1 Equip window frames with site installed air barrier and vapour retarder material for sealing to building air barrier and vapour retarder as follows:

.1 Material: identical to, or compatible with, building air barrier and vapour retarder materials to provide required air tightness and vapour diffusion control throughout exterior envelope assembly.
.2 Material width: adequate to provide required air tightness and vapour diffusion control to building air barrier and vapour retarder from interior.

3.0 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.
  .1 Visually inspect substrate in presence of Departmental Representative .
  .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative .

3.2 INSTALLATION

.1 Window installation:
  .1 Install in accordance with CSA A440.4
  .2 Arrange components to prevent abrupt variation in colour.

.2 Sill installation:
  .1 Install metal sills with uniform wash to exterior, level in length, straight in alignment with plumb upstands and faces.
  .2 Cut sills to fit window opening.
  .3 Secure sills in place with anchoring devices located at ends joints of continuous sills and evenly spaced 600 mm on centre in between.
  .4 Fasten expansion joint cover plates and drip deflectors with self-tapping stainless steel screws.
  .5 Maintain 6 to 9 mm space between butt ends of continuous sills. For sills over 1200 mm in length, maintain 3 to 6 mm space at each end.

.3 Caulking:
  .1 Seal joints between windows and window sills with sealant. Bed sill expansion joint cover plates and drip deflectors in bedding compound. Caulk between sill upstand and window-frame. Caulk butt joints in continuous sills.
  .2 Apply sealant in accordance with Section 07 92 00 - Joint Sealants. Conceal sealant within window units except where exposed use is permitted by Departmental Representative.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management 01 74 19 Waste Management and Disposal.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by window installation.

END OF SECTION 08 50 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Finish Carpentry Section 06 20 00

.2 Metal Doors & Frames Section 08 11 00

.3 Electrical Division 26

.4 Electronic Safety and Security Division 28

1.2 REFERENCES

.1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)

- .1 ANSI/BHMA A156.1- 2000, American National Standard for Butts and Hinges.
- .2 ANSI/BHMA A156.2- 2003, Bored and Preassembled Locks and Latches.
- .3 ANSI/BHMA A156.3- 2001, Exit Devices.
- .4 ANSI/BHMA A156.4- 2000, Door Controls - Closers.
- .5 ANSI/BHMA A156.5- 2001, Auxiliary Locks and Associated Products.
- .6 ANSI/BHMA A156.6- 2005, Architectural Door Trim.
- .7 ANSI/BHMA A156.8- 2005, Door Controls - Overhead Stops and Holders.
- .8 ANSI/BHMA A156.12- 2005, Interconnected Locks and Latches.
- .9 ANSI/BHMA A156.13- 2002, Mortise Locks and Latches Series 1000.
- .10 ANSI/BHMA A156.15- 2006, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
- .11 ANSI/BHMA A156.16- 2002, Auxiliary Hardware.
- .12 ANSI/BHMA A156.17- 2004, Self-closing Hinges and Pivots.
- .13 ANSI/BHMA A156.18- 2006, Materials and Finishes.
- .14 ANSI/BHMA A156.20- 2006, Strap and Tee Hinges and Hasps.

.2 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)

- .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

1.3 HARDWARE/SECURITY COORDINATION

.1 Prior to preparation and submittal of hardware list, door hardware supplier’s hardware consultant shall arrange a coordination meeting with the following attendees:

- .1 Hardware supplier’s hardware consultant.
- .2 Facility’s Building Maintenance Manager.
- .3 Departmental Representative.
- .4 General Contractor.

.2 The final door hardware lists shall reflect all decisions made at said coordination meeting.

1.4 ACTION & INFORMAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Samples:
.1 Submit for review and acceptance of each unit.
.2 Samples will be returned for inclusion into work.
.3 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
.4 After approval samples will be returned for incorporation in Work.

.4 Hardware List:
.1 Submit contract hardware list.
.2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.

.5 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.5 CLOSEOUT SUBMITTALS
.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for door hardware for incorporation into manual.

1.6 MAINTENANCE MATERIALS SUBMITTALS
.1 Extra Stock Materials:
.1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
.2 Tools:
.1 Supply 2 sets of wrenches for door closers, locksets, and fire exit hardware.

1.7 QUALITY ASSURANCE
.1 Regulatory Requirements:
.1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.8 DELIVERY, STORAGE & HANDLING
.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

.4 Storage and Handling Requirements:
.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect door hardware from nicks, scratches, and blemishes.

.3 Protect prefinished surfaces with wrapping strippable coating.
.4 Replace defective or damaged materials with new.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal

1.9 REDUNDANT LOCKSETS

.1 Where existing and other lock-bearing devices are to be removed and disposed of: turn-over to Departmental Representative and obtain receipt. In order to maintain building keying security, no existing locksets are to be removed from building.

2.0 PRODUCTS

2.1 HARDWARE ITEMS

.1 Use one manufacturer's products only for similar items.

2.2 DOOR HARDWARE

.1 Locks and latches:
.1 Mortise locks and latches: to ANSI/BHMA A156.13, series 1000 mortise lock, grade 1, designed for function and keyed as stated in Hardware Schedule.
.2 Lever handles: plain 64mm x 114mm x 51mm design.
.3 Roses: round
.4 Normal strikes: box type, lip projection not beyond jamb.
.5 Cylinders: key into keying system as noted as directed.
.6 Finished to 652, 626 & 630.
.7 6 pin (or7) tumbler keying to Maintenance’s Master System.

.2 Butts and hinges:
.1 Butts and hinges: to ANSI/BHMA A156.1, designated by letter A and numeral identifiers, followed by size and finish, listed in Hardware Schedule.

.3 Exit devices: to ANSI/BHMA A156.3, type & function as listed, grade (1)
.1 Auxiliary items: door coordinator.

.4 Door Closers and Accessories:
.1 Door controls (closers): to ANSI/BHMA A156.4, listed in Hardware Schedule, multi-sized sized 1 to though 6 in accordance with ANSI/BHMA A156.4, table A1, finished to 689.
.2 Door controls - overhead holders: to ANSI/BHMA A156.8, designated by letter C and numeral identifiers listed in Hardware Schedule, finished to 626.
.3 Closer/holder release devices: to ANSI/BHMA listed in hardware schedule, finished to 689.
.4 Door co-ordinator: surface for pairs of doors with overlapping astragal.
.5 Magnetic holder floor or wall mounted release on fire alarm: finished to 689.

.5 Auxiliary locks and associated products: to ANSI/BHMA A156.5, numeral identifiers listed in Hardware Schedule, finished to 626.
.1 Cylinders: type as listed, finished to 626, for installation in deadlocks provided with special doors as listed in Hardware Schedule. Key into keying system [as noted] [as directed].

.6 Architectural door trim: to ANSI/BHMA A156.6, designated by letter J and numeral identifiers listed in Hardware Schedule as listed below, finished to 626 or 630.
.1 Architectural door trim: to ANSI/BHMA A156.6, listed in Hardware Schedule as listed below,

finished to 626 or 630

.2 Door protection plates: kick plate type as listed, 1.27 mm thick stainless steel 1 edges, finished to 630.

.3 Push plates: type as listed, 1.27 mm thick stainless steel 1 edge, as listed, finished to 630.

.4 Push/Pull units: type as listed, finished to 630.

.7 Auxiliary hardware: to ANSI/BHMA A156.16, listed in Hardware Schedule finished to 626 or 630.

.8 Door bottom seal: heavy duty, door seal of extruded aluminum frame and solid closed cell neoprene weather seal, recessed in door bottom surface mounted recessed in door face, closed ends, adjustable automatic retract mechanism when door is open, clear anodized finish.

.9 Thresholds: 127mm wide x full width of door opening, extruded aluminum mill finish, serrated surface, with lip and vinyl door seal insert.

.10 Weatherstripping:

.1 Head and jamb seal:

.1 Adhesive backed neoprene vinyl covered foam material.

.2 Door bottom seal:

.1 Extruded aluminum frame and [closed cell neoprene vinyl sweep, clear anodized finish.

.11 Astragal: overlapping, Primed steel meeting stiles Pile.

.12 Electric Strikes

.1 Weatherproof type includes all accessories, transformer and housing. Conduit by Division 26, connection by Division 28.

2.3 MISCELLANEOUS HARDWARE

.1 Indexed key control system: to ANSI/BHMA A156.5, designated by letter E and numeral identifiers, wall mounted, type 50% expandable colour enamel paint finish.

2.4 FASTENINGS

.1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.

.2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.

.3 Exposed fastening devices to match finish of hardware.

.4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.

.5 Use fasteners compatible with material through which they pass.

2.5 KEYING

.1 Doors, padlocks and cabinet locks to be keyed to grand master keyed as directed and as noted in Hardware Schedule. Prepare detailed keying schedule in conjunction with Departmental

Representative.

.2 Supply (five) 5 master keys for each master key or grand master key group.

.3 Supply 5 keys for each lock.

.4 Stamp keying code numbers on keys and cylinders.

.5 Supply construction cores.

.6 Hand over permanent cores and keys to Departmental Representative.

2.6 KEYS

.1 Use standard construction cylinders for locks for Contractor's use during the construction period.

.2 Issue instructions to employees and sub-trades, as necessary, to ensure safe custody of the construction set of keys.

.3 Upon completion of construction, Departmental Representative will, in conjunction with the lock manager:
- .1 Prepare an operational keying schedule.
- .2 Accept the operational keys and cylinders directly from the lock manufacturer.
- .3 Arrange for removal and return of the construction cores.

2.7 ADDITIONAL DOOR HARDWARE SCHEDULED ELSEWHERE

.1 Refer to Division 28- Electronic Safety and Security, for additional door items including, but not limited to the following:
- .1 Access and intrusion control panels.
- .2 Card readers.
- .3 Door Contacts.
- .4 Intrusion detection.

.2 Refer to Division 26-Electrical for all wiring and conduit for above items.

3.0 EXECUTION

3.1 INSTALLATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

.3 Supply manufacturers' instructions for proper installation of each hardware component.

.4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction.

.5 Where door stop contacts door pulls, mount stop to strike bottom of pull.

.6 Use only manufacturer's supplied fasteners.

.1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.

.7 Remove construction cores locks when directed by Departmental Representative.
.1 Install permanent cores and ensure locks operate correctly.

3.2 ADJUSTING
.1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.

.2 Lubricate hardware, operating equipment and other moving parts.

.3 Adjust door hardware to ensure tight fit at contact points with frames.

3.3 CLEANING
.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day.
.2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
.3 Remove protective material from hardware items where present.
.4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

3.4 DEMONSTRATION
.1 Keying System Setup and Cabinet:
.1 Set up key control system with file key tags, duplicate key tags, numerical index, alphabetical index and key change index, label shields, control book and key receipt cards.
.2 Place file keys and duplicate keys in key cabinet on their respective hooks and turn over to Departmental Representative.

.2 Maintenance Staff Briefing:
.1 Brief maintenance staff regarding:
.1 Proper care, cleaning, and general maintenance of projects complete hardware.
.2 Description, use, handling, and storage of keys.
.3 Use, application and storage of wrenches for door closers locksets.

.3 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.5 PROTECTION
.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by door hardware installation.

3.6 FINISH HARDWARE SCHEDULE
1 Double Doors 100A:
.1 2 Set Pivots A1
.2 7 Ea Pivots A2
.3 1 Ea Pivots A5
.4 1 Ea. Spring bolt F3

.5 1 Ea. Cane bolt F4
.6 1 Ea. Lock set B3
.7 1 Ea. Cylinder B1
.8 1 Ea. Electric strike F7
.9 2 Ea. Floor stop F5
.10 1 Ea. Threshold M1
.11 2 Ea. Door sweep M8
.12 1 Set Seals M3
.13 1 Set Astragal M4
.14 Notes: H1

.2 Double Doors 200A:
.1 2 Set Pivots A1
.2 8 Ea Pivots A2
.3 1 Ea. Spring bolt F3
.4 1 Ea. Cane bolt F4
.5 1 Ea. Lock set B4 (Install on inside)
.6 1 Ea. Cylinder B1
.7 1 Ea. Overhead stop F2
.8 1 Ea. Floor stop F5
.9 1 Ea. Threshold M1
.10 2 Ea. Door sweep M8
.11 1 Set Seals M3
.12 1 Set Astragal M4
.13 Notes: H1

.3 Single Door 100B, 101, 102B,200B,200C:
.1 3 Ea. Hinges A3
.2 1 Ea. Lock Set B3
.3 1 Ea. Cylinder B1
.4 1 Ea. Electric strike F7
.5 1 Ea. Closer C1
.6 1 Ea. Threshold M5
.7 1 Set Seals M3
.8 1 Ea. Astragal M6
.9 1 Ea. Kick Plate J1

.4 Single Doors 102A:
.1 3 Ea. Hinges A4
.2 1 Ea. Lock set B5
.3 1 Ea. Cylinder B1
.4 1 Ea. Closer C1
.5 1 Ea. Wall stop F2
.6 1 Ea. Door bottom M9
.7 1 Set Seals M10
.8 1 Ea. Threshold M7
.9 1 Ea. Kick Plate J1

3.7 DOOR HARDWARE TYPE

.1 HINGES:

A1 –Pivot sets Mortised into floor with top pivot, weight to 1,750 lbs., ¾" off set hung, non ferrous x 626 – C0711

A2 –Intermediate Pivot sets full Mortised, ¾" off set hung, non ferrous x 626 – C07311

A3 – Hinge 5 Knuckle-.134 gauge- 114mm x 101mm x Non Removable Pin x 630 – A5111

A4 – Hinge 5 Knuckle-.134 gauge-114mm x 101mm x Non Removable Pin x 652 – A5111

A5 –Transfer Intermediate Pivot sets full Mortised, ¾" off set hung, non ferrous with 8 wires x 630 – C07311

Conduits & wiring in door from transfer to locking device by door supplier

Conduits & wiring from transfer to junction box by electrical

.2 LOCKS:

B1 - Cylinder	Type x length x cam to suit	626
B2 - Lock set	ANSI F04	626
B3 - Lock set	ANSI F07	626
B4 - Lock set	ANSI F18	626
B5 - Lock set	ANSI F01	626

.3 CLOSERS:

Note: Include thru-bolts and grommet nuts fasteners.

C1 - Closer non sized, Jamb mount compression spring buffer arm x delayed action x 689 – C02031

C2 – Closer Institutional, non sized, rigid parallel arm x delayed action x 689 – C02031

C3 - Closer Institutional, non sized, regular arm x delayed action x 689 – C02031

.4 AUXILIARY HARDWARE:

F1 - Floor stop Low dome 28.57mm high x 50mm Dia solid cast x 626

F2 - Overhead door stop

F3 - Spring Bolt Heavy Duty

Bolt Size: 101MM wide x 228MM long x 25mm projection With keeper for hinge side mounting, and 1524mm" steel chain with ring and clip Powder Coat finish

F4 - Cane Bolt Heavy Duty 19mm x 610mm Long

Bolt drops by gravity when handle is lifted out of socket x 630

F5 - Floor stop Heavy Duty wrought Brass and Black Rubber Bumper 82mm(d) x 50mm(h)

F6 –Lever extension Flush Bolt brass material, 19mm bolt throw, 19mm rod backset, 305mm rod length (centre of face to bolt end-retracted, 38mm adjustable bolt head x 31mm x 172mm face plate x 626 with dust proof strike

F7 - Electric Strike Fire rated, 12 VDC, 1500Lbs holding, 19mm keeper depth, Fail secure x 630

Power supply and all hookups by electrical

.5 ARCHITECTURAL DOOR TRIM:

J1 - Kick Plate 254mm x width less 38mm x 630

.6 THRESHOLDS, SEALS, DOOR BOTTOMS, ASTRAGAL

M1 –Threshold Barrier free Saddle 127mm x 6.4mm x width x stainless steel

M2 –Door Sweep Similar to Pemko 345AV-width

M3 – Seals Adjustable jamb type x silicone insert x 2/height x 1 width

M4 –Astragal 50.08mm x 3.2mm x height welded to door by door supplier with Adhesive gasketing

M5 –Threshold Thermal Barrier -free latching panic exit Saddle 127mm x 6.4mm x 6.4 stop strip x ThemoSeal with non skid finish set in solid mastic

and secured with counter sunk SS screws and metal shields every 300 mm, size door to make continuous contact with door.

M6 – Astragal Off set security bar x height welded to door by door supplier
M7 –Threshold Barrier free Saddle 127mm x 6.4mm x width
M8 –Door Sweep Similar to Pemko 56AAV-width
M9 –Door Bottom Mortise type for steel doors x silicone insert-width sound tested
M10- Seals Triple fin design adhesive backing x 2/height x 1 width sound tested

.7 Notes:
H1 Door Casters by door supplier

END OF SECTION 08 71 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Metal doors and frames Section 08 11 00

.2 Windows Section 08 50 00

1.2 REFERENCES

.1 ASTM International
- .1 ASTM C 542-05 (2011), Standard Specification for Lock-Strip Gaskets.
- .2 ASTM D 2240-05 (2010), Standard Test Method for Rubber Property - Durometer Hardness.
- .3 ASTM E 330-02, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
- .2 CAN/CGSB-12.2-M91, Flat, Clear Sheet Glass.
- .3 CAN/CGSB-12.3-M91, Flat, Clear Float Glass.
- .4 CAN/CGSB-12.8-97, Insulating Glass Units.
- .5 CAN/CGSB-12.8-97, (Amendment), Insulating Glass Units.
- .6 CAN/CGSB-12.10-M76, Glass, Light and Heat Reflecting.
- .7 CAN/CGSB-12.11-M90, Wired Safety Glass.

.3 Glass Association of North American (GANA)
- .1 GANA Glazing Manual – 50th Anniversary Edition.
- .2 GANA Laminated Glazing Reference Manual - 2009.

.4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
- .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.3 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Low-Emitting Materials:
- .1 Submit listing of adhesives and sealants used in building, showing compliance with VOC and chemical component limits or restrictions requirements.

.4 Samples: Provide 2 glazed units samples, 300 x 300, in accordance with Section 01 33 00- Submittal Procedures.

.5 Shop Drawings:
- .1 Provide shop drawings in accordance with Section 01 33 00- Submittal Procedures:
  - .1 Shop drawing consist of aluminum framing installation details. Indicate sizes, spacing, location and quantities.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for glazing for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product 'Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labeled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect glazing and frames from nicks, scratches, and blemishes.

.3 Protect prefinished aluminum surfaces with wrapping.

.4 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal

1.6 AMBIENT CONDITIONS

.1 Ambient Requirements:

.1 Install glazing when ambient temperature is 10 degrees C minimum. Maintain ventilated environment for 24 hours after application.

.2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.7 WARRANTY

.1 Provide manufacturer's warranty in writing for insulating glass units against failure of seal of enclosed air space and deposits on inner faces of glass detrimental to vision for a period of 2 years from date of Substantial Performance of Work.

2.0 PRODUCTS

2.1 MATERIALS

.1 Design Criteria:

.1 Ensure continuity of building enclosure vapour and air barrier using glass and glazing materials as follow:

.1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.

.2 Size glass to withstand wind loads, dead loads and positive and negative live loads to National Building Code 2010 and BCBC 2012.

.3 Limit glass deflection to 1/200 with full recovery of glazing materials.

.2 Flat Glass:

.1 Float Glass: to CAN/CGSB-12.3, glazing quality, 6 mm thick.

.2 Interior insulated glass unit: Insulated glass units with 13 mm air space and two 6 mm lites, outer and inner lite clear, tempered.

.3 Exterior Insulated glass unit: performance requirements for insulated glass units with 13 mm

air space and two 6 mm lites, interior lite clear, outer and inner lite both tempered, shall be as follows:

.1 Transmittance: UV-18%, Visible-70%, Solar-32%.
.2 Outdoor reflectance: Visible-11%, Total Solar Energy-29%.
.3 U-Value W/m^2/°C: Winter 1.6466 (029 BTU/Hr/Ft/°F) Summer 1.5898 (028 BTU/HR/Ft/°F)
.4 Solar heat gain coefficient: 0.38
.5 Shading coefficient: 0.43

2.2 ACCESSORIES

.1 Setting blocks: neoprene Shore A durometer hardness to ASTM D 2240, minimum 100 mm x width of glazing rabbet space minus 1.5 mm x height.

.2 Spacer shims: neoprene Shore A durometer hardness to ASTM D 2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self-adhesive on one face.

.3 Glazing tape:
.1 Preformed butyl compound Shore A durometer hardness to ASTM D 2240; coiled on release paper; black colour. Width x thickness recommended by manufacturer to suit installation.

.4 Glazing splines: resilient neoprene, extruded shape to suit glazing channel retaining slot, black colour as selected.

.5 Glazing clips: manufacturer's standard type.

.6 Lock-strip gaskets: to ASTM C 542.

3.0 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written instructions.
.1 Verify that openings for glazing are correctly sized and within tolerance.
.2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
.3 Visually inspect substrate in presence of Departmental Representative.
.4 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

.1 Clean contact surfaces with solvent and wipe dry.

.2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

.3 Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION

.1 All glass shall be cushioned and rattle free. Draw marks shall be installed horizontally unless

prohibited by the size of the sheet.

.2 Install all glass on glazing blocks with spacer blocks, of sizes required to ensure shim spaces as recommended by the glass manufacturer with adequate space for glazing compounds and sealants.

.3 Fill gap between glass and applied stop with sealant to depth equal to bite of frame on glass but not more than 10 mm below sightline.

.4 Apply sealant to uniform and level line, flush with sightline and tooled or wiped with solvent to smooth appearance.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.1 Remove traces of primer, caulking.

.2 Remove glazing materials from finish surfaces.

.3 Remove labels.

.4 Clean glass and mirrors using approved non-abrasive cleaner in accordance with manufacturer's instructions.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 After installation, mark each light with an "X" by using removable plastic tape or paste.

.1 Do not mark heat absorbing or reflective glass units.

.3 Repair damage to adjacent materials caused by glazing installation.

END OF SECTION 08 80 50

ROOM FINISH SCHEDULE

				WALLS					REMARKS
NO.	**ROOM NAME**	**FLOORS**	**BASE**	**WEST WALL**	**NORTH WALL**	**EAST WALL**	**SOUTH WALL**	**CEILING**	
100	ELECTRICAL ROOM	CONC	-	PT	PT	PT	PT	EXP	
101	STAIR 1	CONC	-	PT	PT	PT	PT	EXP	
102	COMM ROOM	VT	RB	PT	PT	PT	PT	EXP	
200	ELECTRICAL ROOM	CONC	-	PT	PT	PT	PT	EXP	
E100	EX. SUB STATION	EX	-	PT	PT	PT	PT	EXP	#1
S100	SERVICE PIT	CONC	-	PT	PT	PT	PT	EXP	

LEGENDS

FLOOR		**BASE**		**WALLS**		**CEILINGS**	
CONC	Sealed Concrete	RB	Rubber Base	PT	Painted	ACT	Suspended T-Bar w/ Acoustic Ceiling Tiles
VT	Anti-Static Vinyl Tile					EXP	Painted Exposed Ceiling
EX.	Apply Newer sealer to existing concrete					GWB	GWB Ceiling Paint Finish

GENERAL NOTES

.1 All wall finishes and wall base to be continuous behind all wall fixtures
.2 Vertical bulkheads/down drops to be finished same as horizontal U.O.N.
.3 Return wall finishes into window frames at jambs and head U.O.N.
.4 Wall finishes to extend down to floor with applied base over.
.5 All exposed services to be painted as adjacent wall and ceiling U.O.N.
.6 All change of flooring in hallways must extend to the room side of the door frame U.O.N.
.7 Make good existing wall to paintable condition prior to applying new painting.
.8 All finishes indicated are new U.N.O.

REMARKS

#1 Make good Ex. Wall & Ceiling & apply new paint finish.

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1	Rough Carpentry for Minor Works	Section 06 08 99
.2	Joint Sealants	Section 07 92 00
.3	Non-Structural Metal Forming	Section 09 22 16
.4	Interior Painting	Section 09 91 23

1.2 REFERENCES

.1 Aluminum Association (AA)
- .1 AA DAF 45-03 (R2009), Designation System for Aluminum Finishes.

.2 ASTM International
- .1 ASTM C 475-12 Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .2 ASTM C 514-04 (2009e1), Standard Specification for Nails for the Application of Gypsum Board.
- .3 ASTM C 557-03 (2009) e1,Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
- .4 ASTM C 840-11, Standard Specification for Application and Finishing of Gypsum Board.
- .5 ASTM C 954-07, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
- .6 ASTM C 1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- .7 ASTM C 1047-10a, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- .8 ASTM C 1280-13, Standard Specification for Application of Gypsum Sheathing.
- .9 ASTM C 1177/C 1177M-08, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- .10 ASTM C 1178/C 1178M-08, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.
- .11 ASTM C 1396/C 1396M-06a, Standard Specification for Gypsum Wallboard.

.3 Association of the Wall and Ceiling Contractors (AWCC)
- .1 Specifications Standards Manual 2012

.4 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-51.34-M86 (R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .2 CAN/CGSB-71.25-M88, Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.

.5 Green Seal Environmental Standards (GS)
- .1 GS-11-2008, 2nd Edition, Paints and Coatings.

.6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2007, Architectural Coatings.
.2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

.7 Underwriters' Laboratories of Canada (ULC)
.1 CAN/ULC-S102-07, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

1.3 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Sustainable Design Submittals.
.1 Low-Emitting Materials:
.1 Submit listing of adhesives and sealants and used in building, showing compliance with VOC and chemical component limits or restriction requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store gypsum board assemblies materials level off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.
.3 Protect from weather, elements and damage from construction operations.
.4 Handle gypsum boards to prevent damage to edges, ends or surfaces.
.5 Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
.6 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

1.5 AMBIENT CONDITIONS

.1 Maintain temperature 10 degrees C minimum (21 degrees C maximum) for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum after completion of joint treatment.

.2 Apply board and joint treatment to dry, frost free surfaces.

.3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

2.0 PRODUCTS

2.1 MATERIALS

.1 Standard board: to ASTM C 1396/C 1396M regular, 12.7mm and 15.9 mm thick Type X, 12.7 mm and 15.9 mm thick, 1200 mm wide x maximum practical length, ends square cut, edges tapered.

.2 Water-resistant board: to ASTM C 1396/C 1396M regular, 12.7mm and 15.9 mm thick and Type X, 12.7mm and 15.9mm thick, 1220 mm wide x maximum practical length.

.3 Glass mat water-resistant gypsum backing board: to ASTM C 1178/C 1178M, 12.7 and 15.9 mm thick, 1200 mm wide x maximum practical length.

.4 Glass mat gypsum substrate sheathing: to ASTM C 1177/C 1177M, 15.9 mm thick, 1200 mm wide x maximum practical length.

.5 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.

.6 Resilient clips and drywall furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.

.7 Nails: to ASTM C 514.

.8 Steel drill screws: to ASTM C 1002.

.9 Laminating compound: as recommended by manufacturer, asbestos-free.

.10 Casing beads, corner beads, control joints and edge trim: to ASTM C 1047, metal, zinc-coated by hot-dip process, 0.5 mm base thickness, perforated flanges, one piece length per location.

.11 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
- .1 VOC limit 250 g/L maximum to SCAQMD Rule 1168.
- .2 Acoustic sealant: in accordance with Section 07 92 00 - Joint Sealants.

.12 Joint compound: to ASTM C 475, asbestos-free.

3.0 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assemblies installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 ERECTION

.1 Do application and finishing of gypsum board to ASTM C 840 except where specified otherwise.

.2 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C 840 except

where specified otherwise.

.3 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.

.4 Install work level to tolerance of 1:1200.

.5 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.

.6 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.

.7 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.

.8 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.

.9 Install wall furring for gypsum board wall finishes to ASTM C 840, except where specified otherwise.

.10 Furr openings and around built-in equipment, cabinets, access panels on four sides. Extend furring into reveals. Check clearances with equipment suppliers.

.11 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

3.3 APPLICATION

.1 Apply gypsum board after bucks, anchors, blocking as specified in Section 06 08 99, sound attenuation, electrical and mechanical work have been approved by Departmental Representative.

.2 Apply single or double layer gypsum board to wood furring or framing using screw fasteners for first layer, screw fasteners for second layer. Maximum spacing of screws 300 mm on centre.

.1 Single-Layer Application:

.1 Apply gypsum board on ceilings prior to application of walls to ASTM C 840.

.2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.

.2 Double-Layer Application:

.1 Install gypsum board for base layer and exposed gypsum board for face layer.

.2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.

.3 Apply base layers at right angles to supports unless otherwise indicated.

.4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.

.3 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, and ducts, in partitions where perimeter sealed with acoustic sealant.

.4 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.

.5 Install gypsum board with face side out.

.6 Do not install damaged or damp boards.

.7 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.4 INSTALLATION

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre.

.2 Install casing beads around perimeter of suspended ceilings.

.3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

.4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.

.5 Construct control joints of preformed units set in gypsum board facing and supported independently on both sides of joint.

.6 Provide continuous polyethylene dust barrier behind and across control joints.

.7 Locate control joints at changes in substrate construction at approximate 10 m spacing on long corridor runs at approximate 15 m spacing on ceilings.

.8 Install control joints straight and true.

.9 Construct expansion joints as detailed, at building expansion and construction joints. Provide continuous dust barrier.

.10 Install expansion joint straight and true.

.11 Install cornice cap where gypsum board partitions do not extend to ceiling.

.12 Fit cornice cap over partition, secure to partition track with two rows of sheet metal screws staggered at 300 mm on centre.

.13 Splice corners and intersections together and secure to each member with 3 screws.

.14 Install access doors to electrical and mechanical fixtures specified in respective sections.
.1 Rigidly secure frames to furring or framing systems.

.15 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

.16 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:
.1 Levels of finish:

.1 At typical wall and ceiling locations. Level 4: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and edges.

.17 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

.18 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.

.19 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.20 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by gypsum board assemblies installation.

END OF SECTION 09 21 16

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Rough Carpentry for Minor Works Section 06 08 99

.2 Thermal Insulation Section 07 21 00

.3 Gypsum Board Assemblies Section 09 21 16

1.2 REFERENCES

.1 ASTM International
- .1 ASTM C 645- 13, Specification for Nonstructural Steel Framing Members.
- .2 ASTM C 754- 11 , Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

.2 Green Seal Environmental Standards (GS)
- .1 GS-11-2008, 2nd Edition, Paints and Coatings.

.3 Association of Wall and Ceiling Contractors of BC (AWCC)
- .1 Specification Standards Manual, 2012 Edition.

1.3 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada. Submit Model Schedule B and C.
- .2 Indicate system dimensions, framed opening requirements and tolerances, adjacent construction, anchor details anticipated deflection under load, affected related Work, weep drainage network, expansion and contraction joint location and details, and field welding required.

1.4 QUALITY ASSURANCE

.1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1. 5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management And Disposal.

2.0 PRODUCTS

2.1 MATERIALS

.1 Steel Studs & Steel Stud Furring:

.1 Conform to ASTM C645, non-loadbearing; C-shape, hot dipped galvanized steel studs with Z180 (G60) zinc coating.
Studs to have knurled face and pre-punched pass-through holes for horizontal runs of wiring and piping. Length to suit, no splicing allowed.

.2 Flange: Depth not less than 32mm, edges bent back 90 deg. and edges hemmed 5mm minimum.

.3 Widths: As scheduled and indicated.

.4 Gauges: Interior steel stud to be a minimum of 0.88mm (20 gauge). Interior door jamb studs: 0.88 mm (20 gauge), two (2) studs each side of opening. Increase gauge of steel studs at over-height locations to suit stud manufacturer's design tables, in order to maintain overall partition dimension as detailed in wall schedule and in accordance with the BC Building Code. Exterior steel stud to be minimum1.23 mm (18 gauge).

.5 Colour code steel studs for gauge in accordance with AWCC colour code chart.

.2 Stud Tracks:

.1 Top and bottom runner tracks fabricated from same materials as studs; leg design min. 32mm high, slightly bent in to hold studs; widths to equal stud width.

.2 Use extended leg top track to partitions as required for deflection.

.3 Stud Fasteners: Manufacturer's standard, suitable for intended application.

.4 Shaft Wall Framing Supports: Stud and track metal components fabricated from hot-dipped zinc coated steel meeting ASTM C645. Zinc coating shall be Z180 (G60). Steel I-studs, J-tracks, T-splines, L-runners, fasteners shall be of design gauge as used within appropriate shaft wall system tested under design numbers indicated in wall schedule.

.5 Furring Channels: Hat section; roll formed from 0.53mm hot dipped galvanized steel having a Z180 (G60) coating, dimensions 68.2 mm or 66.7mm overall width, face width 35 mm by 22.2mm deep, face knurled.

.6 "Z-bar" Furring: Roll formed from 0.46mm (26 ga.) hot dipped galvanized steel having a Z180 (G60) coating, 32mm face dimension x depth to suit rigid insulation thickness, see drawings and wall schedule.

.7 Gypsum Board Ceiling Framing: Conform to Section 9.7, Part 2, Item 4 of the A.W.C.C. Standards which are minimum and as otherwise described below to exceed that minimum.

.1 Tie Wire: 1.62mm (16 ga.) galvanized steel tie wire.

.2 Hangers: 3.6mm (9 ga.) diameter galvanized soft annealed steel wire, or 4.8mm diameter zinc coated or cadmium plated steel rods. Ceiling area supported:

Area	Size of Hangers
Up to 1.15m^2	3.6 mm (9 ga.) diameter galvanized wire.
Up to 1.48 m^2	4.8mm diameter rods

.3 Inserts: Able to develop full strength of supported hangers.

.4 Main Carrying Channels: Cold formed steel channels of dimension and weight as follows and protected with rust inhibitive coating. Main carrying channels shall not be less than 38mm x 12.7mm x 1.37mm cold formed channels.

Maximum Spacing of Hangers	Maximum Spacing of Main Runners
900mm	1200mm
1000mm	1000mm
1200mm	900mm

.5 Cross Furring/Ceilings: Cross furring members shall be hat-shaped furring channels as specified in Clause 2.5, above. Max. spacing between furring channels shall conform to the following requirements, based on gypsum board

thicknesses and layers.

.8 Metal Backing Plates: Flat sheet from 0.91mm (20ga.) thick galvanized steel of same type as are the studs as blocking to support work of other sections.

Gypsum Board Thickness	Maximum Furring Spacing
Single 12.7mm board	400 mm
Single 15.9mm board	600 mm
Double layer	400 mm

3.0 EXECUTION

3.1 ERECTION

.1 Fire Resistance Rated Walls: Comply with requirements of testing agency approved by the Consultant for wall systems detailed on Drawings.

.2 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.

.3 Place studs vertically at on centre as detailed and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.

.4 Erect metal studding to tolerance of 1:1000.

.5 Attach studs to bottom and ceiling track using pop rivets.

.6 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.

.7 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.

.8 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.

.9 Install heavy gauge single jamb studs at openings.

.10 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.

.11 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.

.12 Install steel studs or furring channel between studs for attaching electrical and other boxes.

.13 Extend partitions to ceiling height except where noted otherwise on drawings.

.14 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Use 50 mm leg ceiling tracks.

.15 Install continuous insulating strips to isolate studs from uninsulated surfaces.

.16 Install two continuous beads of acoustical sealant under studs and tracks around perimeter of sound control partitions.

.17 Provide clearances and isolation felt to ensure no contact between steel stud system and adjacent metal components to eliminate electrolytic action.

3.2 CHASE WALLS

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.3 SHAFT WALL ERECTION

.1 At shaft wall partitions, use the methods of assembly as used in the fire test specimen to maintain fire and sound ratings. Coordinate with Section 09 21 16, Gypsum Board Assemblies.

.2 Coordinate construction of shaft walls to suit installation of services.

3.4 CEILING AND SOFFIT SUSPENSION

.1 Hangers:

.1 Ensure hangers for suspended gypsum board ceilings support independent of walls, columns, pipes, ducts, and are erected plumb and securely anchored to structural frame or imbedded in concrete slabs. Do not use powder actuated fasteners/anchors.

.2 Space hangers at 1200mm maximum centers along runner channels and not more than 150mm from boundary walls, interruptions of continuity and change in direction.

.3 Provide at least 25mm clearance at walls.

.2 Runner Channels:

.1 Space channels at max. 900mm centers and not more than 150mm from boundary walls, interruptions of continuity and change in direction. Provide clearance of at least 25mm at walls.

.2 Run the channels transversely to structural framing members.

.3 Where splices are necessary, lap members at least 200mm and wire each end with 2 loops. Avoid clustering or lining up splices.

.4 Attach to rod hangers by bending hanger sharply under bottom flange of runner and securely wire in place with a saddle tie.

.3 Cross Furring:

.1 Erect furring channels transversely across runner channels, or other supports.

.2 Space furring channels at 400mm centers and not more than 150mm from boundary walls, openings, interruptions in ceiling continuity and change in direction. Provide a clearance of at least 25mm at walls.

.3 Secure furring channels to each support with clips or double 1.62 mm (16 ga.) dia. wire ties. Splice joints by nesting and tying channels together.

.4 Level furring channels to a maximum tolerance of 1:1000.

.4 At openings, including ceiling access panels, in ceiling suspension system that interrupts the main carrying channels of furring channels, reinforce grillage with 19mm cold rolled channels, wire tie to top and parallel to main runner channels, extend 19mm channels minimum 300mm past each end of openings.

3.5 WALL FURRING

.1 Place furring channels attached to masonry or concrete surfaces at 400mm o.c. and not more than 100mm from corners and openings.

.2 Secure flanges to wall with hardened nails, power actuated fasteners or equivalent fastenings. Maximum spacing 600 mm alternating to opposite flanges.

3.6 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION 09 22 16

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Gypsum Board Assemblies Section 09 21 16

.2 Electrical Division 26

1.2 REFERENCES

.1 ASTM International

.1 ASTM F 1700-13, Standard Specification for Solid Vinyl Floor Tile.

.2 ASTM F 1861-08 (2012) e1, Standard Specification for Resilient Wall Base.

.3 ASTM F 150-06 (2013) Standard Test Method for Electrical Resistance of Conductive and Static Dissapative Resilient Flooring.

.4 ASTM E 648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

.2 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

.3 National Floor Covering Association (NFCA) Specification Manual.

.4 Electrical Overstress/Electrostatic Discharge Association (EOS/ESD):

.1 EOS/ESD-S7.1 1994 Floor Material Resistive Characterization of Materials.

1.3 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for flooring, adhesive, primer, sealer, and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements, Section 01 35 43 - Environmental Procedures.

.3 Samples:

.1 Submit manufacturer’s standard color range for selection, review and acceptance of each unit.

.2 Submit duplicate full size samples of each type of tile based on selected colors.

.3 Submit 300 mm long base and edge strips based on selected colors.

.4 Samples will be returned for inclusion into work.

.4 Low-Emitting Materials:

.1 Submit listing of adhesives primers used in building, showing compliance with VOC and chemical component limits or restriction requirements.

.5 Quality Assurance Submittals: Submit the following:

.1 Certification of compliance: Letter of compliance signed by manufacturer certifying materials comply with specified performance characteristics and criteria, and physical requirements.

.2 Manufacturer's Instructions: Manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for resilient flooring for incorporation into manual.

.3 Extra Materials.

.1 Provide 10% extra materials of each colour, pattern, and type flooring materials required for project maintenance use.

.2 Extra material to be in the same container and from same production run as installed materials.

.3 Clearly identify each container of tile flooring and each container of adhesive.

.4 Deliver to Departmental Representative upon completion of the work of this Section.

.5 Store where directed by Departmental Representative.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect resilient flooring from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

1.6 SITE CONDITIONS

.1 Ensure high ventilation rate, with maximum outside air, during installation.

.1 Vent directly to outside.

.2 Do not let contaminated air recirculate through a district or whole building air distribution system.

.3 Maintain extra ventilation for 1 month minimum after building occupation.

2.0 PRODUCTS

2.1 RESILIENT TILE FLOORING MATERIALS

.1 Solid Vinyl Tile; to ASTM F1700

.1 **VT**

.1 Category: Conductive/Static Dissipative vinyl tile to ASTM F1700, Class I (monolithic) Type A-smooth surface.

.2 Minimum Binder Content: 34% each ply or layer

.3 Size: 615 mm x 615 mm

.4 Gauge: 2.0 mm

.5 Fire Test Data: ASTM E648, Class I, ASTM E662, Smoke Developed 450 or less.

.6 Static Load Limit: ASTM F970, 250 psi (1500 lb/in^2)

.7 Slip Resistance: ASTM D2047, 0.6 for flat surface

.8 Electrical Resistance: ASTM F150, $1x10^6$ - 10^8 ohms surface to ground.
.9 Recycled Content: 51% pre- consumer
.10 Non-directional Pattern, color: dark grey.

2.2 ACCESSORIES

.1 Resilient base (**RB**): to ASTM F1861, type TP, Group 1, continuous, top set, complete with premoulded end stops and external corners, toe type: toe.
.1 Type: rubber, 3.175 mm thick.
.2 Style: cove.
.3 Height: 101.6 mm.
.4 Lengths: cut lengths minimum 2400 mm.
.5 Color: dark grey, to match color of vinyl tile VT.

.2 Primers and adhesives: of types recommended by resilient flooring manufacturer for specific material on applicable substrate, above, on or below grade.
.1 Adhesives: VOC limit 50 g/L maximum to SCAQMD Rule 1168.
.2 Primer: in accordance with manufacturer's recommendations for surface conditions:
.1 VOC limit: 100 g/L maximum to SCAQMD Rule 1113

.3 Sub-floor filler and leveller: white premix latex requiring water only to produce cementitious paste as recommended by flooring manufacturer for use with their product.

.4 Metal edge strips: extruded aluminum, smooth, mill finish, stainless steel with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.

.5 Sealer and wax: type recommended by resilient flooring material manufacturer for material type and location.
.1 Coating: VOC limit 50 g/L maximum to SCAQMD Rule 1113.

3.0 EXECUTION

3.1 EXAMINATION

.1 Examine conditions, substrates and work to receive work of this Section, co-ordinate with Section 01 71 00 - Examination and Preparation.

.2 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

.3 Ensure concrete floors are clean and dry by using test methods recommended by flooring manufacturer.

3.2 PREPARATION

.1 Prepare for installation in accordance with manufacturer's written recommendations.

.2 Remove sub-floor ridges and bumps and fill low spots, cracks, joints, holes and other defects with sub-floor filler.

.3 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface.
.1 Prohibit traffic until filler is completely cured and dry.

.4 Seal concrete slab as recommended by resilient flooring manufacturer's written instructions.

3.3 APPLICATION - FLOORING

.1 Install flooring as per manufacturer's written instructions.

.2 Apply adhesive uniformly using recommended trowel. Do not spread more adhesive that can be covered by flooring before initial set takes place.

.3 Resilient tile flooring:
.1 Lay flooring with joints parallel to building lines to produce symmetrical tile pattern.
.2 Border tiles: half tile width minimum.
.3 Install flooring to square grid pattern with joints aligned.

.4 As installation progresses, and after installation roll flooring with 45 kg minimum roller to ensure full adhesion.

.5 Cut flooring neatly around fixed objects.

.6 Continue flooring over areas which will be under built-in furniture.

.7 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.

.8 Terminate resilient flooring at centreline of door in openings where adjacent floor finish or color is dissimilar.

.9 Grounding Strap: A minimum of one (1) grounding strap should be installed for every 2,000 square feet of uninterrupted tile.

.10 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.4 APPLICATION - BASE

.1 Install base as per manufacturer's written instructions.

.2 Lay out base to keep number of joints at minimum.

.3 Clean substrate and prime with one coat of adhesive.

.4 Apply adhesive to back of base.

.5 Set base against wall and floor surfaces tightly by using 3 kg hand roller.

.6 Install straight and level to variation of 1:1000.

.7 Scribe and fit to door frames and other obstructions. Use pre-moulded end pieces at flush door frames.

.8 Cope internal corners using pre-moulded corner units for right angle external corners and formed straight base material for external corners of other angles.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.1 Remove excess adhesive from floor, base and wall surfaces without damage.

.2 Clean, seal and wax floor and base surface to flooring manufacturer's printed instructions.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19- Waste Management and Disposal.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Protect new floors in accordance with manufacturer's printed instructions.

.3 Repair damage to adjacent materials caused by resilient flooring installation.

END OF SECTION 09 65 99

1.0 GENERAL

1.1 RELATED REQUIRMENTS

.1 Metal Fabrications Section 05 50 00

.2 Metal Doors and Frames Section 08 11 00

1.2 REFERENCES

.1 Environmental Protection Agency (EPA)
- .1 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings).

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.3 The Master Painters Institute (MPI)
- .1 Architectural Painting Specification Manual – November 2007.
- .2 Standard GPS-1- 05, MPI Green Performance Standard for Painting and Coatings.

.4 National Fire Code of Canada 2010.

.5 Society for Protective Coatings (SSPC)
- .1 Systems and Specifications, SSPC Painting Manual 2005.

1.3 QUALITY ASSURANCE

.1 Qualifications:
- .1 Contractor: to have a minimum of five years proven satisfactory experience. When requested, provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.
- .2 Qualified journeypersons as defined by local jurisdiction to be engaged in painting work
- .3 Apprentices: may be employed provided they work under direct supervision of qualified journeyperson in accordance with trade regulations.

.2 Conform to the standards contained in the Master Painters Institute Architectural Painting Specification Manual, latest edition (hereafter referred to as MPI Painting Specification Manual) for all painting products including preparation and application of materials. MPI Painting Specification Manual as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.

.3 All paint manufacturers and products used shall be as listed under the “Approved Products” section of the MPI Painting Specification manual.

.4 Other paint materials shall be the highest quality product of an approved manufacturer listed in MPI Painting Specification Manual and shall be compatible with other coating materials as required.

.5 Single-Source Responsibility: provide primers and undercoat paint produced by the same manufacturer as the finish coat.

.6 All painting and decorating work shall be inspected by Paint Inspection Agency (inspector) acceptable to the specifying authority and the local MPI Accredited Quality Assurance Association. The painting contractor shall notify the Paint Inspection Agency a minimum of

one week prior to commencement of work and provide a copy of the project painting specification, plans and elevation drawings (including pertinent details) as well as a Finish Schedule.

.7 All surfaces requiring painting or repainting shall be inspected by the inspection agency who shall advise on all aspects of painting work including preparation, notifying the Consultant, the Contractor and the Trade Contractor of any defects or problems prior to commencing painting work or after the prime coat shows defects in the substrate, and as the work progresses.

.8 Standard of Acceptance:
- .1 Wall: No defects visible from a distance of 1000mm at 90° to surface.
- .2 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

.9 Mock-Ups:
- 1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
  - .1 Prepare and paint designated surface, area, room or item (in each colour scheme) to specified requirements, with specified paint or coating showing selected colours, gloss/sheen, textures.
  - .2 Mock-up will be used:
    - .1 To judge workmanship, substrate preparation, operation of equipment and material application and workmanship to MPI Architectural Painting Specification Manual standards.
  - .3 Locate where directed.
  - .4 Allow 24 hours for inspection of mock-up before proceeding with work.
  - .5 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.

.10 Pre-Installation Meeting:
- .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Coordination with other building subtrades.
  - .4 Review manufacturer's installation instructions and warranty requirements.

.11 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.4 PERFORMANCE REQUIREMENTS

.1 Environmental Performance Requirements:
- .1 Provide paint products meeting MPI "Environmentally Friendly”E2 ratings based on VOC (EPA Method 24) content levels.

.2 Green Performance in accordance with MPI Standard GPS-1.

1.5 SCHEDULING

.1 Submit work schedule for various stages of painting to Departmental Representative for approval. Submit schedule minimum of 48 hours in advance of proposed operations.

.2 Obtain written authorization from Departmental Representative for changes in work schedule.

.3 Schedule painting operations to prevent disruption of occupants in and about building.

1.6 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit product data and instructions for each paint and coating product to be used.

.2 Submit product data for the use and application of paint thinner.

.3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOCs during application.

.3 Samples:

.1 Submit manufacturer's standard range of color choices on each specified color type as listed in Colour Schedule of this section for selection, review and acceptance of each color.

.2 Submit triplicates 200 x 300 mm sample panels of each paint with specified paint in colours, gloss/sheen and textures required, based on selected colors, to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:

.1 1 mm plate steel for finishes over metal surfaces.

.3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.

.4 Test reports: submit certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.1 Lead, cadmium and chromium: presence of and amounts.

.2 Mercury: presence of and amounts.

.3 Organochlorines and PCBs: presence of and amounts.

.5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

.7 Closeout Submittals: submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include following:

.1 Product name, type and use.

.2 Manufacturer's product number.

.3 Colour numbers.

.4 MPI Environmentally Friendly classification system rating.

1.7 MAINTENANCE

.1 Extra Materials:

.1 Deliver to extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Section 01 78 00 - Closeout Submittals.

.2 Quantity: provide one - 4 litre (1 gallon) can of each type and colour of primer stain finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

.3 Delivery, storage and protection: comply with Departmental Representative requirements for delivery and storage of extra materials.

1.8 DELIVERY, STORAGE & HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements, supplemented as follows:

.1 Deliver and store materials in original containers, sealed, with labels intact.

.2 Labels: to indicate:

.1 Manufacturer's name and address.

.2 Type of paint or coating.

.3 Compliance with applicable standard.

.4 Colour number in accordance with established colour schedule.

.3 Remove damaged, opened and rejected materials from site.

.4 Provide and maintain dry, temperature controlled, secure storage.

.5 Observe manufacturer's recommendations for storage and handling.

.6 Store materials and supplies away from heat generating devices.

.7 Store materials and equipment in well-ventilated area with temperature range 7 degrees C to 30 degrees C.

.8 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

.9 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Departmental Representative. After completion of operations, return areas to clean condition to approval of Departmental Representative

.10 Remove paint materials from storage only in quantities required for same day use.

.11 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.

.12 Fire Safety Requirements:

.1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.

.2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.2 Paint, stain and wood preservative finishes and related materials (thinners, solvents, etc.) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.

.3 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.4 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.5 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into the ground the following procedures shall be strictly adhered to:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered

out.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.

.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

.6 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

.7 Set aside and protect surplus and uncontaminated finish materials: Deliver to or arrange collection by employees, individuals, or organizations for verifiable re-use or re-manufacturing.

.8 Close and seal tightly partly used sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

1.9 AMBIENT CONDITIONS

.1 Heating, Ventilation and Lighting:

.1 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities to be provided by General Contractor.

.2 Temperature, Humidity and Substrate Moisture Content Levels:

.1 Unless specifically pre-approved by specifying body, Paint Inspection Agency and, applied product manufacturer, perform no painting work when:

.1 Ambient air and substrate temperatures are below 10 degrees C.

.2 Substrate temperature is over 32 degrees C unless paint is specifically formulated for application at high temperatures.

.3 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.

.4 Relative humidity is above 85 % or when dew point is less than 3 degrees C variance between air/surface temperature.

.5 Rain or snow are forecast to occur before paint has thoroughly cured or when it i foggy, misty, raining or snowing at site.

.3 Surface and Environmental Conditions:

.1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

.2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits noted herein.

.3 Apply paint when previous coat of paint is dry or adequately cured.

.4 Apply paint finishes when conditions forecast for entire period of application fall within manufacturer's recommendations.

.5 Do not apply paint when:

.1 Temperature is expected to drop below 10 degrees C before paint has thoroughly cured.

.2 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's limits.

.3 Surface to be painted is wet, damp or frosted.

.6 Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable.

.7 Schedule painting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.

.8 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

.9 Paint occupied facilities in accordance with approved schedule only. Schedule operations to approval of Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

1.10 GUARANTEE

.1 Furnish either the local MPI Accredited Quality Assurance Association's two (2) year guarantee, or, alternatively, a 100% two (2) year Maintenance Bond – both in accordance with MPI Painting Manual requirements. The Maintenance Bond shall warrant that all painting work has been performed in accordance with MPI Painting Manual requirements

.2 All painting and decorating work shall be in accordance with MPI Painting Manual requirements and shall be inspected by the local MPI Accredited Quality Assurance Association's Paint Inspection Agency (inspector), whether using either the MPI Accredited Quality Assurance Association's guarantee, or the Maintenance Bond option. The cost for such inspections, and for either the local MPI Accredited Quality Assurance Association's Guarantee, or the Maintenance Bond, shall be included in the Base Bid Price.

.3 Painting and decorating Subcontractors choosing the Maintenance Bond option shall provide a maintenance bond consent from a reputable surety company licensed to do business in Canada. Cash or certified check are not acceptable in lieu of surety consent.

2.0 PRODUCTS

2.1 MATERIALS

.1 Paint materials listed in latest edition of MPI Approved Products List (APL) are acceptable for use on this project.

.2 Paint materials for paint systems: to be products of single manufacturer.

.3 Only qualified products with E2 "Environmentally Friendly" ratings are acceptable for use on this project.

.4 Use only MPI listed materials.

.5 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids, to be as follows:

.1 Be water-based.

.2 Be non-flammable biodegradable.

.3 Be manufactured without compounds which contribute to ozone depletion in upper atmosphere.

.4 Be manufactured without compounds which contribute to smog in the lower atmosphere.

.5 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.

.6 Water-borne surface coatings must be manufactured and transported in a manner that steps of processes, including disposal of waste products arising therefrom, will meet requirements of applicable governmental acts, by-laws and regulations including, for facilities located in Canada.

.7 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavelant chromium or their

compounds.

.8 Water-borne surface coatings and recycled water-borne surface coatings must have flash point of 61.0 degrees C or greater.

.9 Both water-borne surface coatings and recycled water-borne surface coatings must be made by a process that does not release:
- .1 Matter in undiluted production plant effluent generating a 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
- .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.

.10 Recycled water-borne surface coatings must contain 50 % post-consumer material by volume.

.11 Recycled water-borne surface coatings must not contain:
- .1 Lead in excess of 600.0 ppm weight/weight total solids.
- .2 Mercury in excess of 50.0 ppm weight/weight total product.
- .3 Cadmium in excess of 1.0 ppm weight/weight total product.
- .4 Hexavelant chromium in excess of 3.0 ppm weight/weight total product.
- .5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

.12 The following must be performed on each batch of consolidated post-consumer material before surface coating is reformulated and canned. These tests must be performed at a laboratory or facility which has been accredited by the Standards Council of Canada.
- .1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.
- .2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.
- .3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

2.2 COLOURS

.1 Departmental Representative will provide Colour Schedule after Contract award. Submit proposed Colour Schedule to Departmental Representative for approval.

.2 Colour schedule will be based upon selection of five base colours and three accent colours. No more than eight colors will be selected for entire project and no more than three colours will be selected in each area.

.3 Selection of colours will be from manufacturers full range of colours.

.4 Where specific products are available in restricted range of colours, selection will be based on limited range.

2.3 MIXING AND TINTING

.1 Perform colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials is allowed only with Departmental Representative's written permission.

.2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.

.3 Add thinner to paint manufacturer's recommendations. Do not use kerosene or organic solvents to thin water-based paints.

.4 Thin paint for spraying according in accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Departmental Representative .

.5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

.1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 Matte	Max.5	Max.10
Finish (flat) Gloss Level 2 -Velvet-Like Finish	Max.10	10 to 35
Gloss Level 3 -Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 -Satin-Like Finish	20 to 35	Min.35
Gloss Level 5 -Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 -Gloss finish	70 to 85	
Gloss Level 7 -High Gloss Finish	More than 85	

.2 Gloss level ratings of painted surfaces as indicated.

2.5 EXTERIOR PAINTING SYSTEMS

.1 Structural Steel and Metal Fabrications:

.1 EXT 5.1B - Waterborne light industrial, gloss level 6 coating (over inorganic zinc).

.2 Galvanized Metal: not chromate passivated

.1 EXT 5.3G - Waterborne light industrial, gloss level 6 coating.

.3 All paint systems to be MPI Premium Grade 3 coat system.

3.0 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 EXISTING CONDITIONS

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

3.3 EXAMINATION

.1 Exterior repainting work: inspected by MPI Accredited Paint Inspection Agency (inspector) acceptable to specifying authority and local Painting Contractor's Association. Painting contractor to notify Paint Inspection Agency minimum of one week prior to commencement of work and provide copy of project repainting specification and Finish Schedule.

.2 Exterior surfaces requiring repainting: inspected by both painting contractor and Paint Inspection Agency who will notify Departmental Representative in writing of defects or problems, prior to commencing repainting work, or after surface preparation if unseen substrate damage is discovered.

.3 Where assessed degree of surface degradation of DSD-1 to DSD-3 before preparation of surfaces for repainting is revealed to be DSD-4 after preparation, repair or replacement of such unforeseen defects discovered are to be corrected, as mutually agreed, before repainting is started.

3.4 PROTECTION

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces as directed by Departmental Representative.

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.4 Protect passing pedestrians, building occupants and general public in and about building.

.5 Remove light fixtures, surface hardware on doors, and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Store items and re-install after painting is completed.

.6 Move and cover exterior furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.7 As painting operations progress, place "WET PAINT" signs in pedestrian and vehicle traffic areas to approval of Departmental Representative.

3.5 APPLICATION

.1 Method of application to be as approved by Departmental Representative. Apply paint by brush or roller. Conform to manufacturer's application instructions unless specified otherwise.

.2 Brush and Roller Application:

- .1 Apply paint in a uniform layer using brush and/or roller of types suitable for application.
- .2 Work paint into cracks, crevices and corners.
- .3 Paint surfaces and corners not accessible to brush using spray daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
- .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces shall be free of roller tracking and heavy stipple unless approved by Departmental Representative .
- .5 Remove runs, sags and brush marks from finished work and repaint.

.3 Spray Application:

- .1 Provide and maintain equipment that is suitable for intended purpose, capable of properly

atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

.2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

.3 Apply paint in a uniform layer, with overlapping at edges of spray pattern.

.4 Brush out immediately runs and sags.

.5 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray.

.4 Use dipping, sheepskins or daubers when no other method is practical in places of difficult access and when specifically authorized by Departmental Representative.

.5 Apply coats of paint as continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.7 Sand and dust between coats to remove visible defects.

.8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as projecting ledges.

.9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.6 MECHANICAL/ELECTRICAL EQUIPMENT

.1 Unless otherwise specified, paint exterior exposed conduits, piping, hangers, duct work and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as noted otherwise.

.2 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

.3 Do not paint over nameplates.

.4 Paint fire protection piping red.

.5 Paint steel electrical light standards. Do not paint outdoor transformers and substation equipment.

3.7 RESTORATION & CLEANING

.1 Clean and re-install hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of Departmental Representative. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Departmental Representative.

.6 Proceed in accordance with Section 01 74 11 - Cleaning.

.1 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

3.8 COLOUR SCHEDULE

.1 Metal doors / frames and metal stair and handrails – medium grey.

END OF SECTION 09 91 13

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1	Concrete Unit Masonry	Section 04 22 00
.2	Metal Fabrications	Section 05 50 00
.3	Finish Carpentry	Section 06 20 00
.4	Metal Doors & Frames	Section 08 11 00
.5	Room Finish Schedule	Section 09 06 00

1.2 REFERENCES

.1 Department of Justice Canada (Jus)
- .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33

.2 Environmental Protection Agency (EPA)
- .1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 - 1995, (for Surface Coatings).

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.4 Master Painters Institute (MPI)
- .1 MPI Architectural Painting Specifications Manual, November 2007.
- .2 MPI Maintenance Repainting Manual, latest edition.

.5 National Fire Code of Canada - 2010

.6 Society for Protective Coatings (SSPC)
- .1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.

1.3 QUALITY ASSURANCE

.1 Qualifications:
- .1 Contractor: minimum of five years proven satisfactory experience. Provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.
- .2 Journeymen: qualified journeymen who have "Tradesman Qualification Certificate of Proficiency" engaged in painting work.
- .3 Apprentices: working under direct supervision of qualified trade's person in accordance with trade regulations.

.2 Conform to the standards contained in the Master Painters Institute Architectural Painting Specification Manual, latest edition (hereafter referred to as MPI Painting Specification Manual) for all painting products including preparation and application of materials. MPI Painting Specification Manual as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.

.3 All paint manufacturers and products used shall be as listed under the "Approved Products" section of the MPI Painting Specification manual.

.4 Other paint materials shall be the highest quality product of an approved manufacturer

listed in MPI Painting Specification Manual and shall be compatible with other coating materials as required.

.5 Single-Source Responsibility: provide primers and undercoat paint produced by the same manufacturer as the finish coat.

.6 All painting and decorating work shall be inspected by Paint Inspection Agency (inspector) acceptable to the specifying authority and the local MPI Accredited Quality Assurance Association. The painting contractor shall notify the Paint Inspection Agency a minimum of one week prior to commencement of work and provide a copy of the project painting specification, plans and elevation drawings (including pertinent details) as well as a Finish Schedule.

.7 All surfaces requiring painting or repainting shall be inspected by the inspection agency who shall advise on all aspects of painting work including preparation, notifying the Consultant, the Contractor and the Trade Contractor of any defects or problems prior to commencing painting work or after the prime coat shows defects in the substrate, and as the work progresses.

.8 Mock-Ups:

1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.

.1 Prepare and paint designated surface, area, room or item (in each colour scheme) to specified requirements, with specified paint or coating showing selected colours, gloss/sheen, textures.

.2 Mock-up will be used:

.1 To judge workmanship, substrate preparation, operation of equipment and material application and workmanship to MPI Architectural Painting Specification Manual standards.

.3 Locate where directed.

.4 Allow 24 hours for inspection of mock-up before proceeding with work.

.5 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.

.9 Pre-Installation Meeting:

.1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Coordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

.10 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.4 PERFORMANCE REQUIREMENTS

.1 Environmental Performance Requirements:

.1 Provide paint products meeting MPI "Environmentally Friendly” E2 ratings based on VOC (EPA Method 24) content levels.

.2 Green Performance in accordance with MPI Standard GPS-1.

1.5 SCHEDULING

.1 Submit work schedule for various stages of painting to Departmental Representative for review. Submit schedule minimum of 48 hours in advance of proposed operations.

.2 Obtain written authorization from Departmental Representative for changes in work schedule.

.3 Schedule painting operations to prevent disruption of occupants.

1.6 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit product data and instructions for each paint and coating product to be used.
- .2 Submit product data for the use and application of paint thinner.
- .3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 35 33 - Health and Safety Requirements.

.3 Samples:
- .1 Submit manufacturer’s standard range of color choices on each specified color type as listed in Colour Schedule of this section for selection, review and acceptance of each color.
- .2 Submit triplicates 200 x 300 mm sample panels of each paint with specified paint in colours, gloss/sheen and textures required, based on selected colors, to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:
  - .1 3 mm plate steel for finishes over metal surfaces.
  - .2 50 mm concrete block for finishes over concrete or concrete masonry surfaces.
  - .3 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.
- .3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface. 50mm concrete block for finishes over concrete or concrete masonry surfaces.
- .4 Test reports: submit certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
  - .1 Lead, cadmium and chromium: presence of and amounts.
  - .2 Mercury: presence of and amounts.
  - .3 Organochlorines and PCBs: presence of and amounts.
- .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .6 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.
- .7 Closeout Submittals: submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include following:
  - .1 Product name, type and use.
  - .2 Manufacturer's product number.

.3 Colour numbers.
.4 MPI Environmentally Friendly classification system rating.

1.7 MAINTENANCE

.1 Extra Materials:
.1 Deliver to extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Section 01 78 00 - Closeout Submittals.
.2 Quantity: provide one - 4 litre (1 gallon) can of each type and colour of primer stain finish coating. Identify colour and paint type in relation to established colour schedule and finish system.
.3 Delivery, storage and protection: comply with Departmental Representative requirements for delivery and storage of extra materials.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Packing, Shipping, Handling and Unloading:
.1 Pack, ship, handle and unload materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.

.2 Acceptance at Site:
.1 Identify products and materials with labels indicating:
.1 Manufacturer's name and address.
.2 Type of paint or coating.
.3 Compliance with applicable standard.
.4 Colour number in accordance with established colour schedule.

.3 Remove damaged, opened and rejected materials from site.

.4 Storage and Protection:
.1 Provide and maintain dry, temperature controlled, secure storage.
.2 Store materials and supplies away from heat generating devices.
.3 Store materials and equipment in well-ventilated area with temperature range 7 degrees C to 30 degrees C.

.5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

.6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.

.7 Remove paint materials from storage only in quantities required for same day use.

.8 Fire Safety Requirements:
.1 Provide one Type ABC fire extinguisher adjacent to storage area.
.2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
.3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

.9 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
.3 Collect and separate for disposal paper, plastic, polystyrene corrugated cardboard and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
.4 Separate for recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan (WMP).
.5 Place materials defined as hazardous or toxic in designated containers.
.6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal, regulations.
.7 Ensure emptied containers are sealed and stored safely.
.8 Unused paint, coating materials must be disposed of at official hazardous material collections site as approved by Departmental Representative.
.9 Paint, stain and wood preservative finishes and related materials (thinners and solvents) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.
.10 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.
.11 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.
.12 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:
  .1 Retain cleaning water for water-based materials to allow sediments to be filtered out.
  .2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
  .3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
  .4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.
  .5 Empty paint cans are to be dry prior to disposal or recycling (where available).
.13 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.
.14 Set aside and protect surplus and uncontaminated finish materials. Deliver to or arrange collection by organizations for verifiable re-use or re-manufacturing.

1.9 SITE CONDITIONS

.1 Heating, Ventilation and Lighting:
  .1 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.
  .2 Provide continuous ventilation for seven days after completion of application of paint.
  .3 Coordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.
  .4 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
  .5 Provide minimum lighting level of 323 Lux on surfaces to be painted.

.2 Temperature, Humidity and Substrate Moisture Content Levels:
  .1 Unless pre-approved written approval by Paint Inspection Agency Authority and product

manufacturer, perform no painting when:

.1 Ambient air and substrate temperatures are below 10 degrees C.

.2 Substrate temperature is above 32 degrees C unless paint is specifically formulated for application at high temperatures.

.3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.

.4 The relative humidity is under 85% or when the dew point is more than 3 degrees C variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.

.5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

.6 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.

.2 Perform painting work when maximum moisture content of the substrate is below:

.1 Allow new concrete and masonry to cure minimum of 28 days.

.2 15% for wood.

.3 12% for plaster and gypsum board.

.3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".

.4 Test concrete, masonry and plaster surfaces for alkalinity as required.

.3 Surface and Environmental Conditions:

.1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

.2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.

.3 Apply paint when previous coat of paint is dry or adequately cured.

.4 Additional interior application requirements:

.1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

.2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

1.10 GUARANTEE

.1 Furnish either the local MPI Accredited Quality Assurance Association’s two (2) year guarantee, or, alternatively, a 100% two (2) year Maintenance Bond – both in accordance with MPI Painting Manual requirements. The Maintenance Bond shall warrant that all painting work has been performed in accordance with MPI Painting Manual requirements

.2 All painting and decorating work shall be in accordance with MPI Painting Manual requirements and shall be inspected by the local MPI Accredited Quality Assurance Association’s Paint Inspection Agency (inspector), whether using either the MPI Accredited Quality Assurance Association’s guarantee, or the Maintenance Bond option. The cost for such inspections, and for either the local MPI Accredited Quality Assurance Association’s Guarantee, or the Maintenance Bond, shall be included in the Base Bid Price.

.3 Painting and decorating Subcontractors choosing the Maintenance Bond option shall provide a

maintenance bond consent from a reputable surety company licensed to do business in Canada. Cash or certified check are not acceptable in lieu of surety consent.

2.0 PRODUCTS

2.1 MATERIALS

.1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.

.2 Provide paint materials for paint systems from single manufacturer.

.3 Only qualified products with E2 "Environmentally Friendly" rating are acceptable for use on this project.

.4 Conform to latest MPI requirements for interior painting work including preparation and priming.

.5 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing.

.6 Linseed oil, shellac, and turpentine: highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.

.7 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids:
- .1 Water-based.
- .2 Non-flammable.
- .3 Manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
- .4 Manufactured without compounds which contribute to smog in the lower atmosphere.
- .5 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.

.8 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.

.9 Flash point: 61.0 degrees C or greater for water-borne surface coatings and recycled water-borne surface coatings.

.10 Ensure manufacture and process of both water-borne surface coatings and recycled water-borne surface coatings does not release:
- .1 Matter in undiluted production plant effluent generating 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to natural watercourse or sewage treatment facility lacking secondary treatment.
- .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to natural watercourse or a sewage treatment facility lacking secondary treatment.

.11 Recycled water-borne surface coatings must not contain:
- .1 Lead in excess of 600.0 ppm weight/weight total solids.
- .2 Mercury in excess of 50.0ppm weight/weight total product.
- .3 Cadmium in excess of 1.0ppm weight/weight total product.
- .4 Hexavelant chromium in excess of 3.0 ppm weight/weight total product.
- .5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

2.2 COLOURS

.1 Departmental Representative will provide Colour Schedule after Contract award. Submit proposed Colour Schedule to Departmental Representative for approval.

.2 Colour schedule will be based upon selection of five base colours and three accent colours. No more than eight colors will be selected for entire project and no more than three colours will be selected in each area.

.3 Selection of colours will be from manufacturers full range of colours.

.4 Where specific products are available in restricted range of colours, selection will be based on limited range.

.5 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

.6 Refer to Colour Schedule of this Section, and Section 09 06 00 Finish Schedule and drawings for identification and location of colours.

2.3 MIXING AND TINTING

.1 Perform colour tinting operations prior to delivery of paint to site. Obtain written approval from Departmental Representative for tinting of painting materials.

.2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.

.3 Use and add thinner in accordance with paint manufacturer's recommendations.Do not use kerosene or similar organic solvents to thin water-based paints.

.4 Thin paint for spraying in accordance with paint manufacturer's instructions.

.5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

.1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 Matte	Max.5	Max.10
Finish (flat) Gloss Level 2 -Velvet-Like Finish	Max.10	10 to 35
Gloss Level 3 -Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 -Satin-Like Finish	20 to 35	Min.35
Gloss Level 5 -Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 -Gloss finish	70 to 85	
Gloss Level 7 -High Gloss Finish	More than 85	

.2 Gloss level ratings of painted surfaces as indicated.

2.5 INTERIOR PAINTING SYSTEMS – NEW CONSTRUCTION

.1 Concrete masonry units: smooth and split face block and brick:
.1 INT 4.2D- High Performance Architectural Latex gloss level 3 finish.

.2 Structural steel and metal fabrications: columns, beams, joists:
.1 INT 5.1R - High Performance Architectural Latex gloss level 5 coating.

.3 Steel - high heat: (boilers, furnaces, heat exchangers, breeching, pipes, flues, stacks, etc., with temperature range as noted):
.1 INT 5.2C - Inorganic zinc rich coating, maximum 400 degrees C.

.4 Galvanized metal: doors, frames, railings, misc. steel, pipes, overhead decking, and ducts.
.1 INT 5.3M - High Performance Architectural Latex gloss level 3 coating (over waterborne primer).

.5 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:
.1 INT 9.2B - High Performance Architectural Latex gloss level 3 finish for wall, gloss level 1 for wall typical, gloss level 1 for ceiling.

.6 All paint systems to be MPI Premium Grade 3 coat systems.

2.6 INTERIOR REPAINTING SYSTEMS

.1 Concrete masonry units: smooth and split face block and brick:
.1 RIN 4.2K – High Performance Architectural Latex gloss level 3 finish.

.2 Structural Steel and Metal Fabrications:
.1 RIN 5.1R- High Performance Architectural Latex gloss level 5 coating.

.3 Steel - high heat: (boilers, furnaces, heat exchangers, breeching, pipes, flues, stacks, etc., with temperature range as noted):
.1 RIN 5.2C - Inorganic zinc rich coating, maximum 400 degrees C.

.4 Galvanized Metal: doors, frames, railings, misc steel, pipes, overhead decking, ducts, etc.
.1 RIN 5.3J – High Performance Architectural Latex gloss level 3 coating.

.5 Concrete: vertical surfaces (including ceiling)
.1 RIN 3.1J High Performance Architectural Latex, gloss level 1 finish.

2.7 SOURCE QUALITY CONTROL

.1 Perform following tests on each batch of consolidated post-consumer material before surface coating is reformulated and canned. Testing by laboratory or facility which has been accredited by Standards Council of Canada.
.1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.
.2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.
.3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

3.0 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 GENERAL

.1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.

.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

.2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

.3 Maximum moisture content as follows:

.1 Stucco, plaster and gypsum board: 12%.
.2 Concrete: 12%.
.3 Clay and Concrete Block/Brick: 12%.
.4 Wood: 15%.

3.4 PREPARATION

.1 Protection:

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Departmental Representative.
.2 Protect items that are permanently attached such as Fire Labels on doors and frames.
.3 Protect factory finished products and equipment.
.4 Protect passing pedestrians, building occupants and general public in and about the building.

.2 Surface Preparation in accordance with MPI Repainting Manual:

.1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
.2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
.3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Departmental Representative.

.3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:

.1 Remove dust, dirt, and other surface debris by wiping with dry, clean cloths or compressed air.
.2 Wash surfaces with a biodegradable detergent and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
.4 Allow surfaces to drain completely and allow to dry thoroughly.
.5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
.6 Use trigger operated spray nozzles for water hoses.
.7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.

.4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.

.5 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
.1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
.2 Apply wood filler to nail holes and cracks.
.3 Tint filler to match stains for stained woodwork.

.6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

.7 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes or vacuum cleaning.

.8 Touch up of shop primers with primer as specified.

.9 Do not apply paint until prepared surfaces have been accepted by Departmental Representative.

3.5 APPLICATION

.1 Method of application to be as approved by Departmental Representative. Apply paint by brush, roller, air or airless sprayer. Conform to manufacturer's application instructions unless specified otherwise.

.2 Brush and Roller Application:
.1 Apply paint in uniform layer using brush and/or roller type suitable for application.
.2 Work paint into cracks, crevices and corners.
.3 Paint surfaces and corners not accessible to brush using spray daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
.4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.
.5 Remove runs, sags and brush marks from finished work and repaint.

.3 Spray application:
.1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
.2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
.3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat

application.

.4 Brush out immediately all runs and sags.

.5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.

.4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.

.5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.7 Sand and dust between coats to remove visible defects.

.8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.

.9 Finish closets and alcoves as specified for adjoining rooms.

.10 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.6 MECHANICAL/ELECTRICAL EQUIPMENT

.1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.

.2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.

.3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.

.4 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

.5 Do not paint over nameplates.

.6 Keep sprinkler heads free of paint.

.7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.

.8 Paint fire protection piping red.

.9 Paint disconnect switches for fire alarm system and exit light systems in red enamel.

.10 Paint natural gas piping yellow.

.11 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

.12 Do not paint interior transformers and substation equipment.

3.7 SITE TOLERANCES

.1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.8 FIELD QUALITY CONTROL

.1 Interior painting and decorating work shall be inspected by a Paint Inspection Agency (inspector) acceptable to the specifying authority and local Painting Contractor's Association. Painting contractor shall notify Paint Inspection Agency a minimum of one week prior to commencement of work and provide a copy of project painting specification, plans and elevation drawings (including pertinent details) as well as a Finish Schedule.

.2 Interior surfaces requiring painting shall be inspected by Paint Inspection Agency who shall notify Departmental Representative and General Contractor in writing of defects or problems, prior to commencing painting work, or after prime coat shows defects in substrate.

.3 Where "special" painting, coating or decorating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer shall provide as part of this work, certification of surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to Departmental Representative.

.4 Advise Departmental Representative when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.

.5 Cooperate with inspection firm and provide access to areas of work.

.6 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Departmental Representative.

3.9 RESTORATION

.1 Clean and re-install hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and patter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of Departmental Representative. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Departmental Representative.

3.10 PAINT COLOUR SCHEDULE

.1 All metal doors / frames and metal handrails – medium grey (same as exterior).

.2 All concrete masonry units, expressed concrete ceiling, steel structure, steel joist, metal deck and gypsum wall board – off-white.

END OF SECTION 09 91 23

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Modified Bituminous Membrane Roofing Section 07 52 00

.2 Sheet Metal Flashing and Trim Section 07 62 00

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation meetings: comply with Section 01 31 19 - Project Meetings. Conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to:
- .1 Verify project requirements, including mock-up requirements.
- .2 Verify substrate conditions.
- .3 Co-ordinate products, installation methods and techniques.
- .4 Sequence work of related sections.
- .5 Co-ordinate with other building subtrades.
- .6 Review manufacturer's installation instructions.
- .7 Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.
- .8 Review warranty requirements.

.2 Sequencing: sequence with other work in accordance with 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart. Comply with manufacturer's written recommendations for sequencing construction operations.

.3 Scheduling: schedule with other work in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.

.4 Mock-ups:
- .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
- .2 Mock-up used:
  - .1 To judge workmanship, substrate preparation, operation of equipment and material application.
- .3 Construct mock-up where directed by Departmental Representative.
- .4 Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with work.
- .5 When accepted by Departmental Representative, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of finished work.
- .6 Start work only upon receipt of written acceptance of mock-up by Departmental Representative.

1.3 ACTION & INFORMAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Provide manufacturer's printed product td literature, specifications and datasheet and include product characteristics, performance criteria, limitations and colours.
- .2 Provide two copies of Workplace Hazardous Materials Information System (WHMIS) – Material Safety Data Sheets (MSDS) in accordance with Section 01 35 43 - Environmental Procedures.

.3 Samples:
.1 Netting material and each type of netting hardware.
.2 Furnish samples of system(s) so installation can be coordinated with existing conditions and within on-site conditions.

.4 Submit shop drawings showing location of pole and neeting configuration and mounting details.

1.4 PRODUCT HANDLING
.1 Protect products from damage before, during and after the installation.

1.5 QUALITY ASSURANCE
.1 Single Source Responsibility: Furnish products from one manufacturer for entire project.

.2 Utilize labor or manufacturer's Authorized Installers who are knowledgeable in the product installations.

.3 Installer shall visit the site to gather all information of existing site conditions.

1.6 WARRANTY
.1 Provide 5 years manufacturer's warranty on material against ultra-violet breakdown and defective workmanship.

1.7 CLOSEOUT SUBMITTALS
.1 Provide manufacturer's instructions for care, cleaning and maintenance of prefaced masonry units for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

2.0 PRODUCTS

2.1 MATERIALS
.1 Bird Net
.1 Material: Black, UV resistant polypropylene. UV stabilizer: carbon black - 2% by weight.
.2 Construction: Both Premium and Lightweight grades are knotless, extruded and pre-stretched netting.
.3 Mesh Sizes: 1/2" (1.3cm) square.
.4 Net Sizes: Width - 14'(4.2m)
Lengths - 50'(15.2m), 100'(30.4m), 250'(76.2m) and 3,000'(914.4m).
.5 Physical Properties: Average strength – 10 lbs./strand (4.5kg). Average strand count – 2 per inch. Weight: 8.5 lbs. (3.8kg) per 1,000 square feet.
.6 Thermal Properties: Melting point: 320+ degrees F. Flash point: 625 degrees F. Remains flexible at very low temperatures.
Polypropylene is an inert compound and resistant to a wide range of chemicals.

.2 Bird Netting Hardware
.1 Installer to contact manufacturer for up-to-date information and recommendations for netting hardware applications, item combinations, new items and new procedures. Use the hardware system recommended by the manufacturer.

.2 Provide the net hardware system, connection hardware, and cable anchoring hardware that best suits the netting installation and conditions. All hardware is made from UV stabilized black polypropylene. Hardware combinations can be mixed to suit changing surface materials and conditions.

.1 Secure to perimeter with hardware clips as recommended by manufacturer. Maximum spacing: 12”(30.5cm) O.C.

.2 Seam fastening: Twist Locks join two overlapped pieces of netting together at a seam. Maximum spacing: 3” (7.6cm) O.C.

.3 Net Ties: Multi-purpose fastener. Fastens the netting fabric to all types of objects. Use to prevent netting sag or loose fitting nets by securing the netting to objects above or behind netting installation.

.4 Overhead support straps. 24” (61cm) long to prevent net sag by fastening bird net to objects above or behind netting installation.

.5 Multi-purpose fastener. Reinforce seams, patch tears, close circular openings, use for overhead support.

.6 Tensioned Support Cable Hardware: Use support cables to prevent net sag when spanning large open areas. Maximum spacing between support cables: 30’ (9.1m). Provide the Connection and Anchoring Hardware that best suits the installation surface and conditions. Contact manufacturer for hardware recommendations.

.7 Net Cable: Aircraft grade 302/304 stainless steel 7x7, 49 strand, 3/32” (2.2mm) diameter cable. 900 lb. (407 kg) breaking strength. In 250’ (76.2m) and 500’ (152.4m) spool lengths. Hardware determines max cable run lengths.

.8 Turnbuckles: Stainless steel, hook & eye turnbuckles - three sizes.
Small: Max cable run: 25 feet (7.6m). Safe working load 360 lbs. (163kg).
Medium: Max cable run: 50 feet (15.2m).
Safe working load 500 lbs. (226 kg).

.9 Ferrules: Zinc plated copper ferrules for 3/32” (2.2mm) cable. Acceptable connection for cable runs up to 25’ (7.6m) max. Always use 2 ferrules per connection. Always use in conjunction with Cable Thimble.

.10 Wire Rope Clamps: Galvanized or stainless steel for 3/32” (2.2mm) diameter cable. Recommended connection for all cable runs. Mandatory connection for cable runs over 25’ (7.6m). Always use 2 clamps per connection. Always use in conjunction with Cable Thimble.

.11 Cable Thimble: Stainless steel cable thimble for 3/32” (2.2mm) diameter cable. Cable Thimble prevents cable fraying and creasing when tensioning cable system.

.12 Eyebolts: for steel, iron, and heavy gauge sheet metal. Extreme duty stainless steel eyebolt, 2” (5.1cm) long, 9/16” I.D. (14.2mm) with 1/4-20 stainless steel hex nut. Maximum spacing between eyebolts: 50’ (15.2m).

.13 Screw Eyes: for wood beams, heavy to medium gauge sheet metal and wood core surfaces. Extreme duty stainless steel screw eyes 2” (5.1cm) long, 17/32” I.D. (13.5mm). Pilot holes recommended for all surfaces. Maximum spacing between screw eyes: 50’ (15.2m).

.14 Eyebolts and Machine Screw Anchors: for concrete, stone, masonry block, brick and pre-cast surfaces. Eyebolt specs are same as above. Machine Screw Anchor: Zinc plated anchor – 1/2” (12.7mm) diameter x 1” (25.4mm) deep with 1/4-20 threads inside. Setting tool included with anchors.

.3 Pole Cable Support
- .1 Stainless steel pole to raise netting systems.
- .2 Top of pole to have 4 holes designed to accommodate with perimeter net cable and turn buckles.
- .3 Bolts half way up the poles can be loosened to adjust poles to required height.
- .4 Stainless steel floor base (305mm x 305mm) with neoprene protective pad.
- .5 Pole to be extendable from 1.2m to 2.4m

3.0 EXECUTION

3.1 EXAMINATION

.1 Visually inspect the surfaces that will receive the netting hardware and all areas that will end up behind or inside the netting installation. Note damaged surfaces or incomplete construction that could compromise the bird netting installation.

.2 Note all areas, surfaces or objects that may require maintenance or periodic replacement after the bird netting is installed (i.e. mechanical equipment, etc.). Use the appropriate netting accessories to allow access behind the installed netting system.

.3 Note any objects or conditions that could damage the installed bird netting. Install the net in such a manner as to avoid these conditions.

3.2 PREPARATION

.1 Field Measurements: Verify dimensions of the areas to be enclosed. Make sure you have sufficient quantity of bird netting, netting hardware and surface cleaning products to properly install the Bird Netting System.

3.3 SURFACE CLEANING

.1 All surfaces to be clean, dry and free of obstructions before bird control is installed.

.2 IF BIRD WASTE IS PRESENT: Treat, neutralize and safely remove all bird waste from installation surfaces. Installer must follow all city, state and federal regulations regarding the proper removal and disposal of bird droppings.

.3 Use surface cleaning products to neutralize any bird droppings, nests and related waste materials that may be present. Allow all surfaces to air dry completely, and then reapply to sanitize and deodorize the surface before proceeding. Strictly follow treatment instructions provided with surface cleaning products.

.4 Use anti-bacterial personal protection products to help prevent disease transmittal when working around surfaces contaminated with bird droppings.

3.4 INSTALLATION

.1 Install the bird netting hardware as recommended by manufacturer. General order of installation: install perimeter and support hardware; attach bird netting to installed hardware; install access or additional support hardware as specified.

.2 Install net as recommended by the manufacturer. If necessary cut the net to fit the area. If multiple pieces are needed, join the pieces together with the recommended seam fastening hardware.

.3 Install net to avoid contact with machinery, vehicles, extreme heat, tree branches, etc. Make necessary adjustments to keep netting a sufficient distance from these objects or conditions.

.4 Finished net installation to be taught, free of wrinkles, gaps and openings.

3.5 ADJUSTMENTS/CLEANING

.1 Remove debris and waste materials from project site.

.2 Inspect finished installation. Make any adjustments needed to conform to manufacturer's net installation guidelines.

END OF SECTION 10 81 13

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 74 11	Cleaning
.4	Section 01 74 19	Waste Management Disposal
.5	Section 01 78 00	Closeout Submittals
.6	Section 01 91 13	General Commissioning (Cx) Requirements
.7	Section 01 91 31	Commissioning (Cx) Plan
.8	Section 01 91 33	Commissioning Forms
.9	Section 01 91 41	Commissioning Training
.10	Section 01 91 51	Building Management Manual (BMM)
.11	Section 23 05 00	Common Work Results for Mechanical
.12	Section 23 05 05	Installation of Pipework

1.2 References

.1 American Society for Testing and Materials International, (ASTM).

- .1 ASTM B 32-03, Specification for Solder Metal.
- .2 ASTM B 306-02, Specification for Copper Drainage Tube (DWV).
- .3 ASTM C 564-03a, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

.2 Canadian Standards Association (CSA International).

- .1 CAN/CSA-B70-02, Cast Iron Soil Pipe, Fittings and Means of Joining.
- .2 CAN/CSA-B125-01, Plumbing Fittings.

1.3 Submittals

.1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.4 Health and Safety

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.5 Waste Management and Disposal

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 –Waste Management Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Place materials defined as hazardous or toxic in designated containers.

.4 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.5 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan

.6 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 Copper Tube and Fittings

.1 Above ground sanitary storm and vent, Copper Type DWV to: ASTM B 306.

.1 Fittings.

.1 Cast brass: to CAN/CSA-B125.

.2 Wrought copper: to CAN/CSA-B125.

.2 Solder: tin-lead, 50:50, type 50A or lead free, tin-copper alloy 95:5, type TA to ASTM B 32.

2.2 Cast Iron Piping and Fittings

.1 Buried sanitary storm and vent, cast iron (minimum NPS 2) to: CAN/CSA-B70.

.1 Joints.

.1 Mechanical joints.

.1 Neoprene or butyl rubber compression gaskets: to ASTM C 564 or CAN/CSA-B70.

.2 Stainless steel clamps.

.2 Above ground sanitary storm and vent: Cast iron to CAN/CSA-B70.

.1 Joints.

.1 Mechanical joints.

.1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

2.3 ABS Piping

.1 Drainage piping under the building, provided that such piping does not pass through any fire separations, may be as follows, at the contractor's option:

.1 Underground sanitary drainage piping under building, 150mm in diameter and smaller shall be certified to the current version of CSA B181.1, ABS Drain, Waste and Vent Pipe and Fittings. Piping shall be solid wall in construction. Cell core piping is not acceptable.

PART 3 EXECUTION

3.1 Installation

.1 In accordance with Section 23 05 05 - Installation of Pipework.

.2 Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.

.3 Install buried pipe on 150 mm bed of clean washed sand, shaped to accommodate hubs and fittings, to line and grade as indicated. Backfill with 150 mm of clean washed sand.

.4 Install above ground piping parallel and close to walls and ceilings to conserve headroom and space, and to grade as indicated.

3.2 Testing

.1 Pressure test buried systems before backfilling.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.3 Performance Verification

.1 Cleanouts:

.1 Ensure accessible and that access doors are correctly located.

.2 Open, cover with linseed oil and re-seal.

.3 Verify that cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Storm water drainage:

.1 Verify domes are secure.

.2 Ensure weirs are correctly sized and installed correctly.

.3 Verify provisions for movement of roof system.

.4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

3.4 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Summary

.1 Section Includes:

.1 The supply and installation of Plumbing Specialties and Accessories.

.2 Products Installed but not Supplied Under this Section:

.1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.

.2 Equipment installed by others.

.1 Connect with unions.

.3 Equipment not installed.

.1 Capped for future connection by others.

1.2 Related Section

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 74 11	Cleaning
.4	Section 01 74 19	Waste Management Disposal
.5	Section 01 78 00	Closeout Submittals
.6	Section 01 91 13	General Commissioning (Cx) Requirements
.7	Section 01 91 31	Commissioning (Cx) Plan
.8	Section 01 91 33	Commissioning Forms
.9	Section 01 91 41	Commissioning Training
.10	Section 01 91 51	Building Management Manual (BMM)
.11	Section 23 05 00	Common Work Results for Mechanical
.12	Section 23 08 01	Performance Verification Mechanical Piping Systems

1.3 References

.1 American Society for Testing and Materials (ASTM)

.1 ASTM A 126-95(2001), Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 ASTM B 62-93, Specification for Composition Bronze or Ounce Metal Castings.

.2 American Water Works Association (AWWA)

.3 Canadian Standards Association (CSA)

.1 CSA-B64 Series-01, Backflow Preventers and Vacuum Breakers.

.2 CSA-B356-00, Water Pressure Reducing Valves for Domestic Water Supply Systems.

.4 Plumbing and Drainage Institute (PDI)

.1 PDI-WH201-92, Water Hammer Arresters Standard.

.5 National Sanitation Foundation (NSF).

.1 NSF 61, Drinking Water System Components.

1.4 Submittals

.1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Indicate, for all plumbing specialties and accessories:

.1 Dimensions, construction details, roughing-in dimensions.

1.5 Closeout Submittals:

.1 Submit maintenance data in accordance with Section 01 78 00 – Closeout Submittals.

.2 Include:

.1 Description of plumbing specialties and accessories, giving manufacturer's name, type, model, year, capacity.

.2 Details of operation, servicing, maintenance.

.3 List of recommended spare parts.

1.6 Health and Safety

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.7 Delivery Storage and Disposal

.1 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with Section 01 74 19 – Waste Management Disposal.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan

.3 Fold up metal banding, flatten and place in designated area for recycling.

1.8 Quality Assurance

.1 All potable water system components shall conform to NSF Standard 61.

PART 2 PRODUCTS

2.1 Cleanouts

.1 Cleanout plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.

.2 Access covers:

.1 Wall access: face or wall type, polished nickel bronze or stainless steel round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.

.2 Floor access: round cast iron body and frame with adjustable secured nickel bronze top cast box with anchor lugs and:

.1 Plugs: bolted bronze with neoprene gasket.

.2 Cover for unfinished concrete floors: cast iron round gasket, vandal-proof screws.

.3 Cover for terrazzo finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws

.4 Cover for tile and linoleum floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.

.5 Cover for carpeted floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

2.2 Subsoil Drainage - Pump Station

.1 Provide as indicated on drawings, duplex subsoil drainage – pump station as specified herein or approved equal.

.2 The assembly shall be underground, two pumps, automatic sewage pump station. Each pump station shall be furnished with piping, valves, and all necessary automatic controls, two submersible pumps, float type liquid level controls and a duplex pump control panel. Provide fiberglass basin 914mm [36 inches] diameter, depth as indicated on drawings, filament would FRP construction, manufactured in accordance with ASTM D883-69 standard for filament wound underground fiberglass tanks. The chamber shall be furnished in one (1) main section 0.915 meters (36") diameter, 2.700 meters (110") deep for subsoil drain pump station. The interior to be sanitary white with a dark green exterior, UV stabilized. The bottom shall have a reinforced anti-floatation flange. Provide a slide rail assembly with lifting chains, sealing flange, pump carrier and galvanized rails to suit sump depth. Provide 150mm inlet, 50mm discharge, 2-50mm electrical and 100 mm vent coupling. All aluminum station cover shall be furnished with duplex pump hatch, non-slippery surface; hatch stay, recessed padlock and pad lock clip, lock hasp and upper rail support, BPS36 gastight.

.3 Pumps shall be heavy duty cast iron, non-clog type sewage, oil filled, submersible pumps. Each pump shall have a capacity of 3.8 L/s [60 gpm] against a total dynamic head of 32 kPa [25 ft] operating at a maximum speed of 3,450 RPM with a recessed non-clog type impeller which passes 50mm [2"] solids. Pump motors to be 1/2" HP, 208V, 3PH, 3450 RPM and 60 cycle. Pumps shall be furnished in standard construction c/w 20' of power cable and adaptors for pipe size indicated (2@ Myers WHR5H-03).

.4 Each pump shall be assembled complete with a lift-out slide rail system. Each rail shall include a 50mm (2") cast iron discharge assembly, upper and lower guide rail support, pump carrier and galvanized pump lifting chains.

.5 Provide 4 float type, non-mercury, liquid level controls for automatic pump control of the liquid level. A support bracket with strain relief connectors shall be supplied. A CEMA 4 junction box shall be provided for electrical connection.

FS#4 High water alarm

FS#3 Lag pump #2 on

FS#2 Lead pump #1 on

FS#1 Off-alternate pumps

.6 A duplex automatic 2 pump control panel shall be furnished in a CEMA 1 enclosure with the following equipment.

.1 Inner door mounted controls.

.2 Pump circuit breaker disconnects.

.3 Magnetic contactors with 3 leg overloads.

.4 H.O.A. selector switches for each pump.

.5 Run lights for each pump.

.6 Automatic alternator relay.

.7 Pump motor overload alarm and automatic interlock to lag pump.

.8 Lead-lag pump selector switch.

.9 High level alarm with buzzer, light and silencing switch, test switch and automatic reset.

.10 Provide also remote alarm panel to repeat light and buzzer signal, silencing switch and lamicoid label reading "High Water in Subsoil Drain Sump".

.11 Arrange with electrical contractor for wiring in accordance with manufacturer's installation instructions.

.7 Set inlet invert and supply cover plate frame for flush mounting in floor. Provide 50mm [2”] cast iron check valve and 50mm [2”] ball type isolation valve shall be factory installed on the discharge of each pump. Piping shall be schedule 40 PVC pipe fabricated to suit the installation. A 50mm [2”] discharge NPT coupling shall be furnished for connection to forcemain and field piping to complete the installation.

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with Canadian Plumbing Code provincial codes, and local authority having jurisdiction.

.2 Install in accordance with manufacturer's instructions and as specified.

3.2 Cleanouts

.1 In addition to those required by code, and as indicated, install at base of soil and waste stacks, and rainwater leaders.

.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

.3 Building drain cleanout and stack base cleanouts: line size to maximum NPS4.

3.4 Performance Verification:

.1 General:

.1 In accordance with Section 23 08 01 – Performance Verification Mechanical Piping Systems.

.2 PV procedures:

.1 Vacuum breakers, circulating pumps: operation under all conditions.

.2 Thermostatic controls: Verify temperature settings, operation of control, limit and safety controls.

3.5 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Summary

.1 Section Includes:

.1 The supply and installation of Plumbing Fixtures and Trim.

.2 Products Installed but not Supplied Under this Section:

.1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.

.2 Equipment installed by others.

.1 Connect with unions.

.3 Equipment not installed.

.1 Capped for future connection by others.

1.2 Related Section

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 74 11	Cleaning
.4	Section 01 74 19	Waste Management Disposal
.5	Section 01 91 13	General Commissioning (Cx) Requirements
.6	Section 01 91 31	Commissioning (Cx) Plan
.7	Section 01 91 33	Commissioning Forms
.8	Section 01 91 41	Commissioning Training
.9	Section 01 91 51	Building Management Manual (BMM)
.10	Section 23 05 00	Common Work Results for Mechanical

1.3 References

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA-B45 Series 02, Plumbing Fixtures.

.2 CAN/CSA-B125-01, Plumbing Fittings.

.3 CAN/CSA-B651-95 (R2001), Barrier-Free Design.

.2 National Sanitation Foundation (NSF).

.1 NSF 61, Drinking Water System Components.

1.4 Submittals

.1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Indicate, for all fixtures and trim:

.1 Dimensions, construction details, roughing-in dimensions.

1.5 Closeout Submittals:

.1 Submit maintenance data in accordance with Section 01 33 00 – Submittal Procedures.

1.6 Health and Safety

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.7 Delivery Storage and Disposal

.1 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with Section 01 74 19 – Waste Management Disposal.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan

.3 Fold up metal banding, flatten and place in designated area for recycling.

1.8 Quality Assurance

.1 All potable water system components shall conform to NSF Standard 61.

PART 2 PRODUCTS

2.1 Manufactured Units

.1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.

.2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.

.3 Exposed plumbing brass shall be chrome plated finish. Water supply piping exposed in finished areas shall be chrome plated brass pipe and fittings.

.4 Number, locations: architectural drawings to govern.

.5 Fixtures in any one location to be product of one manufacturer and of same type.

.6 Trim in any one location to be product of one manufacturer and of same type.

.7 Fixture Schedule:

FD- 1 Floor Drain

Floor Drain, all duco coated, 9" (220mm) dia. cast iron body, reversible flashing clamp with seepage openings, no-hub outlet round strainer, 6" (152mm) nickel bronze, back water valve. Cast iron "P" trap.

FD- 2 Floor Drain

Floor Drain, all duco coated large cast iron body, flashing clamp with seepage opening, 12-1/2" x 13-3/4" (318mm x 349mm) top, sediment bucket, galvanized cast iron body, cast iron hinged bar grate, nickel bronze veneer top, backwater valve.

PART 3 EXECUTION

3.1 Installation

.1 Mounting heights:

.1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.

3.2 Supplies

.1 Provide isolation valves or stops for every fixture or appliance connection.

3.3 Adjusting

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

3.4 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 61 00	Product Requirements
.4	Section 01 74 11	Cleaning
.5	Section 01 74 19	Waste Management Disposal
.6	Section 01 78 00	Closeout Submittals
.7	Section 23 05 05	Installation of Pipework
.8	Section 23 08 01	Performance Verification of Mechanical Piping Systems

1.2 References

.1 American Society of Mechanical Engineers (ASME)

- .1 ASME Boiler and Pressure Vessel Code Section VIII Pressure Vessels.
- .2 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
- .3 ASME B16.11-01, Forged Fittings, Socket-Welding and Threaded.

.2 American Society for Testing and Materials (ASTM)

- .1 ASTM A 53/A53M-04, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- .2 ASTM A 181/181M-01, Specification for Carbon Steel Forgings for General Purpose Piping.

.3 Canadian Standards Association (CSA)

- .1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

1.4 Quality Assurance

.1 Health and Safety:

- .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.5 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 – Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.7 Waste Management Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management Disposal.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan

.3 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 Piping

.1 Piping: to ASTM A 53/A53M, schedule 80 seamless Hot-Dipped, Zinc-Coated steel.

.2 Fittings:

.1 NPS2 and smaller: to ASME B16.11, schedule 80 Hot-Dipped, Zinc-Coated steel, threaded.

.2 NPS2 1/2 and larger: to ASME B16.11, schedule 80 Hot-Dipped, Zinc-Coated steel, grooved coupling.

.3 Hot-Dipped, Zinc-Coated Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.

.4 Hot-Dipped, Zinc-Coated Unions: 1000 kPa malleable iron with brass-to-iron ground seat.

.5 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner.

.6 Joints:

.1 NPS2 and smaller: threaded joints with Teflon tape.

.2 NPS2 1/2 and larger: grooved coupling.

2.2 Flexible Connectors

.1 Stainless steel flexible connector

.2 Type 304 stainless steel inner corrugated hose with Type 304 stainless steel outer braid.

.3 End fittings and length as noted on drawings to suit equipment.

.4 Standard of Acceptance: Twin City Hose

2.3 Blowdown Silencer

.1 Atmostpheric vent high-frequency silencer

.2 Expected attenuation 50 to 55 dBA

.3 Heavy duty, all welded carbon steel construction, flanged inlet

.4 Long strand glass wool packing

.5 Factory painted exterior finish, black

.6 Horizontal or vertical support arrangement

.7 Standard of Acceptance: Maxim Silencer VT-3

PART 3 EXECUTION

3.1 Piping Connections and Installations

.1 Install shut-off valves at outlets, major branch lines and elsewhere as indicated.

.2 Grade piping at 1% slope minimum.

.3 Provide compressed air piping system as indicated on drawings and specified herein. The drawings are schematic and do not show all structural and equipment details. Where accurate measurements are required, they shall be taken on site and reference shall be made to the Owner's equipment and detail floor arrangements for exact location of outlets and connection requirements.

3.2 Field Quality Control

.1 In accordance with Section 23 08 01 – Performance Verification of Mechanical Piping Systems

3.3 Cleaning

.1 In accordance with Section 01 74 11 – Cleaning and as specified herein.

.2 Blow out piping to clean interior thoroughly of oil and foreign matter.

.3 Check entire installation is approved by authority having jurisdiction.

.4 Perform cleaning operations in accordance with manufacturer's recommendations.

.5 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Read Division 1 General Requirements in conjunction with these specifications. Division 1 and this section shall form a part of and shall apply to all Mechanical Sections. The most stringent requirements of this and other Mechanical Sections must be adhered to.

.2 The Mechanical work shall consist of the supply and installation of complete and operable mechanical systems and shall include all necessary labour, plant, materials, and incidentals for the work involved as listed in the following division sections:

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 45 00	Quality Control
.4	Section 01 74 19	Waste Management Disposal
.5	Section 01 78 00	Closeout Submittals
.6	Section 01 91 13	General Commissioning (Cx) Requirements
.7	Section 01 91 31	Commissioning (Cx) Plan
.8	Section 01 91 33	Commissioning Forms
.9	Section 01 91 41	Commissioning Training
.10	Section 01 91 51	Building Management Manual (BMM)
.11	Division 22	Plumbing
.12	Division 23	Heating Ventilation & Air Conditioning

1.2 Submittals

.1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop drawings to show:

- .1 Mounting arrangements.
- .2 Operating and maintenance clearances.

.3 Shop drawings and product data accompanied by:

- .1 Detailed drawings of bases, supports, and anchor bolts.
- .2 Acoustical sound power data, where applicable.
- .3 Points of operation on performance curves.
- .4 Manufacturer to certify current model production.
- .5 Certification of compliance to applicable codes.

.4 In addition to transmittal letter referred to in Section 01 33 00 – Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

.5 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.3 Regulations

.1 Comply with most stringent requirements of NBC, Provincial and Municipal regulations and by-laws, specified standards, codes and this specification. Practices contained in these standards or standards suggested or recommended by reference organizations, are to be taken as minimum requirements.

.2 Furnish certificates confirming work installed conforms to requirements of authorities having jurisdiction.

.3 Drawings and specifications should not conflict with these Regulations but where there are apparent discrepancies, notify the Departmental Representative in writing and obtain clarifications before proceeding with the work.

1.4 Quality Assurance

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.5 Definitions

.1 Definitions used in this Division will have the following meaning:

.1 "Concealed": pipes, ducts, etc., in trenches, chases, furred spaces, pipe shafts, or hung ceilings.

.2 “Exposed": regarding insulation and painting of piping, ducts, etc., will mean that they are not "concealed", as defined herein.

.3 "Piping": includes, in addition to pipe, all fittings, valves, hangers, other accessories which comprise a system.

.4 "Provide": to supply and install, complete and ready for use.

1.6 Drawings

.1 Drawings:

.1 Are not intended to show structural details or architectural features.

.2 Are not to be scaled.

.3 Except where dimensioned, indicate general mechanical layouts only.

.4 The drawings are mainly schematic and do not attempt to show all offsets. Make required offsets at no additional cost to contract. Offset angles shall be as small as possible.

.2 Provide field (shop) drawings to indicate relative position of various services when required by Departmental Representative and obtain approval before commencing work.

1.7 Maintenance

.1 Furnish spare parts in accordance with Section 01 78 00 – Closeout Submittals as indicated in the detailed product specification clauses.

.2 Provide access doors for concealed expansion joints, traps, strainers, cleanouts, balance dampers, fire dampers, other parts requiring accessibility for operating and maintenance.

.3 In suspended panel ceilings, use panel in place of access door; provide in such panel a button or other means of identification and easy removal when necessary.

1.8 Delivery, Storage and Handling

.1 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management Disposal.

PART 2 PRODUCTS

2.1 Access Doors

.1 Access door size shall be as indicated and where not indicated, make 305mm x 406mm [12" x 16"] minimum or 610mm x 457mm [24" x 18"] where persons have to enter. For acoustical ceilings, conform to architectural panel pattern.

.2 Unless otherwise indicated, access doors shall be hinged, flush type, steel framed panel, 14 gauge minimum, satin finished galvanized steel or type 304 stainless steel, with anchor straps for wet areas, washrooms, and all walls finished in ceramic tile.

.3 Hinges shall be concealed, spring hinge to allow door to open 175°. Locking devices shall be flush cam type, screwdriver operated, doors and frames shall have prime coated rust inhibiting paint, unless made of stainless steel.

.4 Where doors are required in fire rated walls, access doors shall be uninsulated and for all fire rated ceilings and walls where maximum temperature rise limitation is applicable, shall be insulated. All fire rated access doors shall have Warnock Hersey or ULC listed 2 hour fire rating and shall be installed in accordance with NFPA 80 and manufacturer's installation instructions.

PART 3 EXECUTION

3.1 Co-ordination

.1 Co-ordinate work with work of other sections to avoid conflict.

.2 Locate distribution systems, equipment, and materials to provide minimum interferences and maximum usable space.

.3 Where interference occurs, Departmental Representative shall approve relocation of equipment and materials, regardless of installation sequence.

3.2 Cleaning

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.3 Cutting and Patching

.1 Make arrangements with General Contractor for all cutting and patching in this work.

.2 Minimize cutting and patching. Set sleeves and mark openings in concrete or masonry.

3.4 Waterproofing

.1 Where any work pierces waterproofing including waterproofing concrete, the method of installation shall be as approved by the Engineer before the work is done. Supply and install all necessary sleeves, caulking, roof curbs, and flashing required and make the openings watertight.

3.5 Protection of Work

.1 Protect equipment and material during construction from the weather, moisture, dust, painting, plastering and physical damage. Clean and return to "as new" condition.

.2 Mask or grease and cover machined surfaces. Firmly secure covers over equipment openings and open ends of piping, conduit and ductwork as work progresses. Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

.3 Any equipment that has operating parts, bearings or machined surfaces that show signs of rusting, pitting or physical damage will be rejected.

.4 Refinish damaged or marred factory finishes to the satisfaction of the Departmental Representative, using equal quality materials.

3.6 Field Quality Control

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 – Quality Control and submit report as described in PART 1 - SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Where specified, obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.7 Demonstration

.1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.3 Use operation and maintenance manual and as-built drawings as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 74 19	Waste Management Disposal
.2	Section 01 91 13	General Commissioning (Cx) Requirements
.3	Section 01 91 31	Commissioning (Cx) Plan
.4	Section 01 91 33	Commissioning Forms
.5	Section 01 91 41	Commissioning Training
.6	Section 01 91 51	Building Management Manual (BMM)
.7	Section 23 05 00	Common Work Results – Mechanical

1.2 References

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-1999, Ready-Mixed Organic Zinc-Rich Coating.

1.3 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used

PART 3 EXECUTION

3.1 Connections to Equipment

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

3.2 Clearances

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, or components.

3.3 Pipework Installation

.1 Protect openings against entry of foreign material.

.2 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.5 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.6 Install dielectric coupling between dissimilar metals.

3.4 Sleeves

.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

.2 Material: Schedule 40 black steel pipe.

.3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.

.4 Sizes: 6 mm minimum clearance between sleeve and un-insulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.

.2 Other floors: Terminate 25mm above finished floor.

.6 Sealing:

.1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.

.2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.

.3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.5 Escutcheons

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.

.3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe.

3.6 Cleaning of Piping Systems

.1 Before start-up, clean interior of piping systems.

.2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.7 Pressure Testing of Equipment and Pipework

.1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.

.2 Pipework: Test as specified in relevant sections.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.

.6 Conceal work only after approval and certification of tests by Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 74 19	Waste Management Disposal
.3	Section 01 78 00	Closeout Submittals
.4	Section 01 91 13	General Commissioning (Cx) Requirements
.5	Section 01 91 31	Commissioning (Cx) Plan
.6	Section 01 91 33	Commissioning Forms
.7	Section 01 91 41	Commissioning Training
.8	Section 01 91 51	Building Management Manual (BMM)
.9	Section 23 05 00	Common Work Results – Mechanical

1.2 References

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1-2001, Energy Code for Buildings Except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)

.3 Workplace Hazardous Material Information System (WHMIS)

1.3 Section Includes

.1 Electrical work to conform to Division 26 including the following:

.1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 23. Refer to Division 26 for quality of materials and workmanship.

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 33 00 – Shop Drawings, Product Data & Samples.

1.5 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.6 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management Disposal.

.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

.3 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

PART 2 PRODUCTS

2.1 General

.1 Motors to be high efficiency, in accordance with local Hydro company standards and the requirements of ASHRAE 90.1.

2.2 Motors

.1 Provide motors for mechanical equipment as specified.

.2 Motors under 373 W 1/2 HP : speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120V, unless otherwise specified or indicated.

.3 Motors 373 W 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, 3 phase, 208V, unless otherwise specified or indicated.

.4 Motors used with adjustable speed drives shall be designed specifically for application with adjustable speed controllers on variable torque loads, 20 through 60 Hz, from PWM or six step inverters and shall be so certified by the motor manufacturer.

2.3 Belt Drives

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.

.3 For motors under 7.5 kW 10HP: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5 kW 10HP and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave to be determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

2.4 Drive Guards

.1 Provide guards for unprotected drives.

.2 Guards for belt drives:

.1 Expanded metal screen welded to steel frame.

.2 Minimum 1.2mm thick sheet metal tops and bottoms.

.3 38mm dia. holes on both shaft centres for insertion of tachometer.

.4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.

.5 Guard for flexible coupling:

.1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.

.2 Securely fasten in place.

.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 19 mm mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

PART 3 EXECUTION

3.1 Installation

.1 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 74 19	Waste Management Disposal
.3	Section 01 78 00	Closeout Submittals
.4	Section 01 91 13	General Commissioning (Cx) Requirements
.5	Section 01 91 31	Commissioning (Cx) Plan
.6	Section 01 91 33	Commissioning Forms
.7	Section 01 91 41	Commissioning Training
.8	Section 01 91 51	Building Management Manual (BMM)
.9	Section 23 05 00	Common Work Results – Mechanical
.10	Section 23 05 13	Common Motor Requirements for HVAC Equipment
.11	Section 23 08 00	Commissioning of Mechanical Systems

1.2 References

.1 ANSI/UL 508 Industrial Control Equipment

.2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)

.3 Workplace Hazardous Material Information System (WHMIS)

1.3 Section Includes

.1 Electrical work to conform to Division 26 including the following:

.1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 23. Refer to Division 26 for quality of materials and workmanship.

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

1.5 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.6 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management Disposal.

.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

.3 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.7 Warranty:

.1 The VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer.

PART 2 PRODUCTS

2.1 General

.1 Furnish complete Variable Frequency Drives (VFD's), as specified herein, for mechanical equipment where noted on drawings, equipment schedules, or specifications.

.2 All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. VFD shall be housed in a metal NEMA 1 enclosure, or other NEMA type according to the installation and operating conditions at the job site. The VFD's UL listing shall allow mounting in plenum or other air handling compartments. If a NEMA 12 enclosure is required for the plenum rating, the manufacturer must supply a NEMA 12 rated VFD.

.3 The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control and to eliminate the need for motor de-rating.

.4 With the motor's rated voltage applied to the VFD input, the VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.

.5 The VFD shall include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.

.6 The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD, including all specified options, shall be assembled by the manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Assembly of the option panels by a third-party panel shop is not acceptable. The appropriate UL stickers shall be applied to both the VFD and option panel, in the case where these are not contained in one panel. When these VFDs are to be located in Canada, CSA or C-UL certifications shall apply. Both VFD and option panel shall be manufactured in ISO 9001 certified facilities.

.7 The VFD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFDs without DC link reactors shall provide a minimum 3% impedance line reactor.

.8 The VFD's full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.

.9 The VFD shall be able to provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without de-rating.

.10 An automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.

.11 Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.

.12 An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.

.13 Galvanic and/or optical isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs, not including either galvanic or optical isolation on both analog I/O and discrete I/O, shall include additional isolation modules.

.14 VFD shall minimize the audible motor noise through the used of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.

.15 Interface Features:

.1 Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference.

.2 The VFD shall be able to be programmed to provide a 24 V DC output signal to indicate that the VFD is in Auto/Remote mode.

.3 The VFD shall provide digital manual speed control. Potentiometers are not acceptable.

.16 Bypass:

.1 Provide a manual 3-contactor bypass consisting of a door interlocked main fused disconnect padlockable in the off position, a built-in motor starter and a four position DRIVE/OFF/BYPASS/TEST switch controlling three contactors. In the DRIVE position, the motor is operated at an adjustable speed from the VFD. In the OFF position, the motor and VFD are disconnected. In the BYPASS position, the motor is operated at full speed from the AC power line and power is disconnected from the VFD so that service can be performed. In the TEST position, the motor is operated at full speed from the AC line power while power is applied to the input of the VFD. This allows the VFD to be given an operational test while continuing to run the motor at full speed in bypass. In case of an external safety fault, a customer supplied normally closed dry contact shall be able to stop the motor whether in DRIVE or BYPASS mode.

.2 Service personnel shall be able to defeat the main power disconnect and open the bypass enclosure without disconnecting power. This shall be accomplished

through the use of a specially designed tool and mechanism while meeting all local and national code requirements for safety.

PART 3 EXECUTION

3.1 Installation

.1 Install per manufacturer's instructions.

.2 Install required safety labels.

3.2 Start-up Service

.1 The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.

.2 Commissioning:

.1 In accordance with Section 01 91 13 – General Commissioning (Cx) Requirements, and Section 23 08 00 – Commissioning of Mechanical Systems.

END OF SECTION

PART 1 GENERAL

1.1 Related Section

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 61 00	Product Requirements
.4	Section 01 74 11	Cleaning
.5	Section 01 74 19	Waste Management Disposal
.6	Section 01 78 00	Closeout Submittals
.7	Section 01 91 13	General Commissioning (Cx) Requirements
.8	Section 01 91 31	Commissioning (Cx) Plan
.9	Section 01 91 33	Commissioning Forms
.10	Section 01 91 41	Commissioning Training
.11	Section 01 91 51	Building Management Manual (BMM)
.12	Section 23 05 00	Common Work Results – Mechanical
.13	Section 23 05 48	Vibration & Seismic Control for Ductwork, Piping and Equipment

1.2 References

.1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

- .1 Seismic Restraint Manual, Guidelines for Mechanical Systems, 1998.

.2 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME):

- .1 ANSI/ASME B31.1-01, Power Piping, (SI Edition).

.3 American Society for Testing and Materials (ASTM):

- .1 ASTM A 125-1996, Specification for Steel Springs, Helical, Heat-Treated.
- .2 ASTM A 307-00, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- .3 ASTM A 563-00, Specification for Carbon and Alloy Steel Nuts.

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):

- .1 MSS SP58-1993, Pipe Hangers and Supports - Materials, Design and Manufacture.
- .2 MSS SP69-1996, Pipe Hangers and Supports - Selection and Application.
- .3 MSS SP89-1998, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 National Plumbing Code.

1.3 System Description

.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.

.2 Performance Requirements:

.1 Design supports and hangers to withstand seismic events as specified Section 23 05 48 – Vibration & Seismic Control for Ductwork, Piping and Equipment.

1.4 Submittals

.1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit shop drawings and product data for following items:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.3 Quality assurance submittals: submit following in accordance with 01 33 00 – Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.5 Quality Assurance

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 – Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management Disposal.

PART 2 PRODUCTS

2.1 General

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 Pipe Hangers

.1 Finishes:

.1 Pipe hangers and supports: galvanized after manufacture.

.2 Use electro-plating galvanizing process.

.3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

.2 Upper attachment to concrete.

.1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye [6] mm minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate to MSS SP69.

.3 Hanger rods: threaded rod material to MSS SP58.

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.4 Pipe attachments: material to MSS SP58.

.1 Attachments for steel piping: carbon steel galvanized.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

.5 Hanger rod attachment: material to MSS SP58.

.1 Use expansion anchor on existing concrete structure.

.6 Adjustable clevis: material to MSS SP 69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for rivetting to insulation shields.

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems per Section 23 05 48 – Vibration and Seismic Controls for HVAC Ductwork, Piping and Equipment.

.3 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations. Supporting piping from underside of light weight roof deck (without concrete) is not permitted.

3.2 Hanger Spacing

.1 HVAC piping: in accordance with table below.

.2 Plumbing piping: in accordance with the most stringent requirements of the table below as well as the following:

.1 National. Plumbing Code.

.2 Authority Having Jurisdiction.

.3 Pipe hanger rods shall be sized in accordance to SMACNA Seismic Restraint Manual based on Seismic Hazard Level (SHL). For SHL, see Section 23 05 48 – Vibration and Seismic Controls for HVAC Ductwork, Piping and Equipment.

MAXIMUM HANGER SPACING						
PIPE DIA. NPS	STEEL SCH.40	COPPER L,K Hard Drawn	CAST.I STD.	GLASS	ABS/PVC	PEX
1/2	1.8 m [6’-0”]	1.8 m [6’-0”]			1.2 m [4’-0”]	0.8 m [2’-6”]
3/4 & 1	2.4 m [8’-0”]	2.4 m [8’-0”]			1.2 m [4’-0”]	0.8 m [2’-6”]
1-1/4	2.4 m [8’-0”]	3.0 m [10’-0”]			1.2 m [4’-0”]	0.8 m [2’-6”]
1-1/2 & 2	2.4 m [8’-0”]	3.0 m [10’-0”]	3.0 m [10’-0”]		1.2 m [4’-0”]	0.8 m [2’-6”]
2-1/2, 3, 4 & 5	2.4 m [8’-0”]	3.0 m [10’-0”]	3.0 m [10’-0”]	2.4 m [8’-0”]	1.2 m [4’-0”]	0.8 m [2’-6”]

6 & 8	3.0 m [10’-0”]	3.0 m [10’-0”]	3.0 m [10’-0”]	2.4 m [8’-0”]	1.2 m [4’-0”]	0.8 m [2’-6”]

3.3 Hanger Installation

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.4 Horizontal Movement

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.5 Final Adjustment

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

3.6 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 74 11	Cleaning
.3	Section 01 74 19	Waste Management Disposal
.4	Section 01 91 13	General Commissioning (Cx) Requirements
.5	Section 01 91 31	Commissioning (Cx) Plan
.6	Section 01 91 33	Commissioning Forms
.7	Section 01 91 41	Commissioning Training
.8	Section 01 91 51	Building Management Manual (BMM)
.9	Section 23 05 00	Common Work Results – Mechanical

1.2 References

.1 National Building Code of Canada (NBC)

.2 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

.1 Seismic Restraint Manual, Guidelines for Mechanical Systems, 1998.

1.3 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Provide vibration isolation systems shop drawings complete with performance and product data. Shop drawings shall demonstrate compliance with the National Building Code and shall bear the seal of a Professional Engineer.

.3 Provide detailed drawings of all seismic restraint systems for piping and equipment.

1.4 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management Disposal.

.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

.3 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

PART 2 PRODUCTS

2.1 Vibration Isolation System – General

.1 Performance of vibration isolation systems shall be designed by manufacturer specializing in vibration isolation materials and devices.

.2 Size and shape of bases type shall be coordinated with submitted equipment.

.3 Products shall of the same manufacturer unless otherwise noted.

2.2 Elastomeric Pads

.1 Type EP1 - neoprene waffle or ribbed; 9 mm [3/8”] minimum thick; 50 durometer; maximum loading 350 kPa [50 psi].

.2 Type EP2 - rubber waffle or ribbed; 9 mm [3/8”] minimum thick; 30 durometer natural rubber; maximum loading 415 kPa [60 psi].

.3 Type EP3 - neoprene-steel-neoprene; 9 mm [3/8”] minimum thick neoprene bonded to 1.71 mm [16 gauge] steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa [50 psi].

.4 Type EP4 - rubber-steel-rubber; 9 mm [3/8”] minimum thick rubber bonded to 1.71 mm [16 gauge] steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa [60 psi].

2.3 Hangers

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, molded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with molded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with pre-compression washer and nut with deflection indicator.

2.4 Acoustic Barriers for Anchors and Guides

.1 Acoustic barriers: between pipe and support, consisting of 25 mm [1”] minimum thick heavy duty duck and neoprene isolation material.

2.5 Flexible Pipe Connectors

.1 Inner corrugated hose: stainless steel.

.2 Outer braid: Braided wire mesh stainless steel outer jacket.

.3 Type of end connection: threaded for 50mm [2”] or smaller; flange for 65mm [2-1/2”] or larger.

.4 Operating conditions:

.1 Working pressure: 1379 kPa [200 psi].

.2 Working temperature: 4540 °C [850 °F].

2.6 Seismic Control Measures

.1 General:

.1 Design anchorage and attachment methods for all systems and/or equipment as specified herein.

.2 Seismic control systems to work in all directions.

.3 Fasteners and attachment points to resist same maximum load as seismic restraint.

.4 Drilled or power driven anchors and fasteners not permitted.

.5 No equipment, equipment supports or mounts to fail before failure of structure.

.6 Supports of cast iron or threaded pipe not permitted.

.7 Seismic control measures not to interfere with integrity of firestopping.

.8 For equipment mounted on housekeeping pad, specify the minimum distance between anchor bolt and edge of housekeeping pad.

.2 Static equipment:

.1 Anchor equipment to equipment supports. Anchor equipment supports to structure.

.2 Seismic restraints:

.1 Cushioning action to be gentle and steady.

.2 Shall never reach metal-like stiffness.

.3 Vibration isolated equipment:

.1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

.2 Provide seismic restraints in addition to vibration isolation system to resist complete isolator unloading.

.4 Piping systems:

.1 Provide seismic restraints for all piping in accordance to the latest edition of SMACNA Seismic Restraint Manual as described below:

.1 All compressed air piping NPS 1 or larger.

.2 Seismic restraints may be omitted for the following conditions:

.1 All piping suspended by individual hangers 305mm [12”] or less in length, as measured from the top of the pipe to the bottom of the structural support for the hanger.

.3 To be compatible with requirements for anchoring and guiding of piping systems.

.4 Wet weight of piping shall be to be used for designing seismic restraint systems.

.5 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.

.6 Where cable is used for restraining vibration isolated piping systems, install cable with sufficient slack to avoid short-circuiting of vibration isolators.

.5 Ductwork systems:

.1 Provide seismic restraints for all ductwork in accordance to the latest edition of SMACNA Seismic Restraint Manual as described below:

.1 All rectangular ducts with cross sectional areas 0.56m^2 [6 ft^2] and larger.

.2 All round ducts with diameters 711 mm [28”] and larger.

.2 Seismic restraints may be omitted for the following conditions:

.1 All ductwork suspended by hangers 305mm [12”] or less in length, as measured from the top of the duct to the bottom of the structural support for the hanger.

.6 Bracing methods:

.1 Approved by Departmental Representative.

.2 Structural angles or channels.

.3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

PART 3 EXECUTION

3.1 Manufacturer’s Instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Installation

.1 Seismic control measures to meet requirements of NBC.

.2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.4 Where isolation is bolted to floor use vibration isolation rubber washers.

.5 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 Field Quality Control

.1 Provide the services of the Professional Engineer(s) who designed the restraint systems for "Field Review" of the installed components, and submit the following to the Departmental Representative:

.1 Assurance commitment letter, signed and sealed; provided at the commencement of the project.

.2 Signed and sealed shop drawings of seismic restraints for equipment, piping and ductwork; provided prior to installation.

.3 Typewritten inspection reports; provided during the construction period.

.4 Schedule C-B, signed and sealed; provided after performing “Field Review”.

3.4 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 61 00	Product Requirements
.4	Section 01 74 11	Cleaning
.5	Section 01 74 19	Waste Management Disposal
.6	Section 01 78 00	Closeout Submittals
.7	Section 01 91 13	General Commissioning (Cx) Requirements
.8	Section 01 91 31	Commissioning (Cx) Plan
.9	Section 01 91 33	Commissioning Forms
.10	Section 01 91 41	Commissioning Training
.11	Section 01 91 51	Building Management Manual (BMM)
.12	Section 23 05 00	Common Work Results – Mechanical

1.2 References

.1 Canadian Gas Association (CGA)
- .1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
- .2 CAN/CGSB-24.3, Identification of Piping Systems.

.3 National Fire Protection Association (NFPA)
- .1 NFPA 13, Standard for the Installation of Sprinkler Systems.
- .2 NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

1.3 Submittals

.1 Product Data:

.2 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.

.3 Product data to include paint colour chips, other products specified in this section.

.4 Samples:
- .1 Submit samples in accordance with 01 33 00 – Submittal Procedures.
- .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 Quality Assurance

.1 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.2 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.5 Delivery, Storage, and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 – Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 –Waste Management Disposal.

.2 Dispose of unused paint and coating material at official hazardous material collections site approved by Departmental Representative.

.3 Do not dispose of unused paint and coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

PART 2 - PRODUCTS

2.1 Manufacturer's Equipment Nameplates

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 System Nameplates

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	11 x 75	2	3
4	20 x 100	1	8

5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use maximum of 25 letters/numbers per line.

.4 Identification for PWGSC Preventive Maintenance Support System (PMSS):

.1 Use arrangement of Main identifier, Source identifier, Destination identifier.

.2 Equipment in Mechanical Room:

.1 Main identifier: Size #9.

.2 Source and Destination identifiers: Size #6.

.3 Terminal cabinets, control panels: Size #5.

.3 Equipment elsewhere: Sizes as appropriate.

2.3 Piping Systems Governed by Codes

.1 Identification:

.1 Natural gas: to CSA/CGA B149.1.

.2 Sprinklers: to NFPA 13.

2.4 Identification of Piping Systems

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.4 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 Other pipes: pressure sensitive [plastic-coated cloth] [vinyl] with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of

100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Departmental Representative.

.2 Colours for legends, arrows: to following table:

Background colour:	**Legend, arrows:**
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background Colour Marking	Legend
Storm water	Green	STORM
Condensate Drain	Green	CON. DRAIN

2.5 Identification Ductwork Systems

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.6 Valves, Controllers

.1 Plastic tags with 12 mm stamped identification data.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.7 Controls Components Identification

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.8 Language

.1 Identification in English.

PART 3 - EXECUTION

3.1 Manufacturer's Instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Timing

.1 Provide identification only after painting specified has been completed.

3.3 Installation

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide CSA registration plates as required by respective agency.

.3 Identify systems, equipment to conform to PWGSC PMSS.

3.4 Nameplates

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

3.5 Location of Identification on Piping and Ductwork Systems

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 Valves, Controllers

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.7 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 Related Sections

.1	Section 01 91 13	General Commissioning (Cx) Requirements
.2	Section 01 91 31	Commissioning (Cx) Plan
.3	Section 01 91 33	Commissioning Forms
.4	Section 01 91 41	Commissioning Training
.5	Section 01 91 51	Building Management Manual (BMM)

1.3 Qualifications of TAB Company

.1 Testing and balancing shall be performed by an agency that specializes in this type of work. Provide proof that the agency has successfully completed five projects of similar size and scope

.2 All work shall be performed by persons with proven ability and thoroughly versed in the type of testing and balancing. Submit names, complete with experience, record and references for review by the Consultant prior to work being carried out.

1.4 Purpose of TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate installed equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and installed equipment to regulate flow rates to match load requirements over full operating ranges.

1.5 Exceptions

.1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

.2 TAB of existing equipment already in operation.

1.6 Co-Ordination

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.7 Pre-TAB Review

.1 Review contract documents before project construction is started.

.2 Review specified standards and report to Departmental Representative in writing all proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.8 Start-Up

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.9 Operation of Systems during TAB

.1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.10 Start of TAB

.1 Notify Departmental Representative 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.1 Installation of ceilings, doors, windows, other construction affecting TAB.

.2 Application of weather-stripping, sealing, caulking.

.3 All pressure, leakage, other tests specified elsewhere Division 23.

.4 All provisions for TAB installed and operational.

.3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters in place, clean.

.2 Duct systems clean.

.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Access doors, installed, closed.

.8 Outlets installed, volume control dampers open.

1.11 Application Tolerances

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: plus 5%, minus 5%.

1.12 Accuracy Tolerances

.1 Measured values to be accurate to within plus or minus 2% of actual values.

1.13 Instruments

.1 Prior to TAB, submit to Departmental Representative list of instruments to be used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.14 Submittals

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.15 Preliminary TAB Report

.1 Submit for checking and approval of Departmental Representative prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.

.2 Details of TAB procedures employed.

.3 Calculations procedures.

.4 Summaries.

1.16 TAB Report

.1 Format to be in accordance with Associated Air Balance Council Manual.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.17 Verification

.1 Reported results subject to verification by Departmental Representative.

.2 Provide manpower and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results to be at discretion of Departmental Representative.

.4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.

1.18 Settings

.1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.19 Completion of TAB

.1 TAB to be considered complete when final TAB Report received and approved by Departmental Representative.

1.20 Air Systems

.1 Standard: TAB to be to most stringent of this section or TAB standards of ASHRAE.

.2 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop, temperatures (dry bulb, wet bulb, dew point, duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.3 Locations of equipment measurements: To include, but not be limited to, following as appropriate:

.1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.4 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.21 Other TAB Requirements

.1 Air terminal units:

.1 Check individually for correct operation and factory calibration of air volumes at "maximum" and "minimum" settings. Where calibration or adjustment is found to be necessary it shall be carried out as part of the balancing procedure. The mechanical contractor and the Departmental Representative shall be informed of the extent of recalibration required.

.2 Testing of Fire Dampers & Fire Stop Flaps:

.1 Conduct a "trip" test on all fire dampers and fire stop flaps to ensure that fire mechanisms function correctly and that dampers attain a fully closed position when tripped.

.2 Send a copy of test results tabulating the fire damper location, size, and date of trip test, to the Departmental Representative for record purposes. Copies shall also be inserted in Equipment Maintenance Manuals.

.3 Dampers and Flaps which fail to function correctly shall be re-tested after corrective action has been completed. Any fusible links damaged when conducting tests shall be replaced by this Contractor. A signed and dated test label shall be attached to each fire damper upon completion of test and resetting of fire damper.

1.22 CAD Drawings

.1 CAD drawing files of the heating and ventilating tender drawings will be made available to the Balancing Contractor if requested. An "Authorization to use CAD Drawing File" agreement restricting the use of the CAD files to the preparation of the project balancing reports must be signed prior to obtaining the files.

PART 2 - PRODUCTS

2.1 Not Used

.1 Not used.

PART 3 - EXECUTION

3.1 Not Used

.1 Not used.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 61 00	Product Requirements
.4	Section 01 74 11	Cleaning
.5	Section 01 74 19	Waste Management Disposal
.6	Section 01 78 00	Closeout Submittals
.7	Section 01 91 13	General Commissioning (Cx) Requirements
.8	Section 01 91 31	Commissioning (Cx) Plan
.9	Section 01 91 33	Commissioning Forms
.10	Section 01 91 41	Commissioning Training
.11	Section 01 91 51	Building Management Manual (BMM)
.12	Section 23 05 00	Common Work Results - Mechanical
.13	Section 23 05 29	Hangers and Supports for HVAC Piping and Equipment

1.2 References

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1-2004; Energy Standard for Buildings except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials International, (ASTM)

.1 ASTM B 209M-2010, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).

.2 ASTM C 335-2010, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C 411-2005, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C 449/C 449M-2000, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C 547-2007, Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C 553-2000, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C 612-2004, Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM C 795-2008, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.

.9 ASTM C 921-[92(1998)e1], Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-1989, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).

.5 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-M88 (R2000), Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-2001, Thermal Insulation Polyotrene, Boards and Pipe Covering.

.6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 Definitions

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED"-will mean "not concealed" as defined herein.

.2 TIAC Codes:

.1 CRD: Code Round Ductwork,

.2 CRF: Code Rectangular Finish.

1.4 Submittals

.1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Submittal Procedures.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.4 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

1.5 Quality Assurance

.1 Qualifications:

.1 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 – Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management Disposal.

.2 Place excess or unused insulation and insulation accessory materials in designated containers.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

PART 2 PRODUCTS

2.1 Fire and Smoke Rating

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C 335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612. Provide factory applied vapour retarder jacket to CGSB 51-GP-52Ma as scheduled in PART 3 of this Section.

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C 553. Provide factory applied vapour retarder jacket to CGSB 51-GP-52Ma as scheduled in PART 3 of this section.

.1 Mineral fibre: to ASTM C 553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to ASTM C 553.

.5 Evidence shall be provided to the Departmental Representative on the site of ULC listings of all products being used. Duct insulation adhesives and coatings shall be non-toxic as defined by WCB Regulations.

2.3 Jackets

.1 Canvas:

.1 [220] gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.2 Lagging adhesive: Compatible with insulation.

.2 Aluminum foil laminate:

.1 Multi-layer aluminum foil laminate; highly puncture and resistant, non-permeable vapour barrier for complete moisture protection. Inhibits mold growth. UL listed.

.2 Total thickness: 0.20 mm.

.3 Substrate thickness: 0.15 mm sheet.

.4 Finish: Aluminum, stucco embossed.

.5 Adhesive: cold weather acrylic adhesive.

2.4 Accessories

.1 Vapour retarder lap adhesive:

.1 Water based, fire retardant type, compatible with insulation.

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.

.4 Outdoor Vapour Retarder Mastic:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².

.5 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.6 Contact adhesive: quick-setting

.7 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation.

.8 Fasteners: 2 mm diameter pins with 35 mm square clips, length to suit thickness of insulation.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Pre-Installation Requirement

.1 Pressure testing of ductwork systems complete, witnessed and certified.

.2 Surfaces clean, dry and free from foreign material.

3.3 Installation

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer's instructions and as indicated.

.3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

.7 All ductwork exposed to weather shall have waterproof seams for weathertight construction. Exposed, ducts which are not insulated or finish painted, shall be coated with two applications of bitumastic waterproofing compound to prevent corrosion. Exposed ducts, which are insulated, shall have aluminum foil laminate jacket

3.4 Duct Insulation Schedules

.1 Insulation types and thicknesses: Conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Supply, return and exhaust ducts exposed in space being served			None
Outside air ducts to mixing plenum	C-1	Yes	25

Exhaust ducts between dampers and louvers	C-1	No	25
Acoustically lined ducts			None

.2 Finish: Conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, concealed	None	None
Indoor, exposed elsewhere	CRF/2	CRD/3

3.5 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 61 00	Product Requirements
.4	Section 01 74 11	Cleaning
.5	Section 01 74 19	Waste Management Disposal
.6	Section 01 78 00	Closeout Submittals
.7	Section 01 91 13	General Commissioning (Cx) Requirements
.8	Section 01 91 31	Commissioning (Cx) Plan
.9	Section 01 91 33	Commissioning Forms
.10	Section 01 91 41	Commissioning Training
.11	Section 01 91 51	Building Management Manual (BMM)
.12	Section 23 05 00	Common Work Results - Mechanical
.13	Section 23 05 29	Hangers and Supports for HVAC Piping and Equipment

1.2 References

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1-2004; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM B 209M-2010, Specification for Aluminum and Aluminum Alloy Sheet and Plate [Metric].

.2 ASTM C 335-2010, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C 411-2005, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C 449/C449M-2000, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C 534-2007, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

.6 ASTM C 795-2008, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.7 ASTM C 921-2002, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.4 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Surface Burning characteristics of Building Materials and Assemblies.

1.3 Definitions

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED"-will mean "not concealed" as defined herein.

.2 TIAC Codes:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.4 Submittals

.1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Submittal Procedures.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.4 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

1.5 Quality Assurance

.1 Qualifications:

.1 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 – Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management & Disposal.

.2 Place excess or unused insulation and insulation accessory materials in designated containers.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

PART 2 - PRODUCTS

2.1 Fire and Smoke Rating

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C 335.

.3 TIAC Code A-1: Rigid molded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/CGSB-51.9.

.2 Maximum "k" factor: to CAN/CGSB-51.9.

.4 TIAC Code A-3: Rigid molded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/CGSB-51.9.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/CGSB-51.9.

.5 TIAC Code C-2: Mineral fibre blanket faced [with] [without] factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: to CAN/ULC-S702.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702.

.6 TIAC Code A-6: Flexible unicellular tubular elastomer.

.1 Insulation: flexible closed-cell elastomer to ASTM C534.

.2 Jacket: to CGSB 51-GP-52Ma. Required for outdoor application.

.3 Maximum "k" factor: 0.27.

.4 Vapour transmission: 0.08 perm-inch.

.5 To be certified by manufacturer to be free of potential stress corrosion cracking corrodants.

.7 To be formaldehyde free, low VOC; resists mold and mildew.

.8 Evidence shall be provided to the Engineer on the site of ULC listings of all products being used. Duct insulation adhesives and coatings shall be non-toxic as defined by WCB Regulations.

2.3 Insulation Securement

.1 Tape: Self-adhesive, aluminum, reinforced, 50mm wide minimum.

.2 Contact adhesive: Quick setting.

.3 Canvas adhesive: Washable.

.4 Tie wire: 1.5mm diameter stainless steel.

.5 Bands: Stainless steel, 19mm wide, 0.5mm thick.

2.4 Cement

.1 Thermal insulating and finishing cement:

.1 To CAN/CGSB-51.12.

.2 Hydraulic setting or Air drying on mineral wool, to ASTM C 449.

2.5 Vapour Retarder Lap Adhesive

.1 Water based, fire retardant type, compatible with insulation.

2.6 Indoor Vapour Retarder Finish

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 Outdoor Vapour Retarder Finish

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m.

2.8 Jackets

.1 Polyvinyl Chloride (PVC):

.1 One-piece molded type and sheet to CGSB 51-GP-53M with pre-formed shapes as required.

.2 Colours: White.

.3 Minimum service temperatures: 20°C [68°F].

.4 Maximum service temperature: 65°C [150°F].

.5 Moisture vapour transmission: 0.02 perm.

.6 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.2 Canvas:

.1 220 and 120 gm/m cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.2 Lagging adhesive: Compatible with insulation.

.3 Aluminum foil laminate:

.1 Multi-layer aluminum foil laminate; highly puncture and resistant, non-permeable vapour barrier for complete moisture protection. Inhibits mold growth. UL listed.

.2 Total thickness: 0.20 mm.

.3 Substrate thickness: 0.15 mm sheet.

.4 Finish: Aluminum, stucco embossed.

.5 Adhesive: cold weather acrylic adhesive.

PART 3 - EXECUTION

3.1 Pre-Installation Requirement

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces to be clean, dry and free from foreign material.

3.2 Installation

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer's instructions and this specification.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 Removable, Pre-fabricated, Insulation and Enclosures

.1 Application: At expansion joints, valves, primary flow measuring elements flanges and unions at equipment.

.2 Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: PVC.

3.4 Installation of Elastomeric Insulation

.1 Insulation to remain dry at all times. Overlaps to manufacturer's instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.5 Piping Insulation Schedules

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1.

.1 Securements: SS Bands at 300mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.

.1 Securements: SS Bands at 300mm on centre.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.4 TIAC Code: A-6.

.1 Seals: lap seal adhesive, lagging adhesive.

.2 Installation: TIAC Code: 1501-CA; per manufacturer's recommendation.

.5 TIAC Code: C-2 with vapour retarder jacket.

.1 Insulation securements: SS Bands at 300mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.6 Thickness of insulation to be as listed in following table.

.1 Run-outs to individual units and equipment not exceeding 4000mm long.

.2 Do not insulate exposed run-outs to plumbing fixtures, chrome plated piping, valves, fittings.

Application	**Temp °C**	**TIAC Code**	**Run out**	**To NPS1**	**1¼-2**	**2½-4**	**5-6**	**8 & over**
Condensate Drain		A-3	25	25	25	25	25	25

.7 Finishes:

.1 Exposed indoors: Canvas and/or PVC jacket.

.2 Exposed in mechanical rooms: Canvas and/or PVC jacket.

.3 Concealed, indoors: ASJ, no further finish.

.4 Exposed outdoors: Aluminum foil laminate.

3.6 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1	Section 01 91 13	General Commissioning (Cx) Requirements
.2	Section 01 91 31	Commissioning (Cx) Plan
.3	Section 01 91 33	Commissioning Forms
.4	Section 01 91 41	Commissioning: Training
.5	Section 01 91 51	Building Management Manual (BMM)
.6	Section 23 05 93	Testing, Adjusting and Balancing for HVAC
.7	Section 25 05 01	EMCS: General Requirements

1.2 Quality Assurance

.1 The commissioning of mechanical systems shall be executed in accordance with the intent of ASHRAE Standard 1-1996 “Guideline for Commissioning of HVAC Systems” and CSA-Z-320 “Building Cx Standard and Check Sheets”.

1.3 General

.1 Commissioning of the mechanical systems, including the HVAC, and Plumbing and Drainage Systems, shall be carried out by an independent Commissioning Agent acceptable to the Departmental Representative with technicians specifically trained in commissioning procedures.

.2 The General Contractor shall retain an independent professional commissioning agent, who shall be active in the commissioning process and actively encourage his own forces and sub-trades to work together to achieve optimum system performance for the mechanical systems in a timely manner. Refer to Section 01 91 13 – General Commissioning (Cx) Requirements for additional requirements.

.3 It is not intended that this work shall, in any way, replace normal factory start-up service for equipment or relieve the Contractor or his sub-trades of their responsibility for providing first-class installation in satisfactory working order.

.4 As part of the final commissioning report, submit a Certificate stating that the commissioning procedures have been completed, that complete factual reports have been distributed and that directions have been given to the Contractor to correct faults and omissions and finally, that follow-up testing, after the correction of faults and omissions has been completed and recorded.

.5 Be responsible for the performance and commissioning of all equipment supplied under the Sections of Division 22 and 23. Commissioning is the process of advancing the installation from the stage of static completion to full working order in accordance with the contract documents and design intent. It is the activation of the completed installation.

.6 In consultation with the General Contractor, ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all mechanical systems.

1.4 Commissioning and Demonstration

.1 Submit a schedule for the commissioning phase of the work. This schedule shall show:

.1 Equipment start-up schedule.

.2 Submission dates for the various documents required prior to substantial completion.

.3 Timing of the commissioning, testing, balancing, and demonstration process.

.2 Commissioning is concluded when the air and water system is balanced and the installation is in full working order and acceptable for use. The work shall include the following:

.1 Balancing of the air systems as specified in this section.

.2 Set up air diffusers, registers and grilles for optimum distribution/comfort.

.3 Plug all air pressure and flow measuring holes.

.4 Adjust vibration isolators and earthquake restraints for optimum performance.

.5 Verification and certification of the sealing of all HVAC penetrations through fire separations (rated & non-rated) and sound separations. Forms in Section 23 08 02 shall be used for this purpose.

.6 Verification of water tightness of all roof and exterior wall penetrations.

.7 Verification that coil drain pan operates.

.8 Set up all automatic control valves/dampers and automatic temperature control devices.

.9 Set up and test all alarm and protective devices.

.10 EMCS:

.1 Commissioning of EMCS is primarily responsible by Controls Contractor. Refer to Section 25 05 01 - EMCS General Requirements.

.2 The Commissioning Agent shall assign one person experienced and qualified in commissioning control systems through practical experience and a comprehensive knowledge of the interactive nature of HVAC systems and DDC controls **to verify** the performance of the control systems by conducting random tests of the control sequences until the Commissioning Agent is satisfied that the controls are performing according to the intended control sequences.

.3 The Controls Contractor shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Controls Contractor in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Controls Contractor for the purchase price of the material.

.3 At the conclusion of commissioning, demonstrate the operation of the systems to the Departmental Representative. For demonstration and instruction to Operating staff requirements, refer to this section of the specification and also to section 25 05 01 - EMCS: General Requirements.

.4 The verification process shall include the demonstration of the following:

.1 The ease of access that has been provided throughout for servicing coils, motors, drives, control dampers and damper operators.

.2 Location of and opening and closing of all access panels.

.3 Operation of all automatic control dampers and automatic temperature control devices.

.4 Operation of all alarm and protective devices.

.5 Operation of all equipment and systems under each mode of operation, and failure.

.5 At the completion of commissioning, testing, balancing and demonstration submit the following to the Departmental Representative:

.1 A letter certifying that all work specified under this contract is complete, clean and operational in accordance with the specification and drawings.

.2 Completed copies of all commissioning check lists plus copies of start-up reports from specialty contractors and vendors.

.3 “As-Built” record drawings, as specified.

.4 A list of all alarm and protective devices tested, with the final operating settings.

.6 Training:

.1 During "Substantial Performance" review, the Mechanical Contractor, Control Sub-contractor, and other Sub-contractors designated by the Cx Agent shall provide training to the operating personnel in the proper operation and maintenance of all systems and equipment installed under the contract.

.2 It shall be the Mechanical Contractor's responsibility to have the specified equipment manuals prepared, previously approved by the Cx Agent, and ready for presentation to the Cx Agent at this meeting.

.3 Convene the meeting with the aforementioned parties at the time called for in the substantial performance review. The arrangements shall include written notices to all the parties concerned. Should the equipment manuals, or system installation not be complete and operable at the proper time, he shall then convene the operating instruction meeting at a later date and pay any additional costs including time and travelling expenses for the personnel involved which are attributable to the delay.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1	Section 22 42 01	Plumbing Specialties and Accessories
.2	Section 01 91 13	General Commissioning (Cx) Requirements
.3	Section 01 91 31	Commissioning (Cx) Plan
.4	Section 01 91 33	Commissioning Forms
.5	Section 01 91 41	Commissioning Training
.6	Section 01 91 51	Building Management Manual (BMM)

1.2 Storm Drainage Systems

.1 Buried systems: Perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.

.2 Cleanouts: Refer to Section 22 42 01 - Plumbing Specialties and Accessories.

PART 2 - PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 - EXECUTION

3.1 Testing and Performance Verification (PV)

.1 Record test results and submit reports of tests to Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 74 19	Waste Management Disposal
.2	Section 01 91 13	General Commissioning (Cx) Requirements
.3	Section 01 91 31	Commissioning (Cx) Plan
.4	Section 01 91 33	Commissioning Forms
.5	Section 01 91 41	Commissioning Training
.6	Section 01 91 51	Building Management Manual (BMM)
.7	Section 23 05 00	Common Work Results-Mechanical
.8	Section 23 05 93	Testing Adjusting and Balancing for HVAC

1.2 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management Disposal.

.2 Dispose of unused cleaning solutions at official hazardous material collections site approved by the Departmental Representative.

.3 Do not dispose of unused cleaning solutions into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.

.4 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.5 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.3 Scope

.1 All air systems installed by this contract shall be cleaned by a Cleaning Contractor.

.2 The Cleaning Contractor shall visit the site in the case of existing systems or shall review the drawings and specifications of new systems, in order to be fully acquainted with the scope of work and requirements before tendering. No consideration will be granted for any misunderstanding of work to be done resulting from failure to visit the site or inspect the contract documents.

.3 The following air systems shall be cleaned, as applicable:

- .1 Relief
- .2 Supply
- .3 Return
- .4 Exhaust
- .5 Air Conditioning

.4 All components within each system shall be thoroughly cleaned to the Departmental Representative's satisfaction and shall include but not be limited to the following:

- .1 Intake exhaust and relief louvres
- .2 Bird screens

.3 Auto dampers

.4 Filter frames

.5 Fans & motors - complete assembly

.6 All plenum surfaces

.7 Terminal heating/cooling coils

.9 Supply air grilles, registers and diffusers

.10 Ductwork

.11 Mixing boxes, air terminal units

.12 Return, exhaust and relief air grilles and diffusers.

1.4 Qualifications

.1 Cleaning shall be performed by a cleaning service company with high capacity cleaning equipment designed specifically for the work involved, executed by personnel specifically trained for the application.

PART 2 PRODUCTS

2.1 Cleaning Equipment

.1 Cleaning shall generally by high capacity power vacuum.

.2 High pressure compressed air, wire brushing and/or non-toxic solvent cleaning shall be used where dirt or scale cannot be removed otherwise.

PART 3 EXECUTION

3.1 Cleaning HVAC Systems

.1 The Cleaning Contractor shall provide access as required for the work and shall reseal and make good any duct or insulation damaged in the process of this work.

.2 Remove cheesecloth from grilles, etc., let over from the temporary use of the air systems.

.3 Air systems must not be shut down without prior approval from the owner

.4 The Cleaning Contractor shall be responsible for removing and replacing filter media. In new buildings this Contractor will remove the temporary filters and replace with new after cleaning the systems. In existing buildings this Contractor may re-use existing filter media (cleaned if possible) or new media will be provided by the Owner as established by the Departmental Representative.

.5 The Cleaning Contractor shall mark balancing damper positions before cleaning and return them to their original position when cleaning is completed unless the system is to be balanced.

.6 Re-install any grilles, registers and diffusers which may have been removed for cleaning purposes.

3.2 Report

.1 After completion of the work, the Contractor shall provide four copies of a certificate stating that all systems have been cleaned as specified and that all access panels for all cleaning openings are in place. This certificate shall be placed in the Operating and Maintenance Manuals.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 74 11	Cleaning
.4	Section 01 74 19	Waste Management Disposal
.5	Section 01 91 13	General Commissioning (Cx) Requirements
.6	Section 01 91 31	Commissioning (Cx) Plan
.7	Section 01 91 33	Commissioning Forms
.8	Section 01 91 41	Commissioning Training
.9	Section 01 91 51	Building Management Manual (BMM)
.10	Section 23 05 00	Common Work Results - Mechanical
.11	Section 23 05 48	Vibration and Seismic Controls for Ductwork, Piping and Equipment
.12	Section 23 07 13	Thermal Insulation for Ducting

1.2 References

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 American Society for Testing and Materials (ASTM)

.1 ASTM A 480/A 480M-2003c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A 635/A 635M-2002, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.

.3 ASTM A 653/A 653M-2003, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 Department of Justice Canada (Jus).

.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33 .

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.5 National Fire Protection Agency (NFPA)

.1 NFPA 90A-1999, Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B-1999, Installation of Warm Air Heating and Air Conditioning Systems.

.3 NFPA 91-1995, Standard for Exhaust System for Air Conveying of Vapours, Gases, Mists, and Non-combustible Particle Solids.

.6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.

.2 SMACNA HVAC Duct Leakage Test Manual, 1985, Technical Research Update-92.

.3 IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.

.7 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 Submittals

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets for the following:

.1 Sealants.

.2 Adhesive

.3 Duct tape.

.4 Duct liners.

1.4 Quality Assurance

.1 Certification of Ratings:

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.5 Delivery Storage and Handling

.1 Protect on site stored or installed absorptive material from moisture damage.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with 01 74 19 – Waste Management Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

.4 Separate for reuse and recycling and place in designated containers in accordance with Waste Management Plan.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.7 Fold up metal and plastic banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 Seal Classification

.1 Classification as follows:

Pressure Class	Maximum Pressure (Pa)	SMACNA Seal Class
Low Pressure	500	[B]

.2 Seal classification:

.1 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

2.2 Ductwork - General

.1 Duct dimension noted on drawings are clear inside dimensions. Insulation thickness shall be as noted on the drawings.

.2 All seams, joints and raw edges shall be sealed and covered with glassfab.

.3 Insulation shall be applied with mechanical fasteners and suitable adhesives. Duct insulation adhesive and coatings shall be non-toxic as defined by WCB Regulations.

.4 Round duct: with spiral seams. Sections shall be joined with a RT1 slip joint, screw fastened and sealed with no visible duct sealant to interfere with finish painting.

.5 Exposed round duct shall be installed in a neat workmanlike manner parallel to building walls and roof with no sags or misalignment, and shall be true and round.

2.3 Fittings

.1 Fabrication: to SMACNA. Fittings shall be 2 gauges heavier than connecting ductwork.

.2 Radius elbows:

.1 Rectangular: Centre-line radius equal to 1.5 times width of duct, with single thickness turning vanes.

.2 Round: Centre-line radius equal to 1.5 times diameter. 5-gore for 300mm [12”] and larger; die-stamped for 254mm [10”] and smaller.

.3 Mitered elbows, rectangular:

.1 To 400mm [16”]: with single thickness turning vanes.

.2 Over 400mm [16”]: with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: 45° entry on branch.

2 Round main and branch: enter main duct at 45° or with conical connection. The use of spin-in collars is not acceptable.

.5 Transitions:

.1 Diverging: 20° maximum angle.

.2 Converging: 30° maximum angle.

.6 Offsets: full radius elbows.

.7 Obstruction deflectors: maintain full cross-sectional area.

.8 Elbows in autoclave exhaust shall be unvaned, smooth radius construction with centre-line equal to 1.5 times width of duct.

2.4 Galvanized Steel

.1 Lock forming quality: to ASTM A 653, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA.

.4 Applications:

.1 All supply and exhaust ductwork unless otherwise noted.

2.5 Hangers and Supports

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500mm [20”].

.2 Hangers, hanger configuration and attachment to structure: to SMACNA.

2.6 Duct Liner

.1 Fibrous glass duct liner: air stream side faced with FSK facing.

.2 Rigid:

.1 Use on flat surfaces.

.2 25mm [1”] or 50mm [2”] thick fibrous glass rigid board duct liner.

.3 Density: 36 kg/m³ [2.2 lb/ft^3].

.4 Thermal resistance: RSI-0.76 [R-4.3] for 25mm [1”], RSI-1.53 [R-8.7] 50mm [2”].

.3 Flexible:

.1 Use on round or oval surfaces.

.2 25mm [1”] or 50mm [2”] thick fibrous glass blanket duct liner as indicated.

.3 Density: 24 kg/m³ [1.5 lb/ft^3].

.4 Thermal resistance: RSI-0.74 [R-4.2] for 25mm [1"], RSI-1.47 [R-8.3] 50mm [2"].

.4 Fasteners shall be weld pins with metal retaining clips and square head.

.5 Flame and smoke ratings:

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.7 Sealant

.1 Oil resistant, polymer-based duct sealant. Temperature range of -23°C to 65°C [-10°F to 150°F]. ULC listed and comply with NFPA 90A and NFPA 90B.

.2 Flame and smoke ratings:

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.8 Adhesive

.1 Water-based vinyl copolymer adhesive. Temperature range of -23°C to 71°C [-10°F to 160°F]. ULC listed and comply with NFPA 90A and NFPA 90B. Adhesive shall be non-toxic as defined by W.C.B. Regulations.

.2 Flame and smoke ratings:

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.9 Duct Tape System

.1 Two part system combined of treated woven fibreglass tape and liquid sealant/adhesive. ULC listed and comply with NFPA 90A and NFPA 90B.

.2 Flame and smoke ratings:

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

PART 3 EXECUTION

3.1 General

.1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE, SMACNA, and as indicated.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

.7 All openings in ductwork shall be sealed with temporary duct cover during construction. Failure to maintain duct cleanliness will require the inside of all air ducts, plenums and equipment in the air stream to be cleaned with an industrial vacuum cleaner before system balancing is started.

.8 Apply protective galvanize coating to galvanized ductwork and accessories which have been welded.

.9 Apply duct sealer to all joints of metal ducts, connections to diffusers, plenums and flexible duct.

.10 Provide medium pressure duct for the following:

.1 Ductwork serving systems with air terminal units, extending from the air handling unit discharge to the inlet of air terminal units.

.2 As indicated.

.11 The use of plastic duct tape is not permitted.

.12 Thermal insulation to Section 23 07 13 – Thermal Insulation for Ducting.

3.2 Hangers

.1 Strap hangers: Install in accordance with SMACNA.

.2 Rectangular duct: Extend strap hanger down on both sides of duct, turn under bottom 25mm [1”] minimum. On each strap provide two sheet metal screws on the side and one in the bottom.

.3 Angle hangers: complete with locking nuts and washers.

.4 Hanger spacing: to SMACNA.

.5 Seismic restraint to Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

3.3 Duct Liner

.1 Install in accordance with manufacturer's recommendations, and as follows:

.1 Fasten to interior sheet metal surface with 100% coverage of adhesive.

.2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425mm on centres.

.2 Line inside of ducts where indicated.

.3 Duct dimensions, as indicated, are clear inside duct lining.

.4 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:

.1 Bed tape in sealer.

.2 Apply two coats of sealer over tape.

.5 Replace damaged areas of liner.

.6 Protect leading and trailing edges of duct sections with sheet metal nosing having 15mm [1/2”] overlap and fastened to duct.

.7 Provide 50mm [2”] liner for ductwork exposed to weather which is not insulated

3.4 Sealing and Taping

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

3.5 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 74 11	Cleaning
.4	Section 01 74 19	Waste Management Disposal
.5	Section 01 78 00	Closeout Submittals
.6	Section 01 91 13	General Commissioning (Cx) Requirements
.7	Section 01 91 31	Commissioning (Cx) Plan
.8	Section 01 91 33	Commissioning Forms
.9	Section 01 91 41	Commissioning Training
.10	Section 01 91 51	Building Management Manual (BMM)
.11	Section 23 05 00	Common Work Results - Mechanical

1.2 References

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

- .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 1995 and Addendum No. 1, 1997.

.2 National Fire Protection Association (NFPA)

- .1 NFPA 90A-2009, Installation of Air Conditioning and Ventilating Systems.
- .2 NFPA 90B-2009, Installation of Warm Air Heating and Air Conditioning Systems.

.3 Underwriter's Laboratories of Canada (ULC)

- .1 CAN/ULC-S110-M86(R2001), Fire Tests for Air Ducts.
- .2 UL 181-1996, Factory Made Air Ducts and Connectors.

1.3 Submittals

.1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
  - .1 Flexible connections.
  - .2 Duct access doors.
  - .3 Turning vanes.
  - .4 Instrument test ports.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturer's Field Reports: manufacturer's field reports specified.

.7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.4 Quality Assurance

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 – Health Safety Requirements.

1.5 Delivery, Storage and Handling

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan (WMP).

.4 Separate for reuse and recycling and place in designated containers in accordance with Waste Management Plan (WMP).

.5 Divert unused materials from landfill to recycling facility as approved by Departmental Representative.

PART 2 PRODUCTS

2.1 General

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 Flexible Duct

.1 General:

.1 UL-181 listed and labeled as Class I air duct, and complies with NFPA 90A and 90B.

.2 Non-metallic, Insulated:

.1 Constructed of CPE liner duct permanently bonded to a spring steel wire helix and with factory applied fibreglass insulation, lower permeability vapour barrier and laminate jacket for low and medium pressure systems.

.2 Maximum rated pressure: 1,000Pa [4” w.g.] positive, 250Pa [1” w.g.] negative.

.3 Operating temperature: -29 to 121 °C [-20 to 250 °F].

.4 Thermal resistance: RSI-0.74 [R-4.2].

.5 Application: cold air supply duct.

.3 Non-metallic, un-insulated:

.1 Constructed of supporting helix of coated spring steel wire permanently bonded to a coated woven fiberglass.

.2 Maximum rated pressure: 2,500Pa [10" w.g.] positive, 250Pa [1" w.g.] negative.

.3 Operating temperature: -18 to 121 °C [-0 to 250 °F].

.4 Application: warm air supply duct.

2.3 Flexible Duct Connectors

.1 Frame: galvanized sheet metal frame 0.66mm [24 gauge] thick with fabric clenched by means of double locked seams.

.2 Fabric:

.1 Indoor: Fire resistant, self extinguishing, neoprene coated fibreglass fabric, temperature rated at -40°C to 90°C [-40°F to 200°F], thickness of 0.63mm [0.025"].

.2 Outdoor: Fire resistant, self extinguishing, DuPont Hypalon coated fibreglass fabric, temperature rated at -40°C to 120°C [-40°F to 250°F], thickness of 0.61mm [0.024"].

2.4 Access Doors in Ducts

.1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6mm [24 gauge] thick complete with sheet metal angle frame.

.2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6mm [24 gauge] thick complete with sheet metal angle frame and 25mm [1"] thick rigid fibreglass insulation.

.3 Gaskets: neoprene.

.4 Hardware:

.1 Up to 300 x 300 mm: two sash locks complete with safety chain.

.2 301 to 450 mm: four sash locks complete with safety chain.

.3 451 to 1000 mm: piano hinge and minimum two sash locks.

.4 Doors over 1000 mm: piano hinge and two handles operable from both sides.

2.5 Turning Vanes

.1 Factory-made, single or double thickness as specified elsewhere, with trailing edge. Vanes shall be constructed of same material as duct, 0.55mm [26 gauge].

.2 Rails shall be fabricated of same material as duct, 0.66m [24 gauge]. Vanes shall be attached to rails using fasteners.

2.6 Instrument Test Ports

.1 Alloy casting with screw-in cap, neoprene gasket, 18 mm [3/4"] inside diameter opening for pitot tube or velometer.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 Installation

.1 Flexible Duct

.1 Provide flexible duct connecting air outlets as indicated. Flexible duct with integral volume damper is not acceptable.

.2 Install flexible duct fully extended, without tight bends and kinks. The radius at the centre-line shall not be less than one duct diameter. Do not install in compressed state.

.3 Length of flexible duct shall note exceed 1,800mm (6'-0").

.4 Provide support for flexible duct at 1,200mm (4'-0") on centre. Maximum permissible sag is 42 mm/m (1/2 inch per foot) of spacing between supports. A connection to a rigid duct or equipment shall be considered a support joint.

.5 Sheet metal strap for flexible duct support shall be minimum 38mm (1-1/2") wide.

.6 Sheet metal collars to which the flexible ducts are attached shall be minimum 50mm (2") in length.

.7 Repair torn or damaged vapour barrier jackets approved duct tape. If the internal core is penetrated, replace the flexible duct.

.8 Do not use flexible duct for connecting mixing box and air terminal unit inlets.

.9 Do not use flexible duct on return and exhaust ductwork.

.2 Flexible Duct Connectors

.1 Install in following locations:

.1 Inlets and outlets to supply air units and fans.

.2 Inlets and outlets of exhaust and return air fans.

.3 As indicated.

.2 Length of connection: 100mm [4"].

.3 Minimum distance between metal parts when system in operation: 75mm [3"].

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on sides of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.3 Access Doors in Ducts

.1 Size:

.1 610mm x 1520 mm [24”x60”] for person size entry.

.2 460mm x 460 mm [18”x18”] for service.

.3 300mm x 200mm [12”x8”] for cleaning.

.4 As indicated.

.2 Locations:

.1 Fire dampers and smoke dampers.

.2 Control dampers.

.3 Devices requiring maintenance.

.4 Required by code.

.5 Reheat coils.

.6 On both sides of turning vanes.

.7 At the base of all duct risers.

.8 At 12,000m [40’-0”] intervals in all duct systems, and 6,000mm [20’-0”] intervals in horizontal exhaust ducts for cleaning purposes.

.4 Instrument Test Ports

.1 Install in accordance with manufacturer's instructions.

.2 Locate to permit easy manipulation of instruments.

.3 Locations:

.1 For traverse readings:

.1 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub-main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

.5 Turning Vanes

.1 Install in accordance with manufacturer's recommendations.

3.3 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 61 00	Product Requirements
.4	Section 01 74 11	Cleaning
.5	Section 01 74 19	Waste Management Disposal
.6	Section 01 78 00	Closeout Submittals
.7	Section 01 91 13	General Commissioning (Cx) Requirements
.8	Section 01 91 31	Commissioning (Cx) Plan
.9	Section 01 91 33	Commissioning Forms
.10	Section 01 91 41	Commissioning Training
.11	Section 01 91 51	Building Management Manual (BMM)
.12	Section 23 05 00	Common Work Results – Mechanical
.13	Section 23 33 00	Air Duct Accessories

1.2 References

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

- .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 1995 and Addendum No. 1, 1997.
- .2 SMACNA – Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems, 2002.

.2 Underwriters Laboratories of Canada (ULC)

- .1 CAN4-S112-M82 (R1987), Fire Test of Fire Damper Assemblies.
- .2 CAN4-S112.2-M84, Fire Test of Ceiling Firestop Flap Assemblies.
- .3 ULC-S505-1974, Fusible Links for Fire Protection Service.

.3 National Fire Protection Agency (NFPA)

- .1 NFPA 90A-1999, Installation of Air Conditioning and Ventilating Systems.

1.3 Submittals

.1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria and limitations.
  - .1 Indicate the following:
    - .1 Volume dampers.

.2 Remote control damper regulators.

.3 Fire dampers.

.4 Backdraft dampers.

.5 Barometric Relief dampers.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

1.4 Quality Assurance

.1 Health and Safety Requirements:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.5 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 – Product Requirements.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management Disposal.

1.6 Extra Materials

.1 Provide maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.

.2 Provide following:

.1 Six (6) fusible links for each type of fire damper.

PART 2 PRODUCTS

2.1 General

.1 Manufacture to SMACNA standards.

2.2 Single Blade Volume Dampers

.1 Blade: Of same material as duct. Two gauges heavier than duct but not less than 0.6mm [24 gauge], stiffened.

.2 Maximum dimension: 305mm [12”] height for rectangular ducts.

.3 Axles: 9.5mm [3/8”] continuous square rod up to 457mm [18”] wide duct, and 13mm [1/2”] continuous square rod up to 1,219mm [48”] wide duct.

.4 Linkage: shaft extension with locking quadrant and position indicator.

.5 Bearings: bronze oilite.

.6 Frame: of the same material as duct. Complete with angle stop for rectangular duct.

2.3 Multi-Bladed Volume Dampers

.1 Opposed blades: 1.2mm [18 gauge] of same material as adjacent duct, stiffened.

.2 Maximum blade width: 150mm [6”].

.3 Axles: 9.5mm [3/8”] or 13mm [1/2”] continuous square rod.

.4 Bearings: bronze oilite.

.5 Linkage: shaft extension with locking quadrant and position indicator.

.6 Frame: 51mm [2”] or 40 x 13 x 3 mm [1-1/2”x1/2”x1/8”] structural or roll-formed channel, complete with angle stop.

2.4 Fire Dampers

.1 Arrangement B, ULC listed and labelled, meeting requirements of provincial fire authority and NFPA 90A. Fire damper assemblies to be fire tested in accordance with CAN4-S112. Factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.2 Frame and integral sleeve shall be of same material as duct with mounting angles furnished by the damper manufacturer. Sleeve thickness to SMACNA and NFPA-90A.

.3 Top hinged: offset, round or square, interlocking blade type and sized to maintain full duct cross section.

.4 Fusible link: 74°C [165°F], replaceable. Gravity-operated for vertical installation and spring-actuated for horizontal installation.

.5 40 x 40 x 3 mm [1-1/2” x 1-1/2” x 1/8”] retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

2.5 Backdraft Dampers

.1 Multi-blade, gravity-operated, centre pivoted, constructed of aluminum with nylon bearings.

2.6 Barometric Relief Dampers

.1 Multi-blade, insulated, counter-weight, centre pivoted, constructed of aluminum brass bearings, set to open at 12.4 Pa [0.05 in. w.g.] static pressure unless otherwise noted.

PART 3 EXECUTION

3.1 General

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

3.2 Volume Damper

.1 For supply, return and exhaust systems, locate balancing dampers in each branch duct.

.2 Run-outs to registers and diffusers: install single blade damper located as close as possible to main ducts.

.3 All dampers to be vibration free.

.4 Attach fluorescent tape to regulator handle for concealed volume dampers.

.5 Provide remote control damper regulator for volume dampers above inaccessible ceiling where ceiling access panel is not provided, and as indicated.

3.3 Fire Dampers

.1 Install in accordance to Part 3, Sub-section 3.1.8 of the National Building Code.

.2 Provide fire damper where duct penetrates through fire-rated floor, wall, or fire separation.

.3 Provide fire stop flap at fire-rated ceiling assembly.

.4 Provide access door per Section 23 33 00 – Air Duct Accessories.

3.4 Field Quality Control

.1 Tests:

.1 Tests to cover period of not less than 2 days and demonstrate that system is functioning as specified.

3.5 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 61 00	Product Requirements
.4	Section 01 74 11	Cleaning
.5	Section 01 74 19	Waste Management Disposal
.6	Section 01 78 00	Closeout Submittals
.7	Section 01 91 13	General Commissioning (Cx) Requirements
.8	Section 01 91 31	Commissioning (Cx) Plan
.9	Section 01 91 33	Commissioning Forms
.10	Section 01 91 41	Commissioning Training
.11	Section 01 91 51	Building Management Manual (BMM)
.12	Section 23 05 13	Common Motor Requirements for HVAC Equipment
.13	Section 23 05 48	Vibration & Seismic Controls for HVAC Piping & Equipment
.14	Section 23 08 00	Commissioning of Mechanical Systems
.15	Section 23 33 00	Air Duct Accessories

1.2 References

.1 Air Conditioning and Mechanical Contractors (AMCA)

- .1 AMCA Publication 99-2003, Standards Handbook.
- .2 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.
- .3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

- .1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB 1.181-1999, Ready-Mixed Organic Zinc-Rich Coating.

1.3 System Description

.1 Performance Requirements:

- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

.2 Capacity: flow rate, static pressure, BHP, HP, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.

.4 Sound ratings: comply with AMCA 301, tested to AMCA 300.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210.

1.4 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

.3 Provide:

.1 Fan performance curves showing point of operation, BHP and efficiency.

.2 Sound rating data at point of operation.

.4 Indicate:

.1 Motors and sheaves details.

.5 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.6 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.5 Quality Assurance

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 – Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Waste Management and Disposal:

.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management Disposal.

PART 2 PRODUCTS

2.1 Fans General

.1 Motors:

.1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.

.2 For use with variable speed controllers where specified.

.3 Sizes as specified.

.2 Accessories and hardware: as specified.

.3 Scroll casing drains: as indicated.

.4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.5 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for Ductwork Piping and Equipment.

.6 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 Centrifugal Fans

.1 Fan wheels:

.1 welded steel construction.

.2 Maximum operating speed of centrifugal fans not more than 50% of first critical speed.

.3 Air foil or backward inclined blades, as indicated.

.2 Bearings: heavy duty grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life (L50) of 200,000 hours.

.3 Housings:

.1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, steel, for smaller wheels, braced, and with welded supports.

.2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.

.3 Provide bolted or latched airtight access doors with handles.

.4 Provide belt driven sets with adjustable motor bed plate and variable pitch driver sheave.

2.3 Cabinet Fans – General Purpose

.1 Fan characteristics and construction: as centrifugal fans.

.2 Cabinet hung single wheel with centrifugal fan in factory fabricated casing complete with vibration isolators and seismic control measures, motor and other accessories as noted.

.3 Fabricate casing of zinc coated or phosphate treated steel of 18 gauge reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to CAN/CGSB 1.181.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Fan Installation

.1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

3.3 Anchor Bolts and Templates

.1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

3.4 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.5 Field Quality Control

.1 Commissioning:

.1 In accordance with Section 01 91 13 – General Commissioning (Cx) Requirements, and Section 23 08 00 – Commissioning of Mechanical Systems.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 61 00	Product Requirements
.4	Section 01 74 11	Cleaning
.5	Section 01 74 19	Waste Management Disposal
.6	Section 01 78 00	Closeout Submittals
.7	Section 01 91 13	General Commissioning (Cx) Requirements
.8	Section 01 91 31	Commissioning (Cx) Plan
.9	Section 01 91 33	Commissioning Forms
.10	Section 01 91 41	Commissioning Training
.11	Section 01 91 51	Building Management Manual (BMM)
.12	Section 23 05 00	Common Work Results – Mechanical

1.2 System Description

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.3 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Indicate following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

1.4 Quality Assurance

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.5 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management Disposal.

1.6 Maintenance

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Include:

.1 Keys for volume control adjustment.

.2 Keys for air flow pattern adjustment.

PART 2 PRODUCTS

2.1 General

.1 Size as indicated.

.2 Capacity, pressure drop, terminal velocity, throw, noise level, neck velocity shall conform to intended performances of specified materials.

.3 Frames:

.1 Full perimeter gaskets.

.2 Plaster frames where set into plaster or gypsum board and as specified on architectural reflected ceiling plans.

.3 Concealed fasteners.

.4 Where balancing damper is scheduled, damper shall be of opposed blade type.

.5 Diffusers, grilles and registers in areas with high humidity shall be of aluminum construction.

.6 Provide neck transition as required.

2.2 Manufactured Units

.1 Grilles, registers and diffusers of same generic type, product of one manufacturer.

2.3 Supply Grilles and Registers

.1 Supply grille, Type SG-1: fixed louvre, steel, 32 mm border, 19 mm o.c. blade spacing, double deflection, front blades parallel to long dimension. Finish: white powder coat.

.2 Supply grille, Type SG-2: High capacity drum louvre. Individually adjustable spread control vanes housed within a rotatable drum. Curved outer drum and vanes extruded aluminum, other components are steel. Drum pivot mechanism shall incorporate a positive positioning detent device to hold field adjusted drum angles of up to 30° off centre. Adjustable vanes are to pivot and maintain blade setting. Steel border with welded, reinforced corners and countersunk screw holes. Finish: white powder coat.

.3 Supply register, Type SR-1: fixed louvre, steel, 32 mm border, 19 mm o.c. blade spacing, double deflection, front blades parallel to long dimension, coated steel opposed blade damper. Finish: silver baked enamel.

2.4 Exhaust Grilles and Registers

.1 Exhaust register, Type ER-1: fixed louvre, aluminum, 32 mm border, 45 degree deflection, 19mm blade pacing, front blades parallel to long dimension, coated steel opposed blade damper. Finish: white baked enamel.

PART 3 EXECUTION

3.1 Manufacturer’s Instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Installation

.1 Install in accordance with manufacturers instructions.

.2 Install with flat head screws in countersunk holes where fastenings are visible.

.3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.

.4 Paint matte black behind all diffusers, grilles and registers so that no metallic part will be visible from the exposed side.

3.3 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 61 00	Product Requirements
.4	Section 01 74 11	Cleaning
.5	Section 01 74 19	Waste Management Disposal
.6	Section 01 78 00	Closeout Submittals
.7	Section 01 91 13	General Commissioning (Cx) Requirements
.8	Section 01 91 31	Commissioning (Cx) Plan
.9	Section 01 91 33	Commissioning Forms
.10	Section 01 91 41	Commissioning Training
.11	Section 01 91 51	Building Management Manual (BMM)
.12	Section 23 05 00	Common Work Results – Mechanical
.13	Section 23 05 48	Vibration and Seismic Controls for Ductwork, Piping and Equipment

1.2 References

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM E 90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.3 Air Movement and Control Association (AMCA)

1.3 System Description

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.4 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Indicate following:

.1 Pressure drop.

.2 Face area

.3 Free area.

.4 Beginning point of water penetration.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.3 Test Reports:

.1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E 90.

1.5 Quality Assurance

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management Disposal.

PART 2 PRODUCTS

2.1 Gravity Roof Outside Air Intake and Relief Vents

.1 Factory manufactured aluminum hooded, roof mounted gravity ventilator.

.1 Bolted and welded construction utilizing corrosion resistant fastener. Minimum 18 gauge aluminum, bolted to minimum 8 gauge aluminum support structure. Complete with lifting lugs, rain gutter, anti-condensate coating.

.2 The base shall have continuously welded curb cap corners.

.3 Birdscreen: 12mm [1/2”] galvanized mesh screen.

.4 Roof curb: galvanized steel construction, minimum 18 gauge. Complete with damper tray,

.5 Accessories: as scheduled or indicated.

2.2 Fixed Louvres – Aluminum

.1 Louvres shall have free areas as scheduled, be of extruded aluminum sections and have all welded assemblies. Fitted with removable aluminum 12mm (1/2") mesh, 16 gauge

bird-screen on interior. Louvre flanges shall be suitable for type of construction encountered, caulked and weather-tight.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Installation

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Anchor securely into opening. Seal with caulking around to ensure weather tightness.

3.3 Anchor Bolts and Templates

.1 Gravity Ventilator: Size anchor bolts to withstand seismic acceleration and velocity forces as specified in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

3.4 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus material, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 61 00	Product Requirements
.4	Section 01 74 11	Cleaning
.5	Section 01 74 19	Waste Management Disposal
.6	Section 01 78 00	Closeout Submittals
.7	Section 01 91 13	General Commissioning (Cx) Requirements
.8	Section 01 91 31	Commissioning (Cx) Plan
.9	Section 01 91 33	Commissioning Forms
.10	Section 01 91 41	Commissioning Training
.11	Section 01 91 51	Building Management Manual (BMM)
.12	Section 23 05 00	Common Work Results – Mechanical
.13	Section 23 33 00	Air Duct Accessories

1.2 References

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 52.1-[1992], Gravimetric And Dust Spot for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI Approved).

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-115.10-[M90], Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.

.2 CAN/CGSB-115.11-[M85], Filters, Air, High Efficiency, Disposable, Bag Type.

.3 CAN/CGSB-115.12-[M85], Filters, Air, Medium Efficiency, Disposable, Bag Type.

.4 CAN/CGSB-115.13-[85], Filter Media, Automatic Roll.

.5 CAN/CGSB-115.14-[M91], High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.

.6 CAN/CGSB-115.15-[M91], High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.

.7 CAN/CGSB-115.16-[M82], Activated Carbon for Odor Removal from Ventilating Systems.

.8 CAN/CGSB-115.18-[M85], Filter, Air, Extended Area Panel Type, Medium Efficiency.

.9 CAN/CGSB-115.20-[95], Polarized Media Air Filter.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 Underwriters' Laboratories of Canada

.1 ULC -S111-[95], Standard Method of Fire Tests for Air Filter Units.

.2 ULC-S649-[1993], Exhaust Hoods and Related Controls for Commercial and Institutional Kitchens.

1.3 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.3 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 Quality Assurance

.1 Health and Safety Requirements:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.5 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 – Product Requirements.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management Disposal.

1.6 Maintenance

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.

.2 Provide following:

.1 Two (2) complete sets of filters for each filter unit or filter bank.

PART 2 PRODUCTS

2.1 General

.1 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.

.2 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

2.2 Accessories

.1 Holding frames: permanent "T" section or channel section construction of 304 stainless steel, 1.6 mm thick, except where specified.

.2 Seals: to ensure leak-proof operation.

.3 Blank-off plates: as required, to fit all openings and of same material as holding frames.

.4 Access and servicing: through doors/panels on each side and/or from upstream face of filter bank, or as indicated.

2.3 Cotton Panel Filters

.1 Disposable pleated reinforced cotton dry media: to CAN/CGSB 115.18.

.2 Performance:

.1 Average atmospheric dust spot efficiency 30% to ASHRAE 52.1.

.2 MERV value: 8.

.3 Initial pressure drop: 65 Pa [0.26” w.g.] at 2.5 m/s [500 FPM].

.3 Fire Rated: to ULC -S111.

.4 Nominal thickness: 50 mm [2”].

2.4 Pleated Filters

.1 Media shall be 100% synthetic gradient dual density media that does not support microbial growth. Frame shall be constructed with high-impact plastic and impervious to moisture and high humidity. Media pack shall be adhered to plastic frame on all sides to prevent air bypass. Filter shall have a hot melt bead separator to maintain pleat pack stability and ensure consistent pleat spacing for optimum airflow. UL 900 and cUL-S11077 listed.

.3 Performance:

.1 Average atmospheric dust spot efficiency 80 – 90 % to ASHRAE 52.1.

.2 MERV value: 13.

.3 Initial pressure drop: 83 Pa [0.33” w.g.] at 2.5 m/s [500 FPM].

.4 Fire Rated: to ULC -S111.

.5 Nominal thickness: 100mm [4”].

2.5 Filter Gauge – Dial Type

.1 Magnehelic gauge, 0-250 Pa. [0-1"wg.], for each filter bank, complete with static pressure. Mount in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.1 Manufacturer’s Instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Installation – General

.1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.3 Filter Gauges

.1 Install across each filter bank (pre-filter and final filter) in approved and easy readable location.

.2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

3.4 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Halocarbons

.1 Comply with all of:

.1 Federal Halocarbon Regulations, 2003;

.2 *Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems* (the Environment Canada "Refrigeration Code of Practice") Cat. No.: En14-207/2015E-PDF. . April, 2015.

.2 Work on Halocarbon Systems includes installation, servicing, leak testing or charging of a refrigeration system or an air-conditioning system or doing any other work on the system that may result in the release of a halocarbon.

.3 All work on Halocarbon Systems shall be carried out only by a "Certified Person" as defined by the Federal Halocarbon Regulations 2003.

.1 Provide copies of all technicians' certificates to the Departmental Representative.

.4 Halocarbons listed under Item 1 through 10 of Schedule 1 of Federal Halocarbon Regulations, 2003 (SOR/2003-289) are not acceptable refrigerants.

.5 Document **all** work on Halocarbon Systems using CSCs halocarbon form "**Information Required for Refrigeration Systems at Federal Correctional Facilities**". Obtain the latest form from Departmental Representative. Affix the completed form to equipment, and submit a copy of the form to Departmental Representative.

.6 Comply with the following timelines:

.1 Upon delivery of halocarbon-containing equipment to site, submit the following information to Departmental Representative within 24 hours of service;

.1 Make

.2 Model

.3 Serial number

.4 Type of halocarbon

.5 Halocarbon charging capacity of system (kg or lbs)

.6 Factory Halocarbon Charge (kg or lbs)

.7 Cooling capacity (kW, BTUH, or Tons)

.2 Leak-test factory-charged halocarbon-containing equipment containing over 10kg of refrigerant in accordance with the Refrigeration Code of Practice within one week of equipment delivery to site.

.3 Leak-test field-charged halocarbon-containing equipment in accordance with Section 4.4 of the Refrigeration Code of Practice at the time of field charging of system.

.4 For all work on Halocarbon Systems, submit forms to Departmental Representative within 48 hours of work.

.5 For release of halocarbons >10 kg and <100 kg, submit forms to Departmental Representative within 24 hours of discovery of release.

.6 For release or potential release of halocarbons > 100 kg, submit forms to Departmental Representative **immediately**.

.7 Conduct annual leak tests of halocarbon-containing equipment with 19kW (5.4 tons) or greater cooling capacity in accordance with the Federal Halocarbon Regulations, 2003 until such time as Interim Certificate of Completion is issued.

1.2 Related Sections

.1	Section 01 91 13	General Commissioning (Cx) Requirements
.2	Section 01 91 31	Commissioning (Cx) Plan
.3	Section 01 91 33	Commissioning Forms
.4	Section 01 91 41	Commissioning Training
.5	Section 01 91 51	Building Management Manual (BMM)

END of SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 61 00	Product Requirements
.4	Section 01 74 11	Cleaning
.5	Section 01 74 19	Waste Management Disposal
.6	Section 01 78 00	Closeout Submittals
.7	Section 01 91 13	General Commissioning (Cx) Requirements
.8	Section 01 91 31	Commissioning (Cx) Plan
.9	Section 01 91 33	Commissioning Forms
.10	Section 01 91 41	Commissioning Training
.11	Section 01 91 51	Building Management Manual (BMM)
.12	Section 23 05 13	Common Motor Requirements for HVAC Equipment
.13	Section 23 05 14	Adjustable Speed Drive Controllers
.14	Section 23 05 48	Vibration & Seismic Controls for HVAC Piping & Equipment
.15	Section 23 08 00	Commissioning of Mechanical Systems
.16	Section 23 44 00	HVAC Air Filtration

1.2 References

.1 Air Conditioning and Mechanical Contractors (AMCA)

- .1 AMCA Publication 99-2003, Standards Handbook.
- .2 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.
- .3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)

- .1 ANSI/ARI 430-[99], Central Station Air Handling Units.

.3 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB 1.181-[99], Ready-Mixed Organic Zinc-Rich Coating.

.4 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

- .1 ANSI/ASHRAE/IESNA 90.1-2004; Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.3 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

.2 Indicate the following:

.1 Unit configuration including plan and elevations drawn to scale.

.2 Fan curve showing point of operation

.3 Fan sound power information.

.4 Fan vibration isolation detail.

.5 Motor data.

.6 Shipping detail and operating weight.

.7 Detailed total static pressure calculations

.8 Coil selections.

.9 VFD

.10 Unit sound data.

1.4 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.5 Quality Assurance

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 – Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Waste Management and Disposal:

.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management Disposal.

1.7 Extra Materials

.1 Provide maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.

.2 Furnish following spare parts:

.1 One set of spare filters.

PART 2 PRODUCTS

2.1 Outdoor Air Handling Units

.1 General:

.1 Custom, outdoor air handling units, fully assembled, consisting of casing, roof curb, fan section with motor and drive, filter section, mixing section, dampers, return air plenums, VFD's (where specified).

.2 Manufacturer shall provide installing contractor all required details of fan installation within plenum chambers and with technical start up assistance including check lists of field tests for inclusion in equipment manuals.

.2 Roof Curb:

.1 Factory fabricated 12 gauge, galvanized steel mounting curb designed for seismic conditions with attachment points for unit to curb and curb to structure. Manufactured by air handling unit manufacturer with full support for unit base frame.

.2 Roof curb shall be field insulated with 50mm [2"] acoustic insulation.

.3 Provide gaskets for field mounting between unit base and roof curb.

.4 Method of installation and flashing shall be coordinated with project construction details.

.5 Minimum 305mm [12"] unless otherwise noted.

.3 Base:

.1 Unit base shall be constructed of structural perimeter channel iron frame with intermediate channel and angle iron supports.

.2 Provide 14 gauge steel floor with all seams continuously welded.

.3 For units 60 inches and higher, the floor shall have epoxy non-slip impregnated painted finish. Floors to be watertight with drains on both sides of coils.

.4 Provide lifting brackets on the unit section bases to accept cable or chain hooks.

.4 Casing:

.1 Walls and roof shall be constructed of double break design 16 gauge galvanized and painted steel panels with overlapped seams gasketed and caulked, not exceeding 610mm [24"].

.2 All required holes in casing for controls, electrical, etc. shall have grommets. Seal all openings neatly and airtight. Site sealed openings shall be to a standard set by manufacturer.

.3 Floor duct openings shall be supplied with safety grates.

.4 Unit shall be manufactured for outdoor application including sloped roofs, door rain gutters and weather shields.

.5 Access Doors:

.1 Provide double neoprene gasketed doors in each equipment section to provide servicing access to all components and to allow for removal of motors and components as required.

.2 Doors shall be of insulated double wall construction with continuous closed cell automotive door gasket, heavy duty "Leverlock" door securing handles.

.3 All doors shall open against pressure, or shall be fitted with a fail safe stop and manual latch release to permit the door to open partially to relieve fan pressure before manually releasing latch.

.4 All access panels to have pad lock and hasp or be key lockable in a manner acceptable to the owner to prevent unauthorized access to unit components and controls.

.6 Acoustic Liner:

.1 All walls, partitions and roof shall be insulated with 50mm [2"], 48 kg/m3 [3 lbs/cubic foot] neoprene coated fibreglass insulation secured with fire retardant adhesive.

.2 Underside of base shall have 50mm [2”], 48 kg/m3 [3 lbs/cubic foot] rigid foam.

.3 All edges of insulation shall be covered with metal Z-bar.

.4 Provide 24 gauge galvanized steel in all sections to protect insulation.

.7 Finish:

.1 Entire unit exterior shall be two part epoxy powder coated with Urethane UV resistant top coat for salt resistance.

.8 Mixing dampers:

.1 Return air: parallel blade, low leakage type, salt resistant.

.2 Outdoor air: insulated, parallel blade, low leakage type, salt resistant.

.3 Dampers shall be sized to a minimum velocity of 5.6 m/sec [1100 fpm] and a maximum velocity of 6.1 m/sec [1200 fpm] and located to provide efficient air mixing and easy access to linkages and damper operators.

.4 Dampers blades shall parallel where needed to eliminate stratification.

.5 Damper blades shall be extruded aluminum air foil shaped with synthetic rubber blade and frame seals mechanically fastened.

.6 Damper locations shall permit easy access to linkages and damper operators.

.9 Fans

.1 All fans shall be belt driven c/w fan base, motor, belts, sheaves, inlet bell, inlet and discharge screens (where applicable) and extended grease nipples.

.2 Provide neoprene coated flexible connector on fan inlet/outlet.

.3 All fans shall be statically and dynamically balanced for quiet operation.

.4 Units shall have solid steel fan shafts mounted in heavy duty, self-aligning, L10-80K re-lubricative ball bearings. Fans with hollow shafts are not acceptable.

.5 Plenum fans shall be completely enclosed by expanded metal mesh including fan inlet and outlet, door latches or door screens shall not be considered a suitable substitute.

.10 Motors

.1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.

.2 Type: heavy duty, high efficiency, 1800 RPM, T.E.F.C. motors with 1.15 service factor.

.3 Motors shall have heavy gauge structural steel base adjustable for motor alignment and belt tensioning by threaded bolt positioners. Extra set of sheaves shall be supplied, if required, when final air balance made. All motors shall be aligned and belts properly tensioned prior to turnover and acceptance by owner. V-belt drive shall be suitable for 150% of motor rating. Fan shall be guarded to WCB regulations, and be provided with openings suitable for instrument.

.11 Fan Base

.1 Fan base shall be formed with structural channel.

.2 Fan base shall have housed spring vibration isolators with seismic restraints selected to meet performance as specified in Section 23 05 48 – Vibration & Seismic Controls for HVAC Piping & Equipment, for the required load.

.12 Filters

.1 Provide 50mm thick MERV 8 pleated filters and 100mm thick MERV 13 filters. See Section 23 44 00 – HVAC Air Filtration.

.2 Filter sections shall have filter racks, and access doors for filter removal and block-offs as required to prevent air bypass around filters. Filter holding frames shall be constructed of 304 stainless steel.

.3 Filter area shall be as scheduled. Where not scheduled, they shall be designed and selected for a face velocity of less than 2.5m/sec. [500fpm].

.4 Provide 0-250 Pa. [0-1"wg.] magnehelic gauge for each filter bank, complete with static pressure tappings and tubing. Mount in accordance with manufacturer's instructions.

.5 All filter media shall be replaced with new filter media upon turn over and acceptance of job. Provide 1 spare set of filters to Owner upon turn over.

.13 Electrical

.1 Units equipped with adjustable speed drives shall be factory wired for single point power connection. For units not equipped with adjustable speed drives, the starters and disconnect switches shall be supplied by Division 26.

.2 Units shall be furnished with dead-front disconnect, adjustable speed drives (where scheduled), transformers for 24 volt control circuit with fuse protection.

.3 Control enclosure will be designed for NEMA 3R.

.4 All wiring shall be run in EMT conduit.

.5 Provide maximum 3 feet of flexible Liquid-tite between EMT and motor.

.6 The manufacturer shall label and number code all wiring and electrical devices in accordance with the unit electrical diagram. The unit shall be labeled and certified to CSA, UL, ETL, or NRTL. The manufacturer is to provide proof of this certification at time of submittal.

.7 Units 1500mm [60"] and higher shall also have switched marine lights in each fan section as well as the filter section where walk in access is provided for servicing. Marine lights shall be glass globe style with a zinc plated steel wire guard. Provide with 100 watt service duty light bulbs. Wiring from switches to lights and junction box to service outlets to be factory installed. All wiring shall be installed in EMT conduit complete with necessary couplings and connectors. The 120V power supply will be provided separately by electrical trade to allow power to lights and receptacles when the main unit disconnect is off.

.8 Provide mounting bracket and factory pre-wire disconnect switch to terminal blocks and motors to terminal blocks.

.14 Adjustable Speed Drives

.1 In accordance with Section 23 05 14 – Adjustable Speed Drive Controllers supplemented as specified herein.

.2 Variable volume units shall incorporate Adjustable Speed Drive controllers in place of magnetic starters.

.3 ASD's shall be supplied for field mounting on unit.

.4 The drive shall be accessed through a hinged access door complete with a 5/16" (8mm) hex key latch. The door shall be hinged.

.5 Variable frequency drives are still to be wired to a single point power connection as noted above.

.6 Control wiring to ASD and wiring from terminal blocks to ASD's shall be provided by Controls Sub-Contractor.

PART 3 EXECUTION

3.1 Installation

.1 Provide appropriate protection apparatus.

.2 Install units in accordance with manufacturer's instructions and as indicated.

.3 Ensure adequate clearance for servicing and maintenance.

.4 Size anchor bolts to withstand seismic acceleration and velocity forces as specified in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

.5 Make piping connections.

.6 Nothing to obstruct ready access to components or to prevent removal of components for servicing.

3.2 Fans

.1 Install fan sheaves required for final air balance.

.2 Install flexible connections at fan inlet and fan outlets.

3.3 Start-up and Commissioning

.1 Charge refrigerant, start-up and submit written report to Engineer.

.2 Commissioning:

.1 In accordance with Section 01 91 13 – General Commissioning (Cx) Requirements, and Section 23 08 00 – Commissioning of Mechanical Systems.

3.4 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 61 00	Product Requirements
.4	Section 01 74 11	Cleaning
.5	Section 01 74 19	Waste Management Disposal
.6	Section 01 78 00	Closeout Submittals
.7	Section 01 91 13	General Commissioning (Cx) Requirements
.8	Section 01 91 31	Commissioning (Cx) Plan
.9	Section 01 91 33	Commissioning Forms
.10	Section 01 91 41	Commissioning Training
.11	Section 01 91 51	Building Management Manual (BMM)
.12	Section 23 05 13	Common Motor Requirements for HVAC Equipment
.13	Section 23 05 48	Vibration & Seismic Controls for HVAC Piping & Equipment
.14	Section 23 08 00	Commissioning of Mechanical Systems
.15	Section 23 33 00	Air Duct Accessories

1.2 References

.1 Air Conditioning and Mechanical Contractors (AMCA)

- .1 AMCA Publication 99-2003, Standards Handbook.
- .2 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.
- .3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

- .1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB 1.181-1999, Ready-Mixed Organic Zinc-Rich Coating.

1.3 System Description

.1 Performance Requirements:

- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

.2 Capacity: flow rate, static pressure, BHP, HP, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.

.4 Sound ratings: comply with AMCA 301, tested to AMCA 300.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210.

1.4 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

.3 Provide:

.1 Fan performance curves showing point of operation, BHP and efficiency.

.2 Sound rating data at point of operation.

.4 Indicate:

.1 Motors and sheaves details.

.5 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.6 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.5 Quality Assurance

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health Safety Requirements.

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 – Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Waste Management and Disposal:

.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management Disposal.

Part 2 PRODUCTS

2.1 Approved Manufactures

.1 Thermolec

2.2 Construction

.1 Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge required by CSA/UL.

2.3 Heater

.1 Heating coil shall be of high grade nickel chromium alloy and shall be insulated by floating ceramic bushings from galvanized steel frame. Coils terminals shall be stainless steel, insulated by means of non-rotating ceramic bushings.

2.4 Safety Controls

.1 Hi-limit with damper shutdown and alarm.
.2 Low-limit with damper shutdown alarm.
.3 High temperature automatic reset thermal cutout that will reset automatically after cool off.
.4 Manual reset.

2.5 Components

.1 Fan Speed controller.
.2 Duct temperature sensor.
.3 Fan section.
.4 Damper.
.5 Built in electronic controller (SCR).
.6 Current sensor.

2.6 Filters

.1 Washable filter.
.2 Provide filter section.

2.7 Air Flow

.1 Built in temperature sensor controls the heater proportionally to maintain the the pre-set air temperature in the duct.

2.8 Control

.1 All control components to be provided by unit manufacturer. Unit to be able to be controlled by building digital control system.
.2 The following functions shall be provided or monitored by building automation system:

- Unit on/off control.
- Filter high pressure drop alarm.
- Unit off on low temperature alarm.
- Discharge temperature adjustment.

.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Fan Installation

.1 Install units as indicated, complete with resilient mountings specified in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

3.3 Anchor Bolts and Templates

.1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

3.4 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.5 Field Quality Control

.1 Commissioning:

.1 In accordance with Section 01 91 13 – General Commissioning (Cx) Requirements, and Section 23 08 00 – Commissioning of Mechanical Systems.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 61 00	Product Requirements
.4	Section 01 74 11	Cleaning
.5	Section 01 74 19	Waste Management Disposal
.6	Section 01 78 00	Closeout Submittals
.7	Section 01 91 13	General Commissioning (Cx) Requirements
.8	Section 01 91 31	Commissioning (Cx) Plan
.9	Section 01 91 33	Commissioning Forms
.10	Section 01 91 41	Commissioning Training
.11	Section 01 91 51	Building Management Manual (BMM)
.12	Section 23 05 13	Common Motor Requirements for HVAC Equipment
.13	Section 23 05 48	Vibration & Seismic Controls for HVAC Piping & Equipment
.14	Section 23 08 00	Commissioning of Mechanical Systems
.15	Section 23 33 00	Air Duct Accessories

1.2 References

.1 Air-Conditioning and Refrigeration Institute (ARI)

.1 ARI 210/240, Standard for Unitary Air Conditioning and Air-Source Heat Pump Equipment.

.2 Canadian Standards Association (CSA International)

.1 CAN/CSA-C273.3-M91, Performance Standard for Split-System Central Air-Conditioners and Heat Pumps.

.2 CAN/CSA-C656-M92, Performance Standard for Single Package Central Air Conditioners and Heat Pumps.

.3 Environment Canada, (EC)/Environmental Protection Services (EPS)

.1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

.2 Environment Canada-1994, Ozone-Depleting Substances Alternatives and Suppliers List.

1.3 System Description

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

.2 Capacity: flow rate, static pressure, BHP, HP, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.

.4 Sound ratings: comply with AMCA 301, tested to AMCA 300.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA/ARI 210.

1.4 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

.3 Provide:

.1 Fan performance curves showing point of operation, BHP and efficiency.

.2 Sound rating data at point of operation.

.4 Indicate:

.1 Motors and sheaves details.

.5 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.6 As part of the shop drawing submission, the Refrigeration contractor shall prepare and include the coil and condensing unit balance curves detailing the S.S. temperature, the estimated line loss, and the system balance point that meets the required total and sensible cooling capacities at the specified ambient temperatures. A refrigerant piping schematic, showing refrigerant pipe sizes, lengths, and refrigerant receiver size requirement, shall also be submitted to confirm installation is in accordance with manufacturer’s recommendations, and does not contravene warranty requirements

.7 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management Disposal.

PART 2 PRODUCTS

2.1 Split System A/C Unit

.1 General:

.1 Indoor, wall-mounted, DX fan coil with matching cooling only condensing unit.

.2 For use with R-410A or R-407C refrigerant.

.2 Evaporator:

.1 Indoor, DX, high ceiling type fan coil. Complete with coil, fan, fan motor, duct collars, piping connection, electrical controls and drain pan. Provide condensate drain pump as indicated. Each condensate pump shall be c/w field-fabricated sheet metal emergency drip pan and water detection sensor interlocked to DDC system alarm.

.2 Unit cabinet: constructed of high-impact polystyrene; fully insulated.

.3 Fan: direct-drive centrifugal blower.

.4 Coil: Aluminum fins mechanically bonded to copper tubing.

.5 Motor: open drip-proof, permanently lubricated ball bearing. Fan motor shall be 3-speed.

.6 Controls: microprocessor-based control for space temperature, fan speed and self diagnostics.

.7 Filters: cleanable.

.8 Electrical: Power is supplied from condensing unit.

.9 Accessories: condensate pump.

.3 Condensing unit:

.1 Factory assembled air-cooled condensing unit. Complete rotary compressor, outdoor coil, fan, metering devices, controls and full charge of refrigerant.

.2 Cabinet: constructed of galvanized steel, bake-enamel finish. Removable access panels. Outdoor compartment shall be isolated and acoustically lined

.3 Fan: propeller, direct-driven from factory lubricated, inherently protected, resiliently mounted motor.

.4 Compressor: fully hermatic rotary type. Complete with oil system, operating oil charge, overload protection, crankcase heater. Compressor assembly shall be installed on rubber vibration isolators and shall have internal spring isolation. DC Inverter technology.

.5 Outdoor coil: Aluminum plate fins mechanically bonded to copper tubing.

.6 Refrigeration components: service valves with gage ports on both liquid and suction lines, accumulator, pressure relief, fully charge of refrigerant.

.7 Controls and safety: operating controls and safeties shall be factory assembled and tested. Include high-pressure and low-pressure switches, outdoor fan motor protection, system diagnostics, compressor, motor current and temperature overload protection, high pressure relief.

.8 Electrical: single point connection.

2.2 Refrigerant Piping:

.1 Between condensing unit, compressor section and evaporator, complete with refrigerant metering devices and valves.

.2 Provide all necessary type “L” hard copper tubing and wrought copper fittings with silver soldered joints as required to complete indicated installation. Gas lines shall be insulated with 20mm (3/4”) thick vapour-sealed elastomeric insulation. Insulation shall be sealed at seams and butt joints with adhesive. Outdoor exposed suction & liquid piping shall be insulated and finished with aluminum jacket.

PART 3 EXECUTION

3.1 Installation

.1 Install where indicated and in accordance with manufacturer's instructions.

.2 Install outdoor units. For flashing, roofing, weatherproofing, refer to Architectural drawings.

.3 Secure with hold-down bolts.

.4 Make duct connections through flexible connections.

.5 Level unit with fans running. Align ductwork, flexible connections. Misalignment with fan stopped not to strain or damage flexible connection.

.6 Make piping connections.

.7 Nothing to obstruct ready access to components or to prevent removal of components for servicing.

.8 Provide condensate drain and pipe to nearest floor drain or as indicated.

3.2 Refrigeration Piping

.1 When the system is completely fabricated, the refrigeration Contractor shall leak test with a nitrogen pressure test at 1723 kPa [250 psi] for a minimum of 24 hours, shall evacuate the system down to 500 microns and shall certify the system stayed at 500 microns for 1/2 hour after shutting off the vacuum pump and connection line. When this test passes, he shall fully charge the system with refrigerant and compressor oil.

.2 Provide 12 months service for all refrigeration system components and fluids at no additional cost to Owners. Start of 12 month service period shall be the first summer occasion on which unit is adjusted for cooling conditions.

3.3 Start-up and Commissioning

.1 Provide interlock wiring between indoor and outdoor units in strict accordance with manufacturer's installation instructions.

.2 Charge refrigerant, start-up and submit written report to Engineer.

.3 Commissioning:

.1 In accordance with Section 01 91 13 – General Commissioning (Cx) Requirements, and Section 23 08 00 – Commissioning of Mechanical Systems.

3.4 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.46-M1988, Electric Air-Heaters.

.2 Underwriters' Laboratories (UL) Inc.

.1 UL 1042-1994, Electric Baseboard Heating Equipment.

1.2 PRODUCT DATA

.1 Submit product data sheets for baseboard convectors. Include:

.1 Product characteristics.
.2 Performance criteria.
.3 Mounting methods. Physical
.4 size.
.5 kW rating, voltage, phase.
.6 Cabinet material thicknesses.
.7 Limitations.
.8 Colour and finish.

.2 Manufacturer's Instructions: Provide to indicate special handling, installation and maintenance procedures.

1.3 CLOSEOUT SUBMITTALS

.1 Submit operation and maintenance data for baseboard convectors in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 BASEBOARD CONVECTORS

.1 Heaters: to CSA C22.2 No.46 standard wattage density as indicated with connection box one end.

.1 Element through-type fitted with aluminum convector vanes and resistor wire enclosed in mineral insulation in copper sheath.

.2 Element: locked to cabinet and supported at additional points throughout length to allow for linear expansion with non metallic supports.

.3 Cabinet: to CSA C22.2 No.46, pre-drilled back for securing to wall. Integral air diffusion reflector with wireway at bottom and built-in clamps.

.1 Bottom inlet/top outlet.
.2 Bottom inlet/front outlet.
.3 Front inlet/front outlet.
.4 Sloping inlet/sloping front outlet.
.5 Panel: steel, metal thickness, bottom 0.8 mm, front 1.2 mm thick.
.6 Finish: phosphatized and finished with baked enamel; white colour.

2.2 CONTROLS

.1 Wall mounted thermostats: type line voltage, 2 pole complete with tamper proof cover.

.2 Integral thermostats: type line voltage, 2 pole.

Part 3 Execution

3.1 INSTALLATION

.1 Install baseboard convector heaters, blank sections and controls.

.2 Install grounding wire to maintain ground integrity between heating, blank, and auxiliary sections.

.3 Install thermostats in locations indicated.

.4 Make power and control connections.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Ensure heaters and controls operate correctly.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 35 33	Health Safety Requirements
.3	Section 01 74 11	Cleaning
.4	Section 01 74 19	Waste Management Disposal
.5	Section 01 78 00	Closeout Submittals
.6	Section 01 91 13	General Commissioning (Cx) Requirements
.7	Section 01 91 31	Commissioning (Cx) Plan
.8	Section 01 91 33	Commissioning Forms
.9	Section 01 91 41	Commissioning Training
.10	Section 01 91 51	Building Management Manual (BMM)
.11	Section 23 05 00	Common Work Results – Mechanical
.12	Section 26 05 00	Common Work Results for Electrical

1.2 References

.1 Canadian Standards Association (CSA International):

.1 CSA C22.2 No.46-[M1988], Electric Air-Heaters.

1.3 Product Data

.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures

.2 Submit product data sheets for unit heaters. Include:

.1 Product characteristics.

.2 Performance criteria.

.3 Mounting methods.

.4 Physical size.

.5 kW rating, voltage, phase.

.6 Cabinet material thickness.

.7 Limitations.

.8 Colour and finish.

.3 Manufacturer's Instruction: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.4 Closeout Submittals

.1 Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.5 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal packaging material for recycling.

.4 Diver unused metal and wiring materials from landfill to metal recycling facility.

1.6 Quality Assurance

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

PART 2 PRODUCTS

2.1 Unit Heaters

.1 Unit heater: to CSA C22.2 No. 46, horizontal or down-flow discharge complete with adjustable louvres finished to match cabinet.

.2 Fan type unit heaters with built-in high-heat limit protection, fan-delay switches, heavy duty contactor and wall-mounted line voltage thermostat.

.3 Fan motor: with resilient mount.

.1 Built-in fan motor thermal overload protection.

.4 Hanger: 12mm [1/2”] diameter hanger rod with rubber vibration isolators on supporting rods.

.5 Element: steel sheath with brazed fins.

.6 Cabinet: steel, fitted with brackets for rod or wall mounting.

.7 Controls: as scheduled.

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with manufacturer's instructions.

.2 Suspend unit from ceiling or mount on wall as indicated.

.3 Maintain sufficient clearance to permit performance of service maintenance.

.4 Install thermostats in locations indicated.

3.2 Field Quality Control

.1 Perform test in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Test cut-out protection when air movement is obstructed.

.3 Test fan delay switch to assure dissipation of heat after element shuts down.

.4 Test unit cut-off when fan motor protection has operated.

.5 Ensure heaters and controls operate correctly.

3.3 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

MAKE UP AIR UNITS - ELECTRIC								
Mark	MAU-1							
Service	BASEMENT							
Model								
Supply Fan Air Flow - L/s (cfm)	283.2	600						
Supply Fan External S.P. - Pa (in w.g.)	50	0.2						
Collar Size	12							
Heating Input kw (MBH)	15	51						
Weight - kg (lbs.)	50(110)							
Notes	1-3							

Refer to Specification for accessories not scheduled. Refer to drawings for installation details.
Interlock operation with exhaust fans as noted on the exhaust fan schedule.
Motors to be sized so normal operating load is not more
than 90% of rated motor capacity.
Units to be suitable for 600/3/60 power.
1. Unit c/w built electronic controller (SCR) and air proving switch.
2. Unit to be single power supply.
3. Unit c/w fan speed controller.

AIR HANLDING UNITS							
Mark		AHU-1					
Service		Second Floor					
Location		Roof					
Supply Fan	Supply Fan Air Flow - L/s (cfm)	14,160	30,000				
	Supply Fan External S.P. - Pa (in w.g.)	188	0.75				
	Supply Fan Size/Type	40" BAE DW					
	Supply Fan RPM	1,750					
	Supply Fan BHP | Horsepower	17	20				
Power		600/3/60					
Filter Area - m^2 (sq. ft.)		5.6	60.0				
Weight - kg (lbs.)		3,636	8,000				
Notes		See Below					

Refer to Specification for accessories not scheduled. Refer to drawings for installation details. Static pressures noted are external to the unit. Fan total pressure to include all cabinet effects as well as an allowance of 75 Pa (0.5" w.g.) for dirty filters for each filter bank. Motors to be sized so normal operating load is not more than 90% of rated motor capacity.

1. Complete with VFD for supply fan.
2. Complete with 350mm (14") high seismic roof curb.
3. Complete with Pre-filter (MERV 8) and after filter (MERV 13).
4. Complete with outdoor air and return air motorized dampers. Provide OA intake hood.
5. Unit shall be epoxy coated. Motorized dampers shall be salt resistant. OA damper shall have insulated blades.

EXHAUST FANS										
Mark	EF-1									
Service	Main Floor									
Type	Square Inline									
Size	90									
Drive	Belt									
Air Flow - L/s (cfm)	283	600								
External S.P. - Pa (in w.g.)	125	0.50								
Motor HP		0.25								
Power Supply	120/1/60									
RPM	1,530									
Tip Speed	4,437									
Sones	12.0									
Notes	1,2,3									

Specification for accessories not scheduled. Refer to drawings for installation details.

1. Complete with autmoatic belt tensioner, belt OSHA guard.
2. Entire fan (housing and wheel) shall be powder epoxy coated.
3. Unit to be installed vertically, complete with aluminum backdraft damper.

SUPPLY FANS											
Mark	SF-1		SF-2								
Service	Main Floor		Main Floor								
Type	Square Inline		Ceiling								
Size	240 high pressure										
Drive	Belt										
Air Flow - L/s (cfm)	3,068	6,500	19	40							
External S.P. - Pa (in w.g.)	500	2.00		0.25							
BHP | Motor HP	1.6	5		40 W							
Power Supply	600/3/60		120/160								
RPM	1,325		625								
Tip Speed	8,480										
Sones	24.0		2.0								
Notes	1,2,3		3, 4								

Specification for accessories not scheduled. Refer to drawings for installation details.

1. Complete with pre-wired disconnect, autmoatic belt tensioner, belt OSHA guard.
2. Entire fan (housing and wheel) shall be powder epoxy coated.
3. Complete with aluminum backdraft damper.
4. C/w motion detector wall mounted switch.

ROOF HOODS									
Mark	RH-1								
Service	Existing SSS								
Type	Hooded								
Size									
Air Flow - L/s (cfm)									
Air P.D. - Pa (in w.g.)									
Throat Width - mm (in.)	914	36							
Throat Length - mm (in.)	610	24							
Free Area - Sq. Metres (Sq. Ft.)									
Notes	1,2								

Contractor to install field built curb. Refer to Mechanical drawings for installation details.
Standard mill finish.

1. Complete with birdscreen, backdraft damper, anti-condensate coat, pre-fabricated roof curb w/ wood nailer in compliance with RCABC curbminimum height requirement.
2. Unit shall have epoxy powder w/ UV coating.

AIR FILTRATION										
Mark	F-1									
Service	SF-1 O/A									
Air Flow - L/s (cfm)	3068	6,500								
Overall Width - mm (in.)	1372	54								
Overall Height - mm (in.)	914	36								
Face Area - m^2 (Sq. Ft.)	1.3	13.5								
Face Velocity - m/s (FPM)	44.4	480								
Bank #1 - Pre-filter										
Type	MERV 8									
Filter Thickness - mm (in.)	51	2								
Initial Air P.D. - Pa (in w.g.)	65	0.26								
Bank #2 - After-filter										
Type	MERV 13									
Filter Thickness - mm (in.)	102	4								
Initial Air P.D. - Pa (in w.g.)	82.5	0.33								
Notes	1,2									

Initial pressure drop based on air velocity of 2.5 m/s [500 FPM]

1. Complete sideload filter housing and filter gauge. Filter housing shall be 304 stainless steel construction.
2. Filter housing shall have access doors on both sides.

LOUVRES										
Mark	L-1		L-2		L-3		L-4		L-4	
Service	SF-1 O/A		SF-1 E/A		AHU E/A		MAU-1		EF-1	
Air Flow - L/s (cfm)	3068	6,500	3068	6,500	14160	30,000	283	600	283	600
Width - mm (in.)	1372	54	1372	54	1829	72	610	24	610	24
Height - mm (in.)	914	36	914	36	2540	100	508	20	508	20
Depth - mm (in.)	152	6	152	6	152	6	152	6	152	6
Face Area - m^2 (Sq. Ft.)	1.3	13.5	1.3	13.5	4.6	50.0	0.3	3.3	0.3	3.3
Face Velocity - m/s (FPM)	44.6	481	44.6	481	55.6	600	16.8	182	16.8	182
Air P.D. - Pa (in w.g.)	25	0.1	25	0.1	25	0.1	25	0.1	25	0.1
Notes										

Select louvre fastening type to suit building construction.

Custom baked enamel finish. Colour to be selected by Architect at shop drawing review.
Air P.D. = 46 Pa (0.18 in. w.g.) at beginning point of water A26 penetration, 381 m/min (1,233 FPM).
Provide 12mm birdscreen on all louvres.
See architectural drawing for flange option and flashing detail.

MOTORIZED DAMPERS										
Mark	MD-1A		MD-1B		MD-2					
Service	SF-1 O/A		SF-1 R/A		SF-1/SF-2 E/A					
Air Flow - L/s (cfm)	3,068	6,500	3,068	6,500	14,160	30,000				
Width - mm (in.)	1,372	54	864	34.0	1,829	72				
Height - mm (in.)	914	36	864	34.0	2,540	100				
Free Area - Sq. Metres (Sq. Ft.)	1.3	13.5	0.7	8.0	4.6	50.0				
Face Velocity - m/s (FPM)	44.6	481	75.0	810	55.6	600				
Notes	1,2,3		1,3		1,2,3					

Mark										
Service										
Air Flow - L/s (cfm)										
Width - mm (in.)										
Height - mm (in.)										
Free Area - Sq. Metres (Sq. Ft.)										
Face Velocity - m/s (FPM)										
Notes										

1. Air P.D. shall be less than 7 Pa (0.03 in. w.g.) at 5.08 m/s (1,000 FPM).
2. Damper shall have insulated blade.
3. Damper shall be salt water resistance.

SPLIT AIR CONDITIONING UNITS												
Indoor Unit Mark	IAC-1											
Location	Comm Rm S103											
Type	High Wall											
Nomial Capacity - kW (MBH)	10.0	34										
MCA	1											
MOCP	15											
Weight - kg. (Lb.)	18.2	40										
Condensing Unit Mark	CU-1											
Location	Ground											
Power Supply	208/1/60											
SEER	14											
Weight - kg. (Lb.)	75	165										
MCA	25											
MOCP	40											
Power	208/1/60											
Notes	1, 2											

Provide the following optional accessories:
-Input/output Interface module for connection to DDC. See Specification 25 90 11 part 3.2 for DDC points list to control on/off, setpoint, operation mode, fan speed. Monitor unit status & space temperature.
- Wired space wall-mounted controlller.
-Provide appropriate Windscreen on outdoor air unit outlet, allowing operation down to -29 deg. C outdoor air temperature.
Refer to Specification for accessories not scheduled. Refer to drawings for installation details.

As part of the shop drawing submission, the Refrigeration contractor shall prepare and include the coil and condensing unit balance curves detailing the S.S. temperature, the estimated line loss, and the system balance point that meets the required total and sensible cooling capacities at the specified ambient temperatures. A refrigerant piping schematic, showing refrigerant pipe sizes, lengths, and refrigerant receiver size requirement, shall also be submitted to confirm installation is in accordance with manufacturer's recommendations, and does not contravene warranty requirements. Refrigeration contractor shall employ equipment manufacturer's service representative to supervise system start up and instructing of Owner's personnel.

Notes:
1. Single point power connection at condensing unit.
2. Control wiring by Div 25. Div. 25 to provide low-voltage control wiring to electric baseboard heater interlock switch by Div. 26. Refer to Div. 26 drawings.

ELECTRIC UNIT HEATERS										
Mark	EUH-1		EUH-2		EUH-3		EUH-4			
Location	Main Floor		Main Floor		Second Floor		Second Floor			
Motor Horsepower	Fractional		Fractional		Fractional		Fractional			
RPM	1,600		1,600		1,600		1,600			
Air Flow - L/s (cfm) @ 21°C (70°F)	165	350	165	350	165	350	165	350		
Heating Cap. - kW (MBH)	5.00	17.1	5.00	17.1	5.00	17.1	5.00	17.1		
Power Supply	600/3/60		600/3/60		600/3/60		600/3/60			
Notes	1		1		1		1			

Refer to specification for accessories not scheduled. Refer to drawings for installation details.

Notes:

1. Complete with wall mounted thermostat with tamper-proof cover.

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 74 11	Cleaning
.3	Section 01 78 00	Closeout Submittals
.4	Section 01 91 13	General Commissioning (Cx) Requirements
.5	Section 01 91 31	Commissioning (Cx) Plan
.6	Section 01 91 33	Commissioning Forms
.7	Section 01 91 41	Commissioning Training
.8	Section 01 91 51	Building Management Manual (BMM)
.9	Section 23 08 00	Commissioning of Mechanical Systems

1.2 General

.1 Provide, install, program and commission a BACnet-based DDC controls system to achieve the performance specified in the following clauses. The DDC system shall be standalone.

.2 Work covered by sections referred to above, consists of fully operational EMCS, including, but not limited to, following:

- .1 Building Controllers.
- .2 Control devices as listed in I/O Summaries.
- .3 Field control devices.
- .4 Complete operating and maintenance manuals and field training of operators, programmers and maintenance personnel.
- .5 Acceptance tests, technical support during commissioning, full documentation.
- .6 Wiring interface co-ordination of equipment supplied by others.
- .7 Miscellaneous work as specified in these sections and as indicated.

1.3 Metric Reference

.1 Conform to CAN/CSA-Z234.1.

.2 Provide required adapters between Metric and Imperial components.

1.4 Standard Compliance

.1 All equipment and material to be from manufacturer's regular production, CSA certified, and manufactured to standard quoted plus additional specified requirements.

.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.3 Submit proof of compliance to specified standards with shop drawings and product data. Label or listing of specified organization is acceptable evidence.

.4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

.5 For materials whose compliance with organizational standards/codes/specifications is not regulated by an organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

1.5 Submittals

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Provide six copies of schematic control diagrams for review. Each valve, actuator and instrument shall be given an identification label which will refer directly to control diagram.

.3 Provide damper shop drawings which include data such as arrangement, velocities, and static pressure drops for each system on shop drawings.

.4 Provide shop drawings including complete operating data, system drawings, wiring diagrams, and type written detailed operational description of sequences, and description and engineering data on each control system component.

.5 At completion of work, make detailed check of automatic control system and submit written report to the Departmental Representative.

.6 Provide sufficient copies of complete parts and repair manuals for binding in O&M Manuals.

.7 Provide "record" control drawings and schedules Submit in accordance with Section 01 78 00 – Closeout Submittals; incorporate into O&M Manuals.

.8 The submittals shall be prepared using the dynamic graphics software normally provided with system.

1.6 Preliminary Design Review Meeting

.1 Convene a Preliminary Design Review meeting within 45 working days of award of contract to:

.1 Undertake functional review of preliminary design documents, resolve inconsistencies.

.2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).

.3 Review interface requirements of materials supplied by others.

.4 Review "Sequence of Operations".

.2 Contractor's programmer to attend meeting.

.3 Departmental Representative retains right to revise sequence or subsequent Control Description Logic prior to software finalization without cost to Departmental Representative and Owner.

1.7 Monitoring and Control Features

.1 Operator defined digital and analogue alarms and automatic alarm condition reporting.

.2 Direct keyboard override of all inputs and outputs, with an indication on the display for any point that is operating under keyboard override.

.3 Addition, deletion, definition and modification of all points from operator keyboard.

.4 Trend log graphing and reporting of user selected points at user defined intervals.

.5 Run time logging of digital points.

.6 Ability to accept a variety of standard analogue and digital input signals.

.7 Ability to generate a variety of standard analogue and digital output signals.

1.8 Offline Storage

.1 The DDC system shall have the capability to be taken off-line in the event of failure or for maintenance and returned to operation without the need for entering any portion of the software program manually.

.2 An off-line disk storage device shall be utilized to provide software backup and reload. Backup and verification of the entire system, with full applications software, shall be less than TWO (2) seconds per real point.

1.9 Power Surge Protection

.1 The DDC system shall be protected from power line surges and voltage transients by installation of a power line filter.

1.10 Power Failure Protection

.1 The DDC system shall have automatic protection from any power failure of at least TWENTY-FOUR (24) hours duration.

.2 This protection shall at a minimum include continuous real-time clock operation and automatic system restart upon power return.

.3 Outputs shall have the option of being set to “staggered start” upon power reset.

1.11 Electrical Components, and Conduit

.1 Provide all control system components, except those supplied as part of packaged equipment controls, but including all auto sequencing devices, electric relays, safety devices and electrical interlocks required to accomplish specified sequences. Refer to the electrical motor schedule in the electrical drawings and/or specification, which delineate the limits of electrical work in Division 26 (Electrical) serving mechanical systems.

.2 Provide all control circuit transformers required for control systems and not supplied by Division 26 including line voltage power connection from indicated outlets shall be included by Division 25.

.3 All line voltage wiring shall be copper with RW90 X-Link P.E. insulation #12 minimum size. AWG wire shall be sized to meet code.

.4 Wiring is to be in conduit in all wall spaces and exposed locations as well as in pipe chases, service spaces, attics, and crawl spaces which are entered for service access. Wiring in suspended ceiling spaces does not require conduit but shall be neatly installed parallel to building lines using bridle rings. All wiring installed under this contract shall be plenum rated FT-6 or FT-4, if approved by all authorities having jurisdiction. Locate wiring away from top or bottom of ceiling joists or trusses to minimize possibility of

accidental damage. Number 18 gauge wire may be used in Class 2 circuits unless voltage drops are excessive. THHN wire will not be acceptable. Twisted shielded wiring, minimum of 22 gauge wire shall be used for all DDC or co-axial communication wiring. Line voltage alternating current wiring shall not be run in the same conduit, or cabling as DDC wiring.

.5 Use 1m of flexible conduit for all connections to vibrating equipment. Use liquid tight flex cable and connections where required.

.6 The Control Contractor shall locate magnetic starters from the electrical drawings. All electrical work provided by this Contractor shall comply with all requirements of the Division 26 electrical specification, the Canadian Electrical Code and Local Codes and Ordinances.

.7 Wire all line voltage thermostats, pressure switches or aquastats for single phase equipment.

.8 Division 26 has been requested to provide specific devices, including magnetic starters supplied with 120 volt holding coils, HOA switching and space for the addition of auxiliary contacts. The Control Contractor shall provide all necessary normally open and normally closed contacts, wired to a terminal strip within the starter enclosure, required to achieve the specified control interlocking and sequencing. Manual starters for 120 volt equipment are to contain On-Off selector, external H.O.A., integral overload protection and pilot lights. The Controls Contractor shall provide control wiring interlocks from the control contacts provided on the automatic branch lines of the assembly, which will be contained within the associated Motor Control or Starter Assembly.

.9 Refer to Division 26 Specifications and Motor Schedule for the scope of work to be provided by the Electrical Contractor. Division 25 shall supply and install all components, in addition to those outlined within the Division 26 documents, as may be deemed necessary to provide all interlocks or sequences as called for elsewhere within the specifications. Include for the supply and installation of 2- 4 pair U.T.P. Level 5, plenum rated cables from the hub location to the communications backboard. Coordinate with Division 26 and the Owner for interconnection of the hub into the Telephone System services.

.10 All power supplies for controls are this Contractor's responsibility unless otherwise specified in the Electrical Specifications. All control transformers to be located in fan rooms or mechanical rooms only and are to be mounted in serviceable locations.

.11 Line voltage will not be run with signal or trunk wiring or be present in the same junction box.

.12 All shielded wiring will be grounded at the BMS panels and prevented from grounding at the terminal end.

.13 Run all wiring parallel to building lines. All wiring to be installed in a neat, workmanlike manner.

.14 Support wiring independent of piping, ductwork, and equipment. Keep wiring clear of hot piping, ductwork/equipment.

.15 Identify all junction boxes with control company label.

.16 There are to be no splices in any of the control wiring except at devices or control panels.

1.12 Identification, Calibration and Programming

.1 Provide a written sequence of operation for each piece of equipment or system being controlled that does not require knowledge of DDC programming. Provide a print out of the complete data base, including program listings, inputs, outputs, controllers, virtual points, trend logs, alarm points, etc. Provide in an organized manner, separated for each panel.

.1 Procedures for daily operation of the system.

.2 Theory of operation of the equipment.

.3 Theory of operation of the control program.

.2 Mount an input/output layout sheet within each controller. This sheet shall include the name of the points connected to each controller channel.

.3 Identify all controllers and associated devices with symbols relating directly to the control diagram. Provide plastic labels for each input and output point with the following information:

.1 Point descriptor.

.2 Point type and channel number.

.3 Corresponding controller number.

.4 Program each controller immediately following installation. Setup and tune all control loops during the initial start-up of the systems. Submit a well documented print out of the controller program for review.

.5 At the time of the Owner's Demonstration and Instruction Period:

.1 Demonstrate and confirm that all systems are programmed and operating correctly. Submit trend logs, 1 week in duration, that confirm systems are operating as designed and follow the internal building loads in an energy efficient manner.

.2 Submit CD’s containing up to date copies of the programs in each controller.

.3 Submit (4) CD’s with printed PDF copies of the final programs that include all point definitions, weekly and annual schedule settings, controller setpoints and tuning parameters, and documented general control language programs. (As Built control shop drawings)

.4 Provide the original software diskettes and the users manuals for all software programs provided as part of this contract. Provide one set of original disks for each notebook, laptop, and desktop computer the software has been installed on. The controls contractor shall be responsible for registering all software with the manufacturer in the owner's name. Provide copies of the registration of all software to the Departmental Representative as part of the final inspection.

.6 Check sensor calibration and control system operation twice during the first year of operation including the first heating season and prior to the first cooling season. Include all parts and labour in service. Following each visit submit:

.1 A report indicating all work performed.

.2 Printed graphs of trend logs one week in duration with hourly samples for all analog inputs connected to each controller.

.3 Update printed and diskette copies of any changes made to programs for any controller.

.7 Provide one day of on-site instruction to the Owner's operating personnel during the first year of operation, scheduled as requested by the Owner, during one or more of the 2 visits.

1.13 Controller Software

.1 Each stand alone control panel shall contain a complete software development system in each panel. The software development system shall consist of a menu driven, prompted programming language containing complete libraries of control algorithms for DDC, Energy Management, and Facilities Management functions. These resident libraries of algorithms shall be drawn from for the creation of the application specific programming of each individual stand alone control panel.

.2 Four user access levels shall be provided with a user access code available at each level. Each level shall permit identifiable multiple user access.

.3 Point names shall be defined using a minimum of 128 alphanumeric characters to provide an English language description of the point function.

.4 The stand alone control panel shall be capable of generating sorted alarm, trend log, energy management, maintenance time remainder, and exception log reports on a prioritized basis. Segregated report generation shall be invoked by manual request, time of day, calendar, accumulated run time, or event occurrence.

.5 DDC Control:

.1 The network of stand alone control panels shall individually perform setpoint reset, ramping functions, 2-position ON/OFF control, PID loop control, linear sequencing, rotating sequencing, binary sequencing, HI/LO/AVE selection, energy dead band, and thermostat controls as required to control their connected systems of equipment.

.6 Energy Management Control:

.1 The network of stand alone control panels shall individually perform time of day scheduling, optimum start/stop, enthalpy optimization, trend logging, demand limiting and all control optimization strategies, such as supply air reset, and soft ramp-up, for their connected systems of equipment.

.2 Coordination of strategies involving multiple systems of equipment shall be performed by sharing of necessary data between the stand-alone control panels on the communicating network.

.7 SAC and Micro Controller Trend Logs:

.1 Controllers shall be capable of storing up to twenty-five (25) full trend logs with a minimum of 200 data samples each. They shall be able to collect and store samples of the value of any system variable (i.e. temperature). The operator shall be able to create a trend log, with each trend log containing up to 4 points. The sample frequency shall be selectable for each trend log between 1 second and 24 hours. The ability to graphically display to 4 points on the screen simultaneously, print a log, or store a log on disk in an ASCII format that can be imported into a standard spreadsheet program shall be provided. This capability shall be provided for all forms of access.

1.14 Related Work

.1 The following incidental work shall be furnished by the mechanical sub-contractor under the supervision of the controls subcontractor:

.1 Installation of control dampers including duct transitions, assembly and interconnection of multiple section dampers.

.2 Supply and installation of sheet metal baffles as required to eliminate air stratification.

.3 Supply and installation of access panels for service and installation of control equipment.

.4 Installation of automatic valves, wells, flow switches, and other pipe related control devices.

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 General

.1 Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats and temperature sensors 1.5m above floor.

.2 Install damper motors on outside of ducts. Do not locate in outside air stream.

.3 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.

.4 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required, for the proper isolation of the equipment.

.5 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.

.6 Equipment shall be installed in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation.

.7 Permanently identify each wire, cable, conduit and tube at each terminal.

.8 Wiring and tubing shall be identified at each DDC panel by termination number. Wiring and tubing shall be identified at terminal device by termination and DDC panel numbers.

.9 All transmitters, interfaces, terminations and control relays, etc. shall be mounted in field cabinets that may be locked.

.10 Freeze protection devices shall be hard wired and also wired to alarm through DDC system.

.11 All wall mounted devices in new finished space shall be mounted on a wall box. The wall box shall be connected to the ceiling space by a conduit stub. On renovations, when

sensors are mounted in existing finished walls, wiring or tubing may be fished into the walls without conduit.

3.2 Enclosure and Conduit

.1 Relays, transformers, and I/O devices and peripherals shall be installed in separate enclosures and not in the enclosures containing the controllers.

.2 All wires penetrating the enclosure that are not required to be in conduit must be neatly bundled and strapped in place.

.3 All Building Controllers will be installed in CSA rated enclosures that are complete with hinged and key-locked doors. The door will be painted and labeled suitably bearing the manufacturer's system name/logos, the controller address, and the installing contractor's contact information. This enclosure will be mounted at a height that provides easy access without the need of a ladder.

.4 A hard points list shall be affixed on the inside of the door/cover of the enclosure.

.5 The inside bottom of the enclosure shall be clean of dirt, metal shavings, and debris.

.6 Provide EMT conduit with set screw metal fittings where wiring is exposed and in all mechanical rooms. All conduit will be piped smoothly and neatly following building lines. Wiring above accessible ceilings and in wall cavities may be run free-air.

.7 Liquid-tight flexible conduit to be used for rooftop unit wiring c/w liquid-tight fittings. Provide spun aluminum roof jack where control wiring penetrates roof unless penetration is within waterproof rooftop unit curb.

.8 All junction boxes will have covers properly and firmly affixed after installation completion.

3.3 I/O Wiring

.1 All input/output device wiring will use #18-2 solid core cable with individually jacked conductors and jacketed sheath over the pair.

.2 Use plenum cable where required.

.3 All I/O wiring passing near or within the enclosure of a VFD will be shielded, with the shield terminated at the device end.

.4 All I/O wiring will be identified using Panduit adhesive wire-marker at the controller and end device ends. Description of point to include point mnemonic, point type and network location.

.5 All I/O wiring within controller enclosure shall be neat and tidy and suitably bundled and strapped or contained in plastic wire duct or equivalent.

.6 All I/O wiring that requires a transition to a different conductor to meet electrical code requirement shall be executed using a terminal strip.

.7 Low voltage I/O wiring may be mixed together within a conduit. Low and line voltages may not be mixed together within a conduit.

3.4 Power Wiring

.1 Provide power wiring and transformers and grounding to each controller and transducer as per the manufacturer's specification.

.2 Each Building Controller will have its own dedicated power supply. No other controller or I/O device will be powered from this supply.

.3 Power wiring shall not be mixed with I/O wiring in a conduit.

3.5 Control System Commissioning

.1 Upon completion of the installation of the controls system and the calibration of all sensors, this Subcontractor shall carry out all required testing, debugging, and revision of operations to suit the intent of the Sequence of Operation and to the review of the Consultant.

.2 The contractor is to supply digital point and non digital checkout data sheets for all controlled components installed in this contract, including components supplied by others. The data sheets shall indicate each components physical installation is complete, End to End, identification, tagged, the result of the functional test, calibration deviation recorded, setpoints and set-up of each device, digital and non digital.

.3 Each digital input or control device shall be checked by physical operation of the monitored device in the field with the result noted. Each digital output or controlled device shall be commanded or tested On/Off, Open/Close as required and the corresponding field device checked for correct operation with the result and comments noted.

.4 Each analog input or control device shall have its field values measured with a calibrated test instrument, with the deviation recorded and adjusted, if necessary, at the AI set up. The field measurement and analog point deviation must be reported. A hard copy of the set up for each digital and non digital controller with adjustments is required. Field set up and setpoints of other devices shall be reported.

.5 Each analog output, control or controlled device shall be field tested. The physical test data sheet is to indicate each controlled device function through its range 0, 25, 50, 75, 100% and 1 to 100% as required with no leakage or bypass of the controlled medium.

.6 Submit copies of all test data sheets intended to be used to the Departmental Representative and Commissioning Authority prior to the contractor's verification at least three months before the scheduled substantial completion of the project.

.7 The controls contractor shall provide sequence of operation check sheets, to the Departmental Representative, Commissioning Agent and Commissioning Authority, in standard letter size for each DDC and non DDC system sequence. Each sequence to be verified with each item/page signed off with comments noted.

.8 Verify all spare points specified have been provided.

.9 The commissioning contractor is not to commence controls checks until the above documentation is received. The Temperature Control Supplier and Installer shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Control Supplier in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Temperature Control Supplier for the purchase price of the material.

.10 All documentation, tagging, identification, as-builts, software, instruction manuals, special control connection to access all devices and panels must be in place before the granting of substantial performance.

.11 The Controls Contractor shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Controls Contractor in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Controls Contractor for the purchase price of the material. The Temperature Control Supplier shall cooperate fully with the Commissioning Agent to work together to obtain a fully operating system, providing additional technicians and trades people to assist the designated commissioning person as required. Refer to Section 23 08 00 – Commissioning of Mechanical Systems.

.12 The controls contractor is to provide the technicians for field checks, calibration, checkouts, and commissioning necessary for a complete and fully operational system. Provide two 2-way portable radios for the commissioning period.

3.6 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 78 00	Closeout Submittals
.3	Section 25 05 01	EMCS: General Requirements

1.2 References

.1 Canadian Standards Association (CSA)

.1 C22.2 No.205-M1983 (R1992), Signal Equipment.

.2 Institute of Electrical and Electronics Engineers

.1 IEEE C37.90.1-1984, Surge Withstand Capabilities Test for Protective Relays and Relays Systems.

1.3 Maintenance Procedures

.1 Provide manufacturers recommended maintenance procedures for insertion in Section 01 78 30 – Closeout Submittals, and 25 05 01 – EMCS: General Requirements.

1.4 Submittals

.1 In accordance with Section 01 33 00 – Submittal Procedures, and Section 25 05 01 – EMCS: General Requirements. Submit product data sheets for each product item proposed for this project.

PART 2 PRODUCTS

2.1 System Descriptions

.1 Provide a fully networked system of controllers which use LAN communications to support the distributed control features as specified herein. Each controller shall be connected directly to the LAN. Each controller shall have equal LAN access priority and shall NOT REQUIRE A SEPARATE GATEWAY or interface controller to accomplish normal, network communications.

.2 Provide a means to ensure communication integrity. At a minimum indicate for each controller in the system: on-line/off-line status, residence of program or no program, the scan rate (frequency at which the controller updates all I/O and runs all programs), the number of network points imported and exported.

.3 The system will display an error message, in the event of a communication error.

.4 To prevent damage to the system, each connection to the LAN shall be provided with a means of isolation, either optically or fast-blow fuse or by some other means.

.5 Upon failure of the LAN to communicate information, each controller will retain the last legitimate value of its imported network points, and continue to control the systems based on those values. Failure of any controller, or any part of a controller on the LAN, shall not affect the ability of the LAN to communicate among the remaining controllers.

.6 Each hard point and soft point shall have a user-definable, unique, system-wide logical point mnemonic. The format of the point mnemonic shall conform to the naming convention of the incumbent system.

.7 The Building Management System components shall be BACNet Testing Laboratory (BTL) tested and certified.

.1 The Standalone Panels (SAP) shall be BTL certified as BACNet building control level device (B-BC).

.2 Terminal Unit Controllers (TUCs) shall be BTL certified as BACNet Advanced Application Controllers (B-AAC).

.3 Portable Operator's Terminals (POTs) shall be BTL certified as BACNet Operation Station (B-OWS).

2.2 Memory

.1 Each controller shall have enough random access memory for all of the following:

.1 Variables - ONE (1) for each hard point connected to the controller.

.2 PID Controllers - TWO (2) for each analogue output point connected to the controller.

.3 Weekly Schedules - ONE (1) for every major system connected to the controller.

.4 Annual Schedule - ONE (1) for the entire LAN.

.5 Trend Logs - ONE (1) for each pair of hard points connected to the controller with 100 samples each.

.6 Runtime Logs - ONE (1) for each digital hard and soft point.

.7 Programs - ONE (1) for each output point connected to the controller. Each program must contain enough memory for TWENTY (20) syntactically correct lines of OCL with at least four operators.

2.3 Processing Speed

.1 Scan Rate - The maximum permissible scan rate is ONE (1) second. The scan rate is defined as the time it takes to controller CPU to sample all inputs, calculate all variables, update all timers and PID controllers, check all schedules, update all trend logs and runtime logs execute all OCL programs and assign values to all outputs.

2.4 Building Controllers

.1 Building Controllers shall reside on the main LAN or highest level of communication.

.2 The controller shall communicate on the main LAN using either Ethernet (IEEE.802.3) with TCP/IP and/or EIA-485.

.3 In addition to main LAN communications, the controller shall support EIA-485 subLANs, PC, modem and intelligent thermostat communications.

.4 The controller shall have at least one port (other than the PC port) which can be configured to BACnet conformance class 3 using EIA-232 point-to-point communications for interface to other BACnet products.

.5 The controller must be modular in design with removable I/O device terminations on separate I/O cards for ease of expansion and replacement.

.6 Controllers will accommodate a maximum of 160 universal I/O points on board using a single address.

.7 All I/O points must be universal (i.e. user definable as digital or analogue). Dedicated analogue/digital points will not be accepted.

.8 All outputs must have optional HOA on board for easy override by non DDC users.

2.5 Custom Application Controllers

.1 An AAC (B-AAC) is a general purpose, field programmable controller capable of carrying out a variety of building automation and control tasks.

.2 Custom Application Controllers shall communicate on the main BACnet Ethernet LAN or BACnet MSTP subLAN. In addition to main or subLAN communications, the controller shall support PC and/or modem communications.

.3 Programming the controller shall be accomplished over the LAN or directly via PC and will not require the mandatory use of any other special interface hardware or a Building Controller.

.4 Operator Control Language shall be fully supported with this controller. FIRMWARE BASED FUNCTIONS OR PROGRAMMING WILL NOT BE ACCEPTED.

2.6 Application Specific Controllers:

.1 ASC BACnet overview: An ASC (B-ASC) is a controller with limited resources relative to a AAC. It is intended for use in a specific application and supports limited programmability.

.2 Application Specific Controllers shall be used for the following mechanical systems:

.1 VAV, Fan Coils, radiation and reheat

.2 Radiant heating and reheat control

.3 Application Specific Controllers shall communicate on the main LAN or subLAN using EIA-485 (MSTP). In addition to main or subLAN communications, the controller shall support PC and/or modem communications and intelligent thermostat communications.

.4 Programming the controller shall be accomplished over the LAN or directly via PC and will not require the mandatory use of any other special interface hardware or a Building Controller. Operator Control Language programming and editing shall be fully supported with this controller. FIRMWARE BASED FUNCTIONS WILL NOT BE ACCEPTED.

2.7 Stand Alone Controllers:

.1 Stand Alone Controllers common requirements (B-BC, B-AAC) (Peer to Peer): Provide a fully distributed processing system such that each major piece of mechanical equipment is controlled by its own stand-alone controller. The DDC system shall operate independently from the Host Computer. Mount all stand alone controllers at locations where indicated on drawings. Provide an outlet port for plug in of a portable PC in each mechanical room containing stand-alone controllers.

.2 The stand-alone digital control panel shall be 16-bit microcomputer based, providing a multi-tasking operating system for simultaneous operation and control of:

.1 facility management functions

.2 DDC control functions

.3 energy management functions

.4 man-machine interface

.5 system communications

.3 Analog to digital and digital to analog conversions shall have a minimum 10 bit resolution.

.4 Panel input points shall be universal allowing each point to be defined as an analog input, or digital input.

.5 The control panel shall contain a real time clock capable of being synchronized with other real time clocks in the network.

.6 Control panel software shall be protected from loss due to power failure for a minimum period of 72 hours.

.7 All sensing inputs shall be provided via the following industry standards:

.1 0 to 20 mA

.2 4 to 20 mA

.3 0 to 5 VDC

.4 0 to 10 VDC

.5 10k type 3 thermister resistance signals

.8 Modulating outputs shall be fully proportional. Pulse width modulation, without analog feedback, shall not be used for analog output signals. Outputs must be capable of being scaled and produce a 0% to 100% output with a fractional PID control algorithm.

.9 Digital outputs shall be capable of directly switching the following voltages. This contractor shall provide solid state relays that will accept this signal:

.1 24 VAC @ 36 VA operating

.2 120 VA`C @ 120 VA operating

2.8 Field Panels

.1 Provide local panels of unitized cabinet type for relays/devices. Mount relays, switches, transducers and controllers with set point adjustment in cabinet and pilot lights, push buttons, and switches flush on cabinet panel face.

.2 Fabricate panels from 3.0 mm furniture steel with baked enamel finish and removable hinged key lock door.

.3 Mount panels adjacent to associated equipment on vibration free walls or free standing angle iron supports.

.4 Field panels are not to be located in ceiling spaces.

.5 All main panels are to be located in Mechanical/Fan Rooms only.

.6 All panels serving microzone controllers (reheat/radiation) should be located in fully recessed panels located in mechanical rooms, fan rooms, storage rooms or janitors' rooms. The panel locations are to be approved by the consultant during the shop drawing stage.

.7 All field panels shall be labeled with lamicoid labels.

PART 3 EXECUTION

3.1 General

.1 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.

.2 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required, for the proper isolation of the equipment.

.3 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.

.4 Equipment shall be installed in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation.

.5 Provide additional 25% spare points (AI, AO, DI, DO) capacity on each DDC system installation. Identify panel & controller spare points on shop drawing submittal

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 78 00	Closeout Submittals
.3	Section 01 91 13	General Commissioning (Cx) Requirements
.4	Section 01 91 31	Commissioning (Cx) Plan
.5	Section 01 91 33	Commissioning Forms
.6	Section 01 91 41	Commissioning Training
.7	Section 01 91 51	Building Management Manual (BMM)
.8	Section 25 05 01	EMCS: General Requirements

1.2 References

.1 American National Standards Institute (ANSI)

.1 ANSI C12.7-1993, Requirements for Watthour Meter Sockets.

.2 ANSI/IEEE C57.13-1978(R1987), Requirements for Instrument Transformers.

.2 National Electrical Manufacturer's Association (NEMA)

1.3 Submittals

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 01 33 00 – Submittal Procedures, and Section 25 05 01 – EMCS: General Requirements.

.2 Include:

.1 Information as specified for each device.

.2 Manufacturer's detailed installation instructions.

.3 Pre-Installation Tests

.1 Submit samples at random from equipment shipped, as requested by Departmental Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.

.4 Manufacturer's Instructions

.1 Submit manufacturer's installation instructions for specified equipment and devices.

1.4 Closeout Submittals

.1 Submit operating and maintenance data for inclusion in operation and maintenance manual in accordance with Section 01 78 00 – Closeout Submittals and Section 25 05 01 – EMCS: General Requirements.

PART 2 PRODUCTS

2.1 General

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.

.3 Operating conditions: 0 - 32 °C with 10 - 90 % RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters to be unaffected by external transmitters (eg. walkie talkies).

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in NEMA 3R enclosures.

.8 Devices to be installed in user occupied space must not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

2.2 Averaging Duct Sensors

.1 Shall be installed in all mixed air ducts and/or plenums, discharge air ducts and/or plenums, or any duct and/or plenum where stratification occurs.

.2 Shall have a minimum length of 1.5 meters with a duct and/or plenum cross sectional area of .75 square meters or less, and a minimum length of 6 meters for duct and/or plenum cross sectional areas in excess of .75 square meters.

.3 The sensor shall have thermistor sensing elements with a scale range lookup table in the DDC producing a linear output over its sensing range.

.4 Accuracy: plus or minus 0.05°C at 21°C.

.5 Minimum sensing range: -40°C to 40°C.

2.3 Duct Sensors

.1 Shall be installed in all ducts and/or plenums where stratification of the air flow does not occur.

.2 Shall have thermistor sensing elements with a scale range lookup table in the DDC producing a linear output over its sensing range.

.3 Minimum length: 203mm.

.4 Accuracy: plus or minus 0.2% over its operating range.

.5 Minimum sensing range: 4.5° C to 60°C.

2.4 Room Temperature Sensors

.1 Shall have a blind cover for all applications. Provide a secured temperature sensor for public areas.

.2 Shall have a thermister sensing element producing a linear output over its sensing range.

.3 Accuracy: plus or minus 0.2% over its operating range.

.4 Minimum sensing range: 4.5°C to 35°C.

2.5 Duct/Room Humidity Sensors

.1 Range: 5 - 90 % RH minimum.

.2 Operating temperature range: [0] - [60] °C.

.3 Absolute accuracy:

.1 Duct sensors: plus or minus 2/3%.

.2 Room sensors: plus or minus 2/3%].

.4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.

.5 Maintenance: by simple field method such as washing with solvent or mild detergent solution so as to remove anticipated airborne contaminants.

.6 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.

.7 Room sensors: as indicated.

.8 Duct mounted sensors: locate so that sensing element is between 1/3 and 2/3 distance across any duct dimension.

.9 Sensors to be unaffected by external transmitters such as walkie-talkies.

2.6 Current Sensors (CT)

.1 Shall vary the output voltage with a change in current.

.2 Provide actual analog current indication for status of all motors 1 horsepower and larger.

.3 In software provide multiple switch points to determine both motor status and belt breakage. Size for inrush and F.L.A.

.4 Provide alarm indication for high and low current.

.5 Provide digital current indication for all motors 3/4 HP and smaller by using current switches (CS) which shall open or close a contact from motor induced current to indicate motor status.

2.7 Dampers and Actuators

.1 All control dampers not furnished with packaged equipment shall be supplied by the controls subcontractor and installed by the sheet metal subcontractor. Provide damper actuators for all dampers shown or specified.

.2 All dampers in a mixing application shall be parallel blade with direction of closing producing opposed air streams for optimal mixing. Return air dampers shall be a tight closing, low leakage type with replaceable blade and edge seals, T.A. Morrison Series 1000 or approved equal.

.3 Actuators shall be electronic, direct coupled, as manufactured by Belimo, Siemens, or Approved Equal. Control voltage shall be 0-10 VDC, or 4-20 mA with an internal spring return on power failure. Provide a 2-10 VDC proportional actuator position feedback signal on all primary equipment (air handling units, relief air and emergency generators) to prove actuator position. Actuators shall permit manual positioning of damper when actuator is not powered.

2.8 Outdoor Air Temperature Sensors

.1 Shall be complete with a sun shield.

.2 Shall have 10,000 Ohm thermistor sensing elements with a scale range lookup table in the DDC producing a linear output over its sensing range.

.3 Accuracy: plus or minus 0.05°C at 21°C.

.4 Minimum sensing range: -40°C to 40°C.

PART 3 EXECUTION

3.1 General

.1 Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats and temperature sensors 1.5m above floor.

.2 Install damper motors on outside of ducts. Do not locate in outside air stream.

.3 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.

.4 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.

.5 All transmitters, interfaces, terminations and control relays, etc. shall be mounted in field cabinets that may be locked.

.6 Freeze protection devices shall be hard wired and also wired to alarm through DDC system.

.7 All wall mounted devices in new finished space shall be mounted on a wall box. The wall box shall be connected to the ceiling space by a conduit stub. On renovations, when sensors are mounted in existing finished walls, wiring or tubing may be fished into the walls without conduit.

3.2 Sensors

.1 Sensors provided shall be installed in accordance with the Manufacturer's prescribed procedures.

.2 Sensors shall be rigidly mounted and mountings shall be adequate for the environment within which the sensor operates.

.3 Averaging type temperature sensors shall be used wherever mixed air or stratified temperature is to be monitored. They shall be installed in a serpentine configuration with adequate provision for the mechanical protection of the sensor and such that it is supported as required along its entire length.

.4 Duct type Thermistors shall be used for the monitoring of all uniform air temperature. Length shall be such that the sensing element is installed to not less than one third of the duct width or duct diameter from the duct wall.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 91 13	General Commissioning (Cx) Requirements
.2	Section 01 91 31	Commissioning (Cx) Plan
.3	Section 01 91 33	Commissioning Forms
.4	Section 01 91 41	Commissioning Training
.5	Section 01 91 51	Building Management Manual (BMM)
.6	Section 25 05 01	EMCS: General Requirements

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 Sequence of Operation

.1 Air Handling Unit (AHU-1):

.1 Supply fan shall be started, stopped and monitored at the DDC.

.2 Provide room temperature sensor, damper actuators (for dampers furnished with unit), relief air motorized damper and actuator, supply air temperature sensor.

.3 When the outdoor air temperature is below 12.8°C (55°F) and there is a call for cooling, enable fan and modulate outdoor air and return air damper to maintain minimum 12.8°C (55°F) supply air temperature. Open relief air damper. Modulate fan speed to maintain room temperature set point.

.4 When the outdoor air temperature is above 12.8°C (55°F) and there is a call for cooling, enable fan and modulate outdoor air damper to 100%. Open relief air damper. Modulate fan speed to maintain room temperature set point.

.5 When there is no call for cooling, disable fan and close outdoor air and relief air damper. Provide DDC override capability to enable fan, open outdoor air and relief air dampers when the room is occupied.

.6 Provide the following outputs to the SCADA system (Div. 26).

.1 Space temperature.

.2 Fan alarm status.

.7 Provide alarm to DDC when room temperature is below 10 deg. C or above 35 deg. C.

.2 Supply Fan (SF-1):

.1 Supply fans shall be started, stopped and monitored at the DDC.

.2 Provide room temperature sensor, motorized dampers and actuators, supply air temperature sensor and outdoor air temperature sensor. Install outdoor temperature sensor on the north side of the building away from the exhaust air outlets from the building.

.3 When the outdoor air temperature is below 12.8°C (55°F) and there is a call for cooling, enable fan and modulate outdoor air and return air damper to maintain minimum 12.8°C (55°F) supply air temperature. Open relief air damper.

.4 When the outdoor air temperature is above 12.8°C (55°F) and there is a call for cooling, enable fan and modulate outdoor air damper to 100%. Open relief air damper.

.5 When there is no call for cooling, disable fan and close outdoor air and relief air damper. Provide DDC override capability to enable fan, open outdoor air and relief air dampers when the room is occupied.

.6 Provide the following outputs the SCADA system (Div. 26).
- .1 Space temperature.
- .2 Fan alarm status.

.7 Provide alarm to DDC when room temperature is below 10 deg. C or above 35 deg. C.

.3 Split AC units:

.1 Provide field control wiring between the outdoor condensing unit, indoor fan coil, DDC interface module and wired remote control panel.

.2 Provide on/off, setpoint, operation mode and fan speed control through the existing DDC system. Monitor unit’s status of on/off, alarms, compressor, and operation mode through the existing DDC system.

.4 Make Up Air Unit (MAU-1):

.1 The DDC control system shall switch the system room “occupied” to “unoccupied” mode of operation and shall allow override capability from the room temperature sensor to restore “occupied” mode of operation. The room temperature sensor shall maintain reduced temperature during "unoccupied" periods and shall be integrated with the system optimal start feature.

.2 During "occupied" mode of operation, the outdoor damper shall be positioned to provide the scheduled air volume.

.3 During the heating season, the electric heating coil shall modulate to maintain scheduled air temperature (27 deg. C) set point in the duct. Upon demand for cooling the electric heat shall be disengaged.

.4 Unit is to run continuously during "occupied" mode of operation and are to cycle to maintain a reduced temperature during "unoccupied" periods. An optimal start program shall control the morning start-up of unit to reach the "occupied" temperature set point at the required time. The unit shall start and run on 100% outdoor air at all times.

.5 Provide analog pressure differential sensor across filter bank and monitor status of fan operation and filter pressure drop.

.8 Provide damper position feedback at the DDC.

.9 Provide exhaust fan (EF-1) as scheduled. EF-1 shall operate when Make Up Air Unit (MAU-1) is enabled.

.10 Provide damper position feedback at the DDC.

.5 Miscellaneous:

.1 Provide an outdoor temperature sensor on the north side of the building away from the exhaust air outlets from the building.

.3 Electric Unit Heaters: install thermostats as indicated.

3.2 Point List

.1 The following point lists are typical of the Analog and Digital output and input points required to achieve the intended sequence of operation and provide the required level of monitoring and control. They are intended to set a minimum level of acceptability. All additional points required to achieve the specified features and sequence of operation shall be provided by the control contractor.

Spare Capacity: Provide additional 25% spare points (AI, AO, DI, DO) capacity on each DDC system installation. Identify panel & controller spare points on shop drawing submittal.

.2

SUPPLY FAN (SF-1) CONTROL – ELECTRICAL ROOM (Main Floor)							
	POINTS				**ALARM/INDICATION**		
POINT DESCRIPTION	**AI**	**AO**	**DI**	**DO**	**HI**	**LO**	**FAIL**
SUPPLY FANS SF-1 (START/STOP/STAT)	CT			CR			X
SUPPLY AIR TEMPERATURE	DTS						
OUTDOOR DAMPER (MD-1A)		DMA					
RETURN DAMPER (MD-1B)		DMA					
RELIEF AIR DAMPER (MD-2)	DMD						
SPACE TEMPERATURE	RTS						
FAN ALARM OUTPUT TO SCADA *				X			

* Coordinate with Division 26.

.3

AIR HANLDING UNIT, AHU-1 – ELECTRICAL ROOM (Second Floor)							
	POINTS				**ALARM/INDICATION**		
POINT DESCRIPTION	**AI**	**AO**	**DI**	**DO**	**HI**	**LO**	**FAIL**
SUPPLY FANS (START/STOP/STAT)	CT			CR			X
SUPPLY FAN ASD (SPEED, FEEDBACK)	X	X					
SUPPLY AIR TEMPERATURE	DTS						
SPACE RELATIVE HUMIDITY	RHS						
OUTDOOR DAMPER		DMA					

RETURN DAMPER		DMA					
RELIEF AIR DAMPER (MD-2)	DMD						
SPACE TEMPERATURE	RTS						
SPACE TEMP. OUTPUT TO SCADA *		X					
SPACE RH OUTPUT TO SCADA *		X					
FAN ALARM OUTPUT TO SCADA *				X			

* Coordinate with Division 26.

.4

MAKE UP AIR UNIT (MAU-1) – New Service Pit (Basement Floor)							
	POINTS				**ALARM/INDICATION**		
POINT DESCRIPTION	**AI**	**AO**	**DI**	**DO**	**HI**	**LO**	**FAIL**
SUPPLY FAN (START/STOP/STAT)	CT			CR			X
SUPPLY AIR TEMPERATURE	DTS						
OUTDOOR DAMPER		DMA			X	X	
FILTER STATUS	DPS				X	X	
SPACE TEMPERATURE	RTS						
SPACE TEMP. OUTPUT TO SCADA *		X					
FAN ALARM OUTPUT TO SCADA *				X			

* Coordinate with Division 26.

.5

MISCELLANEOUS							
	POINTS				**ALARM/INDICATION**		
POINT DESCRIPTION	**AI**	**AO**	**DI**	**DO**	**HI**	**LO**	**FAIL**
OUTDOOR AIR TEMPERATURE	OAT						
SUBSOIL DRAIN SUMP PUMP STAUS (DUPLEX)	CT						X
SUBSOIL DRAIN SUMP HIGH LEVEL ALARM			R-ST		X		
SPLIT AC UNIT EMERGENCY DRIP PAN WATER SENSOR (IAC-1)			WMS		X		

.5

SPLIT DX COOLING SYSTEMS							
	POINTS				**ALARM/INDICATION**		
POINT DESCRIPTION	**AI**	**AO**	**DI**	**DO**	**HI**	**LO**	**FAIL**
IAC-1/CU-1 START/STOP/STATUS				DCI	CR		X

IAC-1/CU1 MODE OF OPERATION CONTROL AND STATUS	X	X					
IAC-1/CU1 SETPOINT CONTROL		X					
IAC-1 FAN SPEED CONTROL		X					
CU-1 COMPRESSOR STATUS			X				

.6

SUPPLY FAN (SF-2) CONTROL – COMMUNICATION ROOM (Main Floor)							
	POINTS				**ALARM/INDICATION**		
POINT DESCRIPTION	**AI**	**AO**	**DI**	**DO**	**HI**	**LO**	**FAIL**
SUPPLY FANS SF-1 (START/STOP/STAT)	CT			CR			X
FAN ALARM OUTPUT TO SCADA *				X			

NOTE: POINT COUNT IS APPROXIMATE. CONTROLS CONTRACTOR SHALL VERIFY EXACT QUANTITY AND PROVIDE ADDITIONAL POINTS AS REQUIRED TO ACHIEVE THE SEQUENCE OF OPERATION DESCRIBED IN THE CONTRACT DOCUMENT.

ATS Averaging Temperature Sensor
ASD Adjustable Speed Drive
CDS Carbon Dioxide Sensor
CS Current Switch
CR Digital Relay
CT Analog Current Transformer
DCI Dry Contact Input
DHS Duct Humidity Sensor
DMA Damper Motor (Analog)
DMD Damper Motor Digital
DPS Diff. Press. Switch (Analog)
DTS Duct Temperature Sensor
DHS Duct Humidity Sensor
ES End Switch
FSA Flow sensor - Air
FSW Flow sensor - Water
LTS Low Temperature Switch
MOP Proportional A.O. (4-20 ma)
MD Motion Detector
O-SW Override Switch
OTS Outdoor Air Temp. Sensor
POT Potentiometer
R-ST Relay Status
RHS Room Humidity Sensor
RTS Room Temperature Sensor
VMA Valve Motor (Analog)
VMD Valve Motor (Digital)
VPM Variable pump motor
WTS Water Temperature Sensor
WMS Water/Moisture Sensor

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.1 Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.

.2 CAN/CSA-C22.3 No. 1, Overhead Systems.

.3 CAN3-C235-83, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.4 CSA B651-12 Accessible Design for the Built Environment.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

.3 National Electrical Manufacturers Association (NEMA)

1.2 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.3 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.3 Language operating requirements: provide identification nameplates for control items in English.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data: submit WHMIS MSDS in accordance with Section 01 47 15 - Sustainable Requirements: Construction and Section 02 81 01 - Hazardous Materials.

.3 Submit for review single line electrical diagrams in glazed frames and locate:

.1 Electrical distribution system in main electrical room.

.2 Electrical power generation and distribution systems in power plant rooms.

.4 Submit for review fire alarm riser diagram, plan and zoning of building in glazed frames at fire alarm control panel and annunciator.

.5 Shop drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of BC, Canada.

.2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

.3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.

.5 Submit one copy of drawings and product data in PDF digital format to authority having jurisdiction.

.6 If changes are required, notify Departmental Representative of these changes before they are made.

.7 Submit .dwg files for all approved switchgear shop drawings.

.6 Quality Control: in accordance with Section 01 45 00 - Quality Control.

.1 Provide CSA certified equipment and material.

.2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to site.

.3 Submit test results of installed electrical systems and instrumentation.

.4 Permits and fees: in accordance with General Conditions of contract.

.5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.

.6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.

.7 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

.8 Submit one copy of all manufacturer specific software packages, including license certifications/quantities required for adjusting the settings and configuration of electrical and communication systems components. Software shall include all required licencing, specialty port adapters and communication protocols. List all manufacturer specific software packages provided.

1.5 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.

.1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

.3 Site Meetings:

.1 In accordance with Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM), Section 01 32 16.07 - Construction Progress Schedule - Bar (GANTT) Charts.

.2 Site Meetings: as part of Manufacturer's Field Services described in Section 01 91 13 - General Commissioning (CX) Requirements, schedule site visits, to review Work, at stages listed.

.1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of Work, after cleaning is carried out.

.4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.

.2 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.7 SYSTEM STARTUP

.1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant will aspects of its care and operation.

1.8 OPERATING INSTRUCTIONS

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.3 Safety precautions.

.4 Procedures to be followed in event of equipment failure.

.5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

.2 Do verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification.

2.2 MATERIALS AND EQUIPMENT

.1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.

.2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.

.3 Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

2.4 WARNING SIGNS

.1 Porcelain enamel signs, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

.1 Sizes as follows:

NAMEPLATE SIZES
Size 1 10 x 50 mm 1 line 3 mm high letters
Size 2 12 x 70 mm 1 line 5 mm high letters
Size 3 12 x 70 mm 2 lines 3 mm high letters
Size 4 20 x 90 mm 1 line 8 mm high letters
Size 5 20 x 90 mm 2 lines 5 mm high letters
Size 6 25 x 100 mm 1 line 12 mm high letters
Size 7 25 x 100 mm 2 lines 6 mm high letters

.2 Wording on nameplates to be approved by Departmental Representative prior to manufacture.

.3 Allow for minimum of twenty-five (25) letters per nameplate.

.4 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.5 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.6 Terminal cabinets and pull boxes: indicate system and voltage.

.7 Transformers: indicate capacity, primary and secondary voltages.

2.7 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, numbered and coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Conduit	Prime	Auxiliary
0 to 250 V	Yellow	
251 to 600 V	Yellow	Green
601 to 5 kV	Yellow	Blue
5 to 15 kV	Yellow	Red
> 15kV	Yellow	Purple
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.9 CABLING AND WIRING IDENTIFICATION

.1 Identify all feeders with coloured tags having 4 slotted tie holes and secured with 2 plastic tag ties as follows:

- .1 Minimum of 1 tag for each feeder in each manhole, pull box, or building.
- .2 Minimum of one tag on each side of every connector, splice assembly, or junction box.
- .3 Size 150 mm x 50 mm.
- .4 Material: 3-ply lamicoid, minimum 5 mm thick.

.2 Tags for 25 kV feeders: minimum 12 mm high engraving of black characters on red background, secured on trefoil bundles.

.3 Identify all other cables with plastic tie-tags. Markings to be indelible and shall identify cable end destinations and service description.

.4 Identify the phasing by colour coding and phase designation letter ("A," "B," "C") at each and every set of 25 kV, 15 kV, and 208 V conductors at each termination (both Line and Load ends) and at both sides of each intermediate connector and splice point, with adhesive cable markers. Maintain phase sequence and colour coding throughout.

.5 Identify concrete duct banks, service ducts and conduits for communication and power and other spare raceways where they enter or leave buildings, with engraved stainless steel marker plates indicating the type of raceway and buried depth. Install marker plates on the exterior wall immediately above point of entry. Obtain prior approval of the Departmental Representative for method of attachment to the building surface.

.6 Colour code: to CSA C22.1.

.7 Paint all exposed steel conduits and steel pull boxes carrying HV cables inside buildings with 100 mm wide yellow and 50 mm wide purple bands and stencil "DANGER 12.5 kV" (or 25 kV) in red characters.

2.10 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.

.2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

Part 3 Execution

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 LOCATION OF OUTLETS

.1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Locate light switches on latch side of doors.

.1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.5 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: In accordance with CSA B651-12 Accessible design for built environment.

.2 Wall receptacles: In accordance with CSA B651-12 Accessible design for built environment.

.3 Panelboards: as required by Code or as indicated.

.4 Telephone and interphone outlets: In accordance with CSA B651-12 Accessible design for built environment.

.5 Wall mounted telephone and interphone outlets: In accordance with CSA B651-12 Accessible design for built environment..

.6 Fire alarm stations: In accordance with CSA B651-12 Accessible design for built environment.

.7 Fire alarm bells: 2100 mm.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 FIELD QUALITY CONTROL

.1 Load Balance:

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.

.1 Power distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Lighting and its control.

.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.5 Systems: fire alarm system communications.

.6 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Megger 600-2.4 kV circuits, feeders and equipment with a 5000 V instrument.

.4 High voltage cable 4.16kV and higher megger and hi-pot to recommended cable manufacturer’s testing procedures.

.5 Check resistance to ground before energizing.

.3 Carry out tests in presence of Departmental Representative.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.5 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

.6 Provide fault study, arc flash study, and protection & coordination study for both the 12.5 kV and 25 kV operating voltages. Studies to be signed and sealed by Professional Engineer registered in British Columbia.

3.8 CLEANING

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 General requirements related to Sequence of Construction.

1.2 RELATED SECTIONS

.1 Section 26 05 00 Common Work Results - Electrical

.2 Section 26 05 05 Existing Buildings, Facilities and Site Conditions

1.3 SUMMARY

.1 The following represents sequence of construction steps necessary to execute this project. Provide a written Sequence of Construction for this contract using the maximum restriction time periods noted for review and approval by Departmental Representative.

1.4 SEQUENCE OF CONSTRUCTION

.1 EGD must remain operational during the construction and commissioning of this project. In order to ensure EGD operations are maintained with minimal power disruptions, the following construction steps shall be used as a guideline for the contractor when developing his sequence of construction plan for submission and approval by the Departmental Representative.

.2 Schedule electrical shutdowns required with the Departmental Representative. Provide at least 4 weeks notice for requested shutdown dates.

1.5 PROPOSED SEQUENCE OF WORK

.1 At the onset of construction, the SSS will be powered by the existing Teck cable feeder in the tunnel from the main substation. At some point in time prior to the SSSR being completed, the SES may be operational and the new feed as provided by the SSES project will have been installed.

.2 Civil works on the SSSR footprint will expose existing power and communications feeders running to the west. These are to be protected until an acceptable cable diversion can be installed and bypass the active construction site. The existing conductors are to be protected for reuse into the new SSSR where noted.

.3 New ducts shall be extended from the south east from manholes installed as part of the SSES project. This will include HV, LV and communications ducts to service the SSSR as well as to support new and existing loads such as the south jetty kiosks.

.4 Existing cable tray and cables from the generator building will need to be rerouted to clear the active construction site. These will be rerouted or removed by completion of the SSSR.

.5 Once the SSSR is operationally ready, a temporary feeder will be used to back feed to the SSS and the permanent feeder from SES will be connected. At this point, both SSS and SSR will be operational to allow for controlled transition of existing loads and removal of all electrical equipment from the SSS. This would include communications cabling from SSS for SCADA and controls.

.6 Once the SSSR is energized, the existing 2500V crane cabling will be run from the existing terminal box at the trailing cable connection to the SSSR 2400V switchgear.

.7 The existing generator will remain in place along with existing load bank and transfer equipment. A generator breaker will be added to reduce existing arc flash hazard levels in this

room at this time. The 600V from the transfer switch will be re-directed to new standby distribution and transformation in the SSSR providing 120/208V, 480V and 600V standby power. Existing standby power panels at 480V and 600V will be removed from the SSS along with their transformers. Panel 2SL in the generator room will remain and be fed from the new SSSR distribution. Panel 2SK in the SSS will remain and be refed from the standby distribution in the SSSR.

.8 The existing 600V compressor, drier and accessories in this room will be refed directly from the SSSR using Teck cable or conduits. Existing panel 2T is to be refed from the new distribution and retained. The existing 2400V-600V substation shall be removed. The existing 2400V cable in the tunnel from the Pumphouse shall be removed.

.9 Remaining 120/208V, 480V and 600V Drydock loads will be spliced at the tunnel near the north east corner of the SSSR and extended into the new distribution. All transits through the tunnel/SSSR wall will be waterproof.

.10 Existing south jetty kiosk loads removed during demolition will have provisions for reinstatement via ducts installed to either new manholes as part of the SSES project or via existing/new ducts to the north or west.

.11 All existing communications cabling to kiosks or buildings will be rerouted, spliced or replaced to connect at the new communications room in the SSSR.

.12 At this point all LV loads should have been transitioned to the SSSR from the SSS at which time the temporary feed to the SSS will be opened and removed. All existing electrical equipment, aside from small power panels and fire alarm equipment, will have been removed from the SSS and compressor room.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 REFERENCE SINGLE LINE DIAGRAMS

.1 Contractor shall provide an updated single line diagram for each substation affected by the project. Updated single line diagrams to be installed in existing single line diagram mounting frames. Single line diagrams shall be updated during each phase of work. All circuit breaker nameplates must be accurate during various phases of work. Each substation must have an accurate single line diagram at all times in accordance with CSA C22.1-12. Single line diagram updates shall be submitted to the Departmental Representative for approval prior to installation in substations.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 General requirements related to existing building.

1.2 RELATED SECTIONS

.1 Section 26 05 00 Common Work Results - Electrical

.2 Section 26 05 01 Sequence of Construction

1.3 SEQUENCING, PHASING AND SCHEDULING OF WORK

.1 Refer to Section 26 05 00: Common Work Results - Electrical and ensure that all work on existing buildings, facilities, services and utilities is coordinated, sequenced, phased and scheduled with all other work.

.2 Contractor shall submit his proposed Sequence of Construction for review and approval by the Departmental Representative, refer to Section 26 05 01-Sequence of Construction.

1.4 EXISTING CONDITIONS

.1 Indication on the drawings of existing conduit, outlets and other electrical apparatus is based on casual field observations and records of past contracts. As such, this information represents the best data available but is not guaranteed to be full or accurate. Verify that field measurements and circuiting diagrams are as indicated on Drawings and that abandoned wiring and equipment serve only abandoned facilities. Report discrepancies to Departmental Representative before disturbing existing installation.

.2 Where alterations and/or additions to existing equipment or apparatus are required to be made by these documents, it shall be assumed that any existing CSA certification may be in jeopardy. Ensure that all changes are made in accordance with the current edition of the Canadian Electrical Code, Part 2; obtain recertification, and include recertification costs in the tender.

.3 Permit no interruptions to the electric power, fire alarm, telephone, data, metering, or other similar systems in the existing building during normal working hours. Advise the Owner in writing of any intended interruptions outside of these normal hours, including the time and duration of outage. Obtain permission from Owner at least 24 hours before partially or completely disabling any of the systems. The Owner may cancel such permission in emergencies at the last minute without penalty or extra cost. Minimize duration of outage.

.4 Assume full responsibility for any disruption to existing services and systems. Provide all necessary material and equipment and provide all labour at no extra cost for any temporary connections be required to maintain services during work in the existing buildings. Include the removal of such temporary connections at completion of the work in the tender price.

1.5 INSTALLATION

.1 Examine drawings of all other trades and allow for all work such as the removal, temporary relocation and re-installation of electrical fixtures, equipment, devices, wiring, raceways, etc. where such work is required due to alterations in or about existing buildings.

.2 Where work requires modification, extension and additions to power and low tension services within the existing building, the wiring required for this work shall be installed concealed wherever possible. In certain cases (e.g. where it is necessary to clear obstructions, or to avoid damage to existing structure and/or finish materials), concealed wiring may not be possible. In such cases, special wiring methods such as mineral-insulated cable or surface mounted raceway, shall be used, provided that, for each specific instance, approval for same is requested from and granted in writing by the Departmental Representative.

.3 Remove abandoned wiring to source. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

.4 Disconnect abandoned outlets and remove devices. Remove abandoned outlets when servicing conduit is abandoned and removed. Blank off all unused outlet boxes.

.5 Disconnect and remove abandoned panelboards and distribution equipment.

.6 Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

.7 Clean and repair existing materials and equipment which remain or are to be reused, as described elsewhere in these Specifications.

.8 Refer to Section 26 05 01 Sequence of Construction – Sequence of Construction.

1.6 SALVAGE

.1 All surplus electrical equipment, devices, and light fixtures shall be considered Owner's property. Determine from the Owner which materials he wishes to keep and transport and store such items at a location as directed by the Owner. All other surplus materials such as conduit, wiring, devices, etc. shall be removed from the site. Request a signed receipt for surplus material turned over to the Owner and provide a copy of same to the Departmental Representative.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No. 131-07, Type TECK 90 Cable.

.2 CAN/CSA-C61089-11, Round Wire Concentric Lay Overhead Electrical Stranded Conductors.

.2 National Electrical Manufacturers' Association (NEMA)/Insulated Cable Engineers Association (ICEA)

.3 ANSI/NEMA WC 74/ICEA S-93-6395-46kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

.1 Provide manufacturer's printed product literature, specifications, data sheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 INSULATED CABLES (5001 - 27000 V)

.1 Cables shall be suitable for operation on a 25 kV, 3-phase, 3-wire, 60 cycle, solidly grounded neutral system with a maximum available short circuit capacity of 700 MVA symmetrical.

.2 25 kV cables shall be single-core copper, Class B stranding, size as indicated, type MV-90, with semi-conducting shield over core conductor, 90 degree C rated cross-linked thermosetting polyethylene (XLPE) insulation, 27 kV, rated for 100% voltage level, with concentrically served copper wire shield over semi-conducting insulation shielding layer, separator tape over shield, PVC jacket rated -40 degrees C.

.3 Single copper conductor: to ICEA S-93-639/NEMA WC74 size as indicated.

2.2 TECK POWER CABLE (1001 - 15000 V)

.1 Cable: to CSA-C22.2 No. 131 in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Bare copper grounding conductor, size as indicated.

.3 Copper circuit conductors, size and number as indicated.

.4 Insulation: chemically cross-linked thermosetting polyethylene rated RW90 5 kV to ICEA S-93-639/NEMA WC74.

.5 Separator tape over conductor assembly.

.6 Inner jacket of PVC.

.7 Interlocked aluminum armour.

.8 Overall PVC jacket rated minus 40 degrees C and FT4 rated.

Part 3 Execution

3.1 INSTALLATION

.1 Install power cable in ducts and manholes as indicated and in accordance with manufacturer's instructions.

.2 Provide supports and accessories for installation of high voltage power cable.

.3 Install stress cones, terminations and splices in accordance with manufacturer's instructions

.4 Install grounding in accordance with local inspection authority having jurisdiction.

.5 Provide cable identification tags and identify each phase conductor of power cable.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Use of qualified tradespersons for installation, splicing, termination and testing of high voltage power cables.

.3 Engage an independent testing agent to test high voltage power cable in accordance with NETA testing standards. Submit test result and inspection certificate.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies the materials and installation for wire and box connectors, rated to 1000V.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2No.18 latest edition, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2No.65 latest edition, Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, latest edition, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper alloy sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper alloy sized to fit copper conductors 10 AWG or less.

.3 Clamps or connectors for armoured cable, flexible conduit, as required to: CAN/CSA-C22.2No.18.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.

.2 Install mechanical pressure type connectors and tighten screws. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.3 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies copper conductors rated 0-1000 Volts and the most common electrical insulation and covering materials.

.2 This section does not include fire rated building wire to ULC S139 and CSA C83, marine, hazardous, mining, instrumentation, communication and fire alarm wiring.

1.2 REFERENCES

.1 CSA C22.2 No .0.3 latest edition, Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No. 131 latest edition, Type TECK 90 Cable.

1.3 GENERAL REQUIREMENTS

.1 Typically use insulated 98% conductivity copper conductor wiring enclosed in EMT (steel) conduit for the general wiring systems unless otherwise indicated.

.2 Teck cable may only be used where specifically indicated on the drawings or in the specifications. Where permitted, Teck wiring up to 750 system volts to be PVC jacketed armoured cable, multi-copper conductor type Teck90 1000 volt having a PVC jacket with FT-4 flame spread rating.

.3 Flexible AC90 armoured cabling (BX) shall not be used for the general wiring system other than final drops to recessed light fixtures in concealed locations.

.4 Provide all control wiring except HVAC controls as specified in Mechanical Divisions.

.5 Refer to Equipment Schedule(s) for detailed responsibilities.

Part 2 Products

2.1 WIRE AND CABLE GENERAL

.1 Conductors: stranded for 10 AWG and larger. Minimum size #12 AWG.

.2 Insulation to be 600 volt RW90XLPE (X link) for the general building wiring in conduit.

.3 Use RW90XLPE for underground installations.

.4 Site services sub-circuits, including site lighting, to be minimum #10 AWG for power and #12 for controls. Increase wiring size for lengthy and/or loaded circuits so that system will not exceed the maximum voltage drop as recommended by the Canadian Electrical Code CSA 22.1, latest edition.

.5 Main feeders to be conduit and copper insulated wiring unless otherwise noted on drawings. Provide ground wiring for all conduits in or below slabs. Increase conduit size as required.

.6 Armoured AC90 (BX) cable may only be utilized for recessed tee bar luminaire drops from ceiling mounted outlet boxes. Use anti-short connectors. Cable from luminaire to luminaire is discouraged. Allow nominally 900mm extra cable looped and supported in the ceiling space to permit fixture relocations of one tile space.

.7 TBS90 #14 AWG stranded shall be used in all switchgear assemblies. Current transformer secondary wiring shall be #12 AWG stranded. Current transformer leads shall incorporate ring type tongues for termination purposes.

.8 Conductors to be colour-coded. Conductors No.10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No.8 gauge and larger may be colour-coded with adhesive colour coding tape, but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible. Where colour-coding tape is utilized, it shall be applied for a minimum of 50 mm at terminations, junctions and pullboxes and conduit fittings. Conductors not to be painted.

2.2 TECK CABLE

.1 Cable: to CAN/CSA-C22.2 No. 131 latest edition.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.3 Insulation:

.1 Type: ethylene propylene rubber.

.2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride material.

.7 Fastenings:

.1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 1000 mm centers.

.3 Threaded rods: 6 mm dia. to support suspended channels.

.8 Connectors:

.1 Watertight approved for TECK cable.

2.3 ARMOURED CABLES

.1 Conductors: insulated, copper, size as indicated.

.2 Type: AC90.

.3 Armour: interlocking type fabricated from aluminum strip.

2.4 ARMOURED FIRE ALARM CABLE

.1 Use flexible armoured fire alarm cable from junction box to ceiling mounted fire alarm device.

.2 Type: armoured FAS cable, fire rated to CSA FT4 requirements.

.3 Armour: interlocked aluminum tape armour. Cable armour shall be colour coded “red”.

2.5 CONTROL CABLES

.1 Type LVT: 2 soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket.

.2 Low energy 300 V control cable: solid annealed copper conductors sized as indicated, with TWH over each conductor and overall covering of PVC jacket.

.3 600 V type: stranded copper conductors, sizes as indicated with R90 (x-link) ethylene-propylene rubber insulation type over each conductor and overall covering of PVC jacket.

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

- .1 In conduit systems in accordance with Section 26 05 34.
- .2 In cable trays for electrical systems in accordance with Section 26 05 36.
- .3 In underground ducts in accordance with Section 26 05 34.
- .4 In wireways and auxiliary gutters in accordance with Section 26 05 37.
- .5 All wires are to be pulled in together in a common raceway, using liberal amounts of lubricant.
- .6 No combining of circuits onto common neutral will be permitted. Use 2 pole or 3 pole breakers for combined circuits, no connector clips will be allowed.
- .7 Ensure that all single phase loadings are reasonably closely balanced over the main feeders.

3.2 INSTALLATION OF TECK CABLE 0 -1000 V

.1 Install cables.

- .1 Group cables wherever possible on channels or in cable trays.

.2 Lay cable in cable trays for electrical systems in accordance with Section 26 05 36.

.3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

3.3 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible.

.2 Lay cable in cable trays for electrical systems in accordance with Section 26 05 36.

.3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

3.4 INSTALLATION OF CONTROL CABLES

.1 Control cable and conduit will be supplied and installed by Mechanical Contractor. Controls wiring must be installed in conformance with Electrical Specifications. Install control cables in conduit.

.2 Ground control cable shield.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for connectors and terminations for 2 kV-25 kV applications.

1.2 RELATED SECTIONS

.1 Section 26 05 00 Common Work Results – Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.41-13, Grounding and Bonding Equipment.

1.4 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.5 CERTIFICATES

.1 Obtain inspection certificate of compliance covering high voltage stress coning from Departmental Representative and include it with as-built drawings and maintenance manuals.

Part 2 PRODUCTS

2.1 CONNECTORS AND TERMINATIONS

.1 Copper long barrel compression connectors as required sized for conductors.

Part 3 Execution

3.1 INSTALLATION

.1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.

.2 Bond and ground as required to CSA C22.2 No.41

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 Common Work Results – Electrical

.2 Section 26 12 16 Dry Type, Medium and High Voltage Transformers

.3 Section 26 13 18 Primary Switchgear Assembly to 27kV

1.2 REFERENCES

.1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE 837, Qualifying Permanent Connections Used in Substation Grounding.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Quality assurance submittals: provide in accordance with Section 01 45 00 - Quality Control.

.1 Manufacturer's Instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions

Part 2 PRODUCTS

2.1 MATERIALS

.1 Rod electrodes: copper clad steel, 19 mm diameter by 3 m long.

.2 Conductors: bare, stranded, soft annealed copper wire, size No. 4/0 AWG and 2/0 AWG for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.

.3 Conductors: PVC insulated coloured green, stranded soft annealed copper wire, minimum size No. 4 AWG for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, and potential transformers.

.4 Conductors: PVC insulated coloured green, stranded soft annealed copper wire, minimum size No. 4/0 AWG for duct bank grounding conductors.

.5 Conductors: PVC insulated coloured green, stranded soft annealed copper wire minimum No. 10 AWG for grounding meter and relay cases.

.6 Conductors: No. 3/0 AWG extra flexible (425 strands) copper conductor for connection of switch mechanism operating rod to gradient control mat, fence gates and vault doors.

.7 Bolted removable test links.

.8 Gradient control mat: copper, size as indicated.

.9 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:

.1 Grounding and bonding bushings.
.2 Protective type clamps.
.3 Bolted type conductor connectors.
.4 Thermit welded type conductor connectors.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.

.10 Wire connectors and terminations: as indicated

Part 3 Execution

3.1 INSTALLATION

.1 Install continuous grounding system including, electrodes, conductors, connectors and accessories as indicated and to requirements of local authority having jurisdiction.
.2 Ground fences to grounding system independent of station ground.
.3 Install connectors and cadweld in accordance with manufacturer's instructions.
.4 Protect exposed grounding conductors during and after construction.
.5 Make buried connections, and connections to electrodes, structural steel work, using copper welding by thermit process.
.6 Use mechanical connectors for grounding connections to equipment provided with lugs.
.7 Use No. 4/0 AWG bare copper cable for main ground bus of substation and No. 2/0 AWG bare copper cable for taps on risers from main ground bus to equipment.
.8 Use tinned copper conductors for aluminum structures.
.9 Do not use bare copper conductors near un-jacketed lead sheath cables.

3.2 ELECTRODE INSTALLATION

.1 Install ground rod electrodes. Make grounding connections to station equipment.
.2 Install ground rod electrodes at transformer and switchgear locations.
.3 Install gradient control mats. Connect mats to station ground electrode and switch mechanism operating rods.
.4 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.
.5 Provide with ground rod electrode inspection wells to access for testing and inspecting of ground rods and ground wire connection to ground rods.

3.3 EQUIPMENT GROUNDING

.1 Install grounding connections as indicated to typical station equipment including: metallic water main, line sky wire, neutral, gradient control mats. Non-current carrying parts of: transformers, generators, motors, circuit breakers, reclosers, current transformers, frames of gang-operated switches and fuse cutout bases, cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers, meter and relay cases, any exposed building metal, within or forming part of station enclosure. Sub-station fences, pothead bodies and outdoor lighting.
.2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.

.3 Connect metallic piping (water, oil, air, etc.) inside station to main ground bus at several locations, including each service location within station. Make connections to metallic water pipes outside station to assist in reduction of station ground resistance value.

3.4 NEUTRAL GROUNDING

.1 Connect transformer neutral together using 25 kV insulated conductor to one side of ground test link, the other side of the test link being connected directly to main station ground. Ensure distribution neutral and neutrals of potential transformers and service banks are bonded.

.2 Interconnect electrodes and neutrals at each grounding installation.

.3 Connect neutral of station service transformer to main neutral bus with tap of same size as secondary neutral.

3.5 GROUNDING IN MANHOLES

.1 Install conveniently located grounding stud, electrode, stranded copper ground conductor in each manhole, size as indicated.

.2 Install ground rod with lug for grounding connection in each manhole so that top projects through bottom of manhole.

3.6 CABLE SHEATH GROUNDING

.1 Bond single conductor, metallic sheathed cables together at one end only. Break sheath continuity by inserting insulating sleeves in cables.

.2 Use No. 6 AWG flexible copper wire soldered, not clamped, to cable sheath.

.3 Connect bonded cables to ground with No. 2/0 AWG copper conductor.

3.7 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Engage an independent testing agent to inspect grounding and perform ground resistance test and submit to Departmental Representative before backfill.

.3 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction.

.4 Perform test before energizing electrical system.

.5 Provide step-and-touch potential calculations using measured station ground resistance measurements. Submit test result and inspection certificate before energizing electrical system.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies U shape support channels either surface mounted. Suspended or set in poured concrete walls or ceilings.

Part 2 Products

2.1 SUPPORT CHANNELS

.1 U shape, size 41 x 41mm, 2.5mm thick, surface mounted, suspended, or set in poured concrete walls and ceilings.

Part 3 Execution

3.1 INSTALLATION

.1 Secure equipment to surfaces with lead anchors or nylon shields as required.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.7 Suspended support systems.

- .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use channels at 1.5m on centre spacing.

.9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.11 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.

.13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 Common Work Results – Electrical

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Provide certified professionally sealed shop and placement drawings for all electrical equipment and equipment assemblies including runs of cable trays and conduit/cable racks showing the methods of attachment to the particular structure for each piece of equipment and assembly ***and provide anchorage/attachment details approved and sealed by a BC Professional Engineer for review by the Departmental Representative***.

.2 If requested by the Departmental Representative, calculations ***sealed by a Professional Engineer registered in BC*** shall be provided for the seismic restraint design shown on the shop drawings. Shop drawings shall show the equipment type, manufacturer's name, model number, and weight of the equipment to be restrained

1.3 SUBMITTALS

.1 Submit samples of materials required to complete the seismic restraint work for review if and when requested.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Earthquake snubbers for resiliently mounted major equipment.

.2 Expansion-deflection fittings for metal conduits crossing building expansion or seismic joints.

.3 Security bridles: Minimum #16 ASWG stranded stainless steel aircraft cable.

.4 All equipment shall be tested in an independent testing laboratory or shall be certified by a ***Registered Professional Engineer*** to demonstrate that the equipment meets the requirements of all Codes and Bylaws in terms of "withstanding" the lateral forces in any direction to be expected in the project seismic zone. ***Withstanding*** shall generally mean remaining in one piece and not breaking away from moorings.

Part 3 Execution

3.1 INSTALLATION

.1 Provide seismic restraint and anchorage for all equipment and services in accordance with the BC Building Code and all applicable Building Bylaws.

.2 Arrange and pay for the ***Professional Engineer*** who designed all anchorage/attachments to inspect same on site (note that multiple inspections will be required as the work progresses) and to provide typewritten Inspection Reports to the Departmental Representative throughout construction and to provide as required by the authorities having jurisdiction all required ***Letters of Assurance and Conformance*** with the specified Codes, Standards and Bylaws.

.3 Free-standing equipment shall be fastened to the basic structure using anchorage/attachments to overcome seismic overturning forces as designed by a Professional Engineer as noted in this Section.

.4 Resiliently-mounted major equipment such as standby generators and the core and coil of large power and distribution transformers shall be restrained by earthquake snubbers, selected for the weight of each piece of equipment to be protected. Securely bolt snubbers through floor or concrete base/housekeeping pad to basic structure and to the frame of equipment using anchorage/attachments, all as designed by a Professional Engineer as noted in this Section.

.5 All transformer core and coils shall be seismically restrained without short circuiting the sound isolation resilient mounting. All transformer enclosures shall be separately restrained against seismic forces.

.6 Provide seismic restraint for all cables, raceways, cable trays and bus ducts exceeding 50mm in any cross-sectional dimension and which are supported more than 300mm vertically from the basic structure.

.7 Provide slack cable restraint systems as designed by a Professional Engineer as described previously, but generally as follows

.1 Connect slack cable restraints to suspended equipment in such a way that the axial projection of the wires passes through the centre of gravity of the equipment.

.2 Orient restraint wires on suspended equipment at approximately 90° to each other (in plan), and tie back to the structure at an angle not exceeding 45° to the horizontal.

.3 Select each anchor in the structure for a load equal to twice the weight of the equipment with a safety factor of 4.

.4 Install cable using appropriate grommets, shackles, thimbles, U-bolts, and other hardware to ensure alignment of the restraints and to avoid bending the cables at connection points.

.5 Restraints shall be installed at least 50mm clear of all other equipment and services.

.6 Adjust restraint cables such that they are not visibly slack, but such that the flexibility is approximately 35mm under thumb pressure for a 1500mm cable length (equivalent ratio for other cable lengths).

.8 Provide transverse and axial restraints within 4m of a vertical bend.

.9 Trapeze hangers for cables, cable trays, raceways and bus ducts shall be restrained utilizing minimum 10mm diameter slack cable restraints which shall be provided at a maximum transverse spacing of 12.5m and longitudinal restraints at 25m maximum spacing, or as otherwise limited by anchor/slack cable performance. Adjacent spacing of restraints on a run shall vary by 10% to 30% to avoid coincident resonances.

.10 Transverse bracing for one raceway section may also act as longitudinal bracing for the raceway connected perpendicular to it, provided the bracing is installed within 610mm of the elbow or junction box. Branch runs shall not be used to restrain main runs.

.11 Install a 300mm length of flexible conduit and a braided bonding jumper in each surface-mounted conduit where it crosses a building expansion or seismic joint.

.12 Install expansion-deflection fittings in each conduit embedded in concrete where it crosses a building expansion or seismic joint. The fitting shall include an integral bonding strap where the conduit is metallic.

.13 Provide custom fabricated flexible sections allowing horizontal and vertical movement of cable trays at building expansion or seismic joint.

.14 Rigid support systems shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. (Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.) Provide loops in cables and flexible connections in raceways where such services leave a suspended trapeze rack or other support and extend down to floor braced equipment or wall-mounted equipment. Freedom of movement shall be up to 300mm in all directions.

.15 All recessed lighting fixtures in mechanical grid ceilings (e.g. T-bar) shall be restrained using at least two (2) security bridles per fixture tied to the basic building structure. Attach security bridles at ends of each fixture using a further attachment to each corner of the fixture and in such a manner that the fixture cannot fall lower than 300mm beneath ceiling.

.16 Surface-mounted lighting fixtures mounted on mechanical grid ceilings shall be attached to the ceiling system with positive clamping devices that completely surround the supporting members. Security bridles shall be attached between the clamping devices and the adjacent ceiling hanger or to the structure above in the same manner as described for recessed fixture supports.

.17 Pendant-hung lighting fixtures supported from their outlet boxes shall be provided with a security bridle from the outlet box to an adjacent ceiling hanger or to the structure above in the same manner as described for recessed fixture supports.

.18 Electrical outlet boxes flush-mounted in mechanical grid ceilings shall be anchored to the ceiling grid.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies materials and installation for splitters, junction boxes, pull boxes and cabinets.

1.2 PRODUCT DATA

.1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data: submit manufacturer's product data sheets indicating dimensions, materials, and finishes, including classifications and certifications.

.3 Shop Drawings: submit shop drawings for custom manufactured items showing materials, finish, dimensions, accessories, layout, and installation details.

Part 2 Products

2.1 SPLITTERS

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters less than 400 A.

2.2 JUNCTION AND PULL BOXES

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

2.3 CABINETS

.1 Sheet steel cabinet, with full length hinged door, latch, lock, 2 keys, containing 19 mm G1S fir plywood backboard (if required) for surface or flush mounting as required.

.2 Include filtered vents and/or fan-cooling when enclosed equipment is heat producing.

Part 3 Execution

3.1 SPLITTER INSTALLATION

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor.

.3 Install terminal blocks as required.

.4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.3 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Install size 2 identification labels indicating system name, voltage and phase, as appropriate to clearly indicate the enclosure use.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies rigid and flexible fasteners, fittings and installation.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES - GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped. Do not use sectional boxes.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. Larger 102 mm square x 54mm deep outlet boxes (No. 52151 or 52171) to be used when more than one conduit enters one side. Provide extension and plaster rings as required.

.2 For larger boxes use GSB solid type as required.

.3 Boxes for surface mounted switches, receptacles, communications, telephone to be 100mm square No. 52151 or 52171 with Taylor 8300 series covers.

.4 Lighting fixture outlets: 102 mm square outlet boxes (No 52151, 52171 or 72171) or octagonal outlet boxes (No 54151 or 54171).

.5 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster and/or tile walls.

2.3 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi gang type MDB boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 SURFACE CONDUIT BOXES

.1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

2.6 FITTINGS – GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of foreign materials.

.3 Conduit outlet bodies for conduit up to 35 mm. Use pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

.1 Typical outlet box mounting heights are indicated in Section 26 05 00 or refer to wiring device and communication specification sections and to architectural layouts for particular mounting heights of outlet boxes where indicated.

.2 Support boxes independently of connecting conduits.

.3 Ceiling outlet boxes to be provided for each surface mounted fixture or row of fixtures installed in other than T bar ceilings with removable tiles.

.4 Fill open boxes with paper, sponges, foam or similar approved material to prevent entry of construction material. Remove upon completion of work.

.5 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.6 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not to be used.

.7 All outlet boxes to be flush mounted in all areas, excluding mechanical rooms, electrical rooms, and above removable ceilings.

.8 Adjust position of outlets in finished masonry walls to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes. All cutting of masonry work for installation of electrical fittings to be done using rotary cutting equipment.

.9 No sectional or handy boxes to be installed.

.10 Provide vapour barrier wrap or boots behind outlets mounted in exterior walls. Maintain integrity of the vapour barrier and insulation to prevent condensation through boxes.

.11 Coordinate location and mounting heights of outlets above counters, benches, splash-backs and with respect to heating units and plumbing fixtures. Coordinate with architectural details.

.12 Outlets installed back to back in party stud walls to be off-set by one stud space.

.13 Back-boxes for all communications systems equipment to be provided in accordance with specific manufacturer's recommendations and as specified in the communications sections of these specifications.

.14 Separate outlets located immediately alongside one another to be mounted at exactly the same height above finished floor. Similarly, outlets mounted on a wall in the same general location at varying heights to be on the same vertical centre-line unless otherwise noted.

.15 Where outlet boxes penetrate through a fire separation, ensure that the boxes are externally tightly fitted with an approved non-combustible material to prevent passage of smoke or flame in the event of a fire.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies rigid and flexible conduits, fasteners, fittings and installation.

1.2 REFERENCES

.1 Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware: to CSA C22.2 No. 18.

.2 Rigid metal conduit (RMC): to CSA C22.2 No. 45.

.3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83.

.4 Rigid PVC conduit: to CSA C22.2 No. 211.2.

.5 Flexible metal conduit (FMC): to CSA C22.2 No. 56.

.6 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.

1.3 BASIC WIRING METHODS

.1 Underground or in concrete exterior to building:

.1 All wiring shall be in Schedule 40 RPVC conduit.

.2 Concrete walls and slabs interior to building:

.1 All wiring shall be in Schedule 40 RPVC conduit.

.3 Partition walls and ceilings:

.1 All wiring to be run in EMT conduit for:

.1 Branch circuits.

.2 Fire alarm.

.3 Low voltage systems.

.4 Distribution feeders and sub-feeders.

.5 Surface wiring in electrical and mechanical rooms.

.4 T-bar ceilings:

.1 EMT to junction box with flexible armoured cable drops for individual luminaires. No feed through wiring to luminaires allowed, except for where luminaires butted together. Allow adequate cable to relocate luminaire one T-bar space in any direction.

.5 Motors, transformers and all vibrating equipment:

.1 Short (600mm to 1200mm) PVC jacketed flexible conduit with liquid tight connectors shall be used. Allow sufficient slack to avoid strain on connectors at extreme extension of equipment movement.

.6 Surface raceways - interior:

.1 All surface raceways shall be EMT, except if located without protection in areas susceptible to damage, which shall be rigid steel conduit.

.7 Surface raceways - exterior:

.1 All surface raceways shall be UV compensated Schedule 40 RPVC conduit, protected from damage and excessive heating to the Departmental Representative’s satisfaction.

1.4 LOCATION

.1 Electrical drawings are diagrammatic and do not show all conduits, wire, cable, etc. Electrical contractor to provide conduit, wire cable, etc., for a complete operating job to meet in all respects the intent of the drawings and specifications.

.2 Outlet positions shown on architectural drawings (plans and elevations) to take precedence over locations and mounting heights indicated on electrical plans or in specifications.

.3 Locate electrical devices on walls with regard given for convenience of operation and conservation of wall space. Switches, receptacles, fire alarm pull stations, etc. generally to be vertically lined up where items are in the same general location. Adjacent common devices to be installed in common outlet box.

.4 Review the exact location criteria of each electrical outlet and device with the Departmental Representative prior to rough-in. Relocate any item installed without architectural confirmation as required by the Departmental Representative at no cost to the owner as long as the relocation is within 3m of the location originally shown on the electrical drawings.

.5 Locate light switches on latch side of doors. Locate disconnect devices in mechanical rooms on latch side of door.

.6 All outlets located on exterior walls to be complete with moulded plastic vapour barriers to maintain integrity of wall vapour barrier system.

.7 All raceways and wiring shall be installed concealed in building fabric, except for mechanical and electrical rooms where they shall be installed on the surface.

.8 All outlet boxes, junction boxes, and cabinets to hold electrical devices shall be mounted so the equipment can be flush mounted unless indicated otherwise.

.9 All junction boxes and other raceway access devices shall be mounted to avoid being visible from public areas. Obtain approval from Departmental Representative for any and all junction boxes that, due to the building design, cannot be concealed.

.10 All junction boxes mounted, out of necessity, on surface of solid walls shall be painted to match adjacent surface, with junction boxes painted to match designated systems.

Part 2 Products

2.1 RIGID PVC RACEWAY SYSTEM

.1 Rigid PVC fittings shall be of the same manufacturer as the conduit.

.2 All fittings with removable covers shall be complete with VC gaskets and brass securing screws and inserts. All metal components shall be brass or stainless steel.

2.2 RIGID METAL CONDUIT RACEWAY SYSTEM

.1 Rigid threaded metal conduits shall be installed as noted in drawings.

.2 All couplings and connection to enclosures shall used threaded fastening or locknuts; use of set screw type connections will not be accepted.

.3 Galvanized coating with easy pull internal treatment.

.4 All threads shall be tapered; Running threads will not be accepted.

.5 Factory formed threads shall be used where possible. When field threading is required, provide application of cold galvanizing paint or coating,

2.3 EMT RACEWAY

.1 Electrical Metallic Tubing (EMT) shall be galvanized steel of sufficient quality and thickness to allow smooth field formed bends.

.2 EMT couplings, connectors and fittings shall be steel. Cast type units shall not be used on this installation.

2.4 PVC JACKETTED FLEXIBLE CONDUIT

.1 PVC jacketed flexible conduit (liquid tight) shall be interlocking spiral aluminum conduit with continuous extruded PVC jacket.

.2 Conduit fittings shall be steel liquid tight type that fit over PVC jacket and seal uniformly all round.

2.5 FLEXIBLE ELECTRIC NON-METALLIC (ENT) TUBING

.1 Flexible electrical non-metallic tubing (ENT) **shall not** be used on this project.

2.6 OUTLET BOXES AND JUNCTION BOXES

.1 Except as noted for rigid PVC raceways, all outlet boxes and junction boxes shall be one piece formed or welded.

.2 Outlet boxes to be galvanized steel.

.3 Junction boxes to be galvanized steel or aluminum.

2.7 INNERDUCTS

.1 Provide and install High Density Poly Ethylene (HDPE) innerducts in underground conduits where called for on plans.

.2 Innerducts to be outdoor rated, smooth wall, suitable for use inside conduits as indicated on plans.

.3 Provide terminal fittings at each end of conduit to securely hold innerduct but still allow for access for pulling additional innerducts of cables around existing innerduct.

.4 Minimum innerduct size of 21mm.

2.8 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1500mm oc.

.4 Threaded rods, 6 mm dia., to support suspended channels.

2.9 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT. Set-screws are not acceptable.

2.10 EXPANSION FITTINGS FOR CONDUIT

.1 Threaded Concrete Encased Conduit Joints

.1 Weatherproof expansion fittings suitable for pass seismic joints in concrete, allowing for the following degrees of movement:

.1 Axial expansion or contraction of 19mm

.2 Angular misalignment of the axes of the conduits in any direction by 30 degrees.

.3 Parallel misalignment of the axes of the conduit in any direction up to 19mm.

.2 Inner sleeve maintaining constant conduit inner diameter and a smooth insulated wireway.

.3 Watertight flexible neoprene outer jacket that is corrosion resistant and protects the grounding straps and connection points.

.4 Copper braided bonded straps.

.5 Stainless steel jacket clamps

.6 Standard tapered conduit threads for rigid threaded electrical conduits.

.7 Rigid threaded conduit hubs are iron alloy.

.2 RPVC Above Ground Joints

.1 Rigid PVC expansion joints allowing for contraction and expansion of conduits where secured to a wall (or similar) and emerging from below grade.

.2 Solvent weld joints.

.3 Sleeves in Concrete at PHS - Pumphouse Connection

.1 Flexible rubber tubing complete with stainless steel crimped compression band connection providing a water tight seal while enabling 19mm of movement in three dimensions.

.2 Assembly shall be embedded in a resilient foam material to allow for movement between concrete assemblies.

.3 Tubing shall be black synthetic rubber, Class A oil resistant with spiral-plied synthetic fabric wire helix reinforcement. Inner diameter to match outer diameter of all conduits/pathways noted in drawings to ensure tight, water resistant seal without bunching upon compression/connection.

2.11 FISH CORD

.1 Polypropylene.

Part 3 Execution

3.1 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

.3 Use electrical metallic tubing (EMT) except in cast concrete and above 2.4 m not subject to mechanical injury.

.4 Use rigid PVC conduit underground, in corrosive areas, and surface mounted in wet areas not subject to damage.

.5 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures and work in movable metal partitions.

.6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.7 Minimum conduit size for lighting and power circuits: 19mm.

.8 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.10 Install fish cord in empty conduits.

.11 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.12 Dry conduits out before installing wire.

.13 Conduits shall be installed mechanically continuous from outlet to outlet and without pockets. All the necessary standard bushings, elbows and bends shall be provided. All conduit bends shall have a radius of not less than six (6) times the internal diameter of the conduit and in no case shall the equivalent of more than four quarter bends from outlet to outlet be made. For all conduit sizes to be used for low voltage raceway, the conduits shall have a minimum bending radius of 230mm.

.14 Conduit bends shall be made with no more than 10% flattening of the conduit. Bends shall be smooth throughout deformations.

.15 On surface wall runs, all conduit shall be installed in true vertical or horizontal direction and on ceilings in true 90 degree angles or parallel to the walls. Crossings of conduits shall also be made at 90 degree angles. Parallel running conduit shall be kept on equal spacing on the entire length of run including bends.

.16 All conduits shall be fastened to structure with steel straps (no cast type straps allowed).

.17 Where more than three conduits are run parallel in ceiling cavity, they shall be installed on cantruss type channel, complete with all Manufacturer's fittings to secure channel to structure and to conduit.

.18 Raceways extending out concrete slabs shall be securely protected using rebar stubs or similar material. All duct stubs are to be kept sealed during construction

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

.1 Locate to suit reinforcing steel. Install in centre one third of slab.

.2 Protect conduits from damage where they stub out of concrete.

.3 Install sleeves where conduits pass through slab or wall.

.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

.5 Do not place conduits is slabs in which slab thickness is less than 4 times conduit diameter.

.6 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.7 Organize conduits in slab to minimize cross-overs.

.8 Do not install conduits in slabs/concrete floors in lab areas.

3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

.1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

.2 Do not install conduits in slabs/concrete floors in lab areas.

3.6 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.7 FIRE STOPPING

.1 Apply ULC approved fire stopping assembly to all conduit penetrations passing through fire rated walls and floors.

.2 Provide shop drawings showing details for each type of application on the project. Shop drawings shall include catalogue data and installation details.

3.8 EXPANSION COUPLINGS

.1 Provide expansion couplings in concrete ductbanks where noted in drawings. Coordinate with structural details for location of seismic joints and orientation. Conduit shall maintain full diameter throughout joint and shall not be reduced or increased.

.2 Install RPVC expansion joints where RPVC conduit emerges from ground and is secured to a building, wall or similar immovable object to ensure the RPVC conduits do not shear or break due to settlement.

.3 Install RPVC expansion joints where RPVC is surface mounted and subject to excessive expansion or contraction as determined by Canadian Electrical Code.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This Section specifies materials and installation for metal and fiberglass cabletroughs and fittings.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.1 No.126.1, Metal Cable Tray Systems.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA FG 1, Fibreglass and Cable Tray Systems.

.2 NEMA VE 1, Metal Cable Tray Systems.

.3 NEMA VE 2, Cable Tray Installation Guidelines.

1.3 PRODUCT DATA

.1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.

.3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.

.4 Identify types of cable trays used.

Part 2 Products

2.1 CABLE TRAY (COMMUNICATION ROOM)

.1 A flex or basket type cable tray shall be provided above equipment cabinets and around the perimeter of the room and shall be attached to the Communications cable tray infrastructure.

.2 The tray shall be mounted @ 2.7M AFF unless otherwise noted.

.3 Wall mounted tray brackets shall be bolted through any plywood backboards to the wall.

.4 Cable tray to have rounded edges where in possible contact with cables.

2.2 CABLE TRAY (ALL OTHER AREAS)

.1 All ventilated tray to be aluminum, complete with angles, offsets, corners, saddles, tees, etc. as indicated and required to suit the installation. Radii on fittings shall be 300mm minimum.

.2 Provide solid bottom cable tray with solid bolt on cover where noted in drawings.

.3 All tray shall have 45 degree corners at all vertical and horizontal corners, tees and width change locations.

.4 Cable tray to have a minimum cable loading depth of 114mm. Cable tray width to be a minimum of 305mm wide for communications, or as indicated on drawings.

.5 Suspended tray supports to be trapeze style hangers of minimum 40mm square “Unistrut” supported from 9.5mm threaded rod hangers from preset or afterset concrete inserts or direct steel support.

.6 Barriers required where different systems are in same cable tray. Barriers to be continuous metal dividers for entire length of the tray.

.7 Fire Barrier Pillows to be self contained firestop product for use in through-penetration firestops. Product to achieve up to three (3) hours fire rating in accordance with ASTM E 814 tests.

.8 Observe cable spacing requirements for power cables to ensure correct deration factors as noted in drawings.

2.3 SUPPORTS

.1 Provide splices and supports for a continuously grounded system as required.

Part 3 Execution

3.1 GENERAL INSTALLATION – POWER & COMMUNICATIONS

.1 Provide cable tray in location and general routing as shown on drawings.

.2 Provide dropouts when cables exiting all horizontal cable trays.

.3 Support suspended cable tray from trapeze style hangers with hangers spaced as recommended by the manufacturer based on a maximum load capacity for the tray. Support trays at all corners, offsets and tee fittings

.4 Where shown and appropriate, support cable tray from wall using a cantilever support arrangement. Cable trays may be supported using wall mounted support on masonry walls or from the building steel only.

.5 Cable tray location and mounting heights to be coordinated on site with other trades to provide minimum headroom and serviceability. Verify drawing details to allow for all services run in ceiling spaces. Provide vertical and horizontal offsets as required to suit job site conditions.

.6 Cable tray sections shall be joined by approved connector plates and rust-resistant (plated) hardware. Torque all hardware as per manufacturer's recommendations.

.7 Unless otherwise indicated, bond all cable tray with a minimum #6 AWG copper bonding conductor installed continuously within the full length of all cable trays. Securely connect the bond wire to the tray at each end and at a minimum of 15m intervals. Connect bonding conductor to the building ground system at one or both ends.

.8 Where cable tray passes through fire separations install fire pillows as required to maintain proper fire rating.

.9 Cable tray may require installation of risers, bend, etc. to adjust tray up or down as well as sideways for the tray routing to fit within limits of space available, and to clear other services, ducts, pipes etc. along the route. Routing may be adjusted somewhat as necessary to enable installation of services under other trades.

.10 Where tray runs change elevation, trays shall overlay each other when manufactured waterfall assemblies can not be used. To prevent cables stress install drop-outs on the top tray when overlap method is to be used. Further, tray sections shall be coupled together to provide some rigidity. This coupling maybe made by using a short length of tray and adjustable elbows or may be coupled by means of common support rods at the tray overlap.

.11 Sharp metal edges in cable trays which could cut the cable shall be smoothed and the cable dressed away from these edges. Manufacturer surface imperfections shall be touched up with a cold galvanizing coating before installing cable.

.12 There shall be no wiring joints or splices within the cable tray.

3.2 INSTALLATION - COMMUNICATIONS

.1 Use ventilated cable tray for Voice/Data service cable down drops in the Communication Rooms.

.2 Cables shall be secured in place in tray with tie wraps where in horizontal runs and with cable clamps in vertical runs. Low tension cabling shall be secured to tray by use of Velcro style straps.

.3 The “communications” cable tray system is for extra-low voltage cabling only. There shall be no cables within the tray that has a voltage exceeding 36V.

.4 Power distribution conduits shall not be located within 200mm of the cable tray.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies wireways, auxiliary gutters and associated fittings and installation.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSAC22.2No.26-R1999, Construction and Test of Wireways, Auxiliary Gutters and Associated Fittings.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 00 Common Work Results - Electrical.

Part 2 Products

2.1 WIREWAYS

.1 Wireways and fittings: to CSA C22 No.26.

.2 Sheet steel with bolted covers to give uninterrupted access.

.3 Finish: baked grey enamel.

.4 Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.

.5 Tagged with ‘High Voltage’ and voltage, phasing and circuit numbers contained.

Part 3 Execution

3.1 INSTALLATION

.1 Install wireways and auxiliary gutters.

.2 Keep number of elbows, offsets, connections to minimum.

.3 Install supports, elbows, tees, connectors, fittings.

.4 Install barriers where required.

.5 Install gutter to full length of equipment.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 Common Work Results – Electrical

.2 Section 25 05 14 Power Cables (1001V – 27kV & 125VDC)

1.2 REFERENCES

.1 Insulated Cable Engineers Association, Inc. (ICEA)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for cables and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off the ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.4 Store and protect cables from nicks, scratches, and blemishes.

.5 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 MARKERS

.1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for cable installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 CABLE INSTALLATION IN DUCTS

.1 Install cables as indicated in ducts.

.2 Do not pull spliced cables inside ducts.

.3 Install multiple cables in duct simultaneously.

.4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension. Pulling tensions to cable manufacturer's requirements and guidelines.

.5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.6 Install plugs and cap both ends of ducts to prevent entrance of foreign materials during and after construction.

.7 Pull through each duct wooden mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign material.

.1 Pull stiff bristle brush through each duct immediately before pulling-in cables.

.8 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.9 After installation of cables, seal duct ends with duct sealing compound.

3.3 MARKERS

.1 Mark cable every 150 m along duct runs and changes in direction.

.2 Where markers are removed to permit installation of additional cables, reinstall existing markers.

.3 Lay concrete markers flat and centred over cable with top flush with finish grade.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Perform tests using qualified personnel.

.1 Include necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds.

.1 Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance tests:

.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests:

.1 Ensure that terminations and accessory equipment are disconnected.

.2 Ground shields, ground wires, metallic armour and conductors not under test.

.3 High Potential (Hipot) Testing.

.1 Conduct hipot testing in accordance with manufacturer's recommendations.

.4 Leakage Current Testing:

.1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.

.2 Hold maximum voltage for specified time period by manufacturer.

.3 Record leakage current at each step.

.7 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.

.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.6 PROTECTION

.1 Repair damage to adjacent materials caused by cables installation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies photoelectric lighting control equipment for exterior use only.

1.2 PRODUCE DATA

.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures

Part 2 Products

2.1 PHOTOELECTRIC LIGHTING CONTROL

.1 Wall and luminaire mounting.
.2 Capable of switching 1000 W of lighting at 120V.
.3 Voltage variation: plus or minus 10%.
.4 Temperature range: minus 40°C to plus 40°C.
.5 Switching on lights at 70 lux.
.6 Switching off lights at 105 lux.
.7 Rated for a minimum of 5000 operations.
.8 Options:
  .1 Lightning arrester.
  .2 Fail-safe circuit completed when relay de-energized.
  .3 Twist-lock type receptacle.
  .4 Terminal strip.
  .5 Sensitivity adjustment.
.9 Switching time delay of 0 to 30 s.
.10 Wall mounting bracket.
.11 Colour coded leads: size 10 AWG, 500mm long.

2.2 CONTACTOR

.1 Cabinet mounting.
.2 Capable of switching multiple lamp circuits with total lighting load of 6000 W.
.3 Waterproof enclosure.
.4 Manual override.

Part 3 Execution

3.1 INSTALLATION

.1 Install photoelectric controls in accordance with manufacturer's instructions.
.2 Install on the building exterior as indicated on plans.
.3 Install contactors and manual override switch in a wall cabinet inside the main electrical room.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CAN/CSA-C88-M90 (R2009) Power Transformers and Reactors

.2 CAN/CSA-C50-97 (R2001) Insulating Oil, Electrical for Transformers and Switches

.3 CAN/CSA-C802.3-01 Maximum Losses for Power Transformers

.4 CSA C227.4-M1978 (R2005) for dead-front {insulated connectors} pad-mounted {bottom entry w/ doors} distribution type transformers

.5 ANSI/IEEE C57.12.90-1999 Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers

1.2 SOURCE QUALITY CONTROL

.1 Submit to Engineer standard factory test certificates of each transformer and type test of each transformer with high voltage accessories in accordance with CSA C88.

1.3 SHOP DRAWINGS

.1 Submit shop drawings.

.2 Indicate:

.1 Anchoring method and dimensioned foundation template.

.2 Dimensioned cable entry locations.

.3 Dimensioned cable termination height.

.4 Identified internal and external component layout on assembly drawing.

.5 Insulating liquid capacity.

.6 Liquid holding tank or containment

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for power transformers for incorporation into manual.

.2 Include insulating liquid maintenance data.

Part 2 Products

2.1 REGULATOR CHARACTERISTICS

.1 Three phase voltage regulator: to CAN/CSA-C88.

.2 Liquid cooled, outdoor/indoor, three phase voltage regulator, complete with primary and secondary cable compartments, dielectric fluid containment, controller, sensing and indicators.

.3 High voltage bushings or high voltage bushing wells for connection to distribution system through dead front.

.4 Primary voltage cable terminals with hole for bolt for attachment of connector in vertical plane.

.5 Connectors for primary and secondary cables.

.6 Voltage: 3 single phase regulators at 14400 nominal, KVA to match connected fully rated 1500kVA transformer.

.7 Range: Minimum of 25 positions providing +/- 10% control.

.8 Temperature rise: 65 Deg. C.

.9 Under oil series arrestors.

.10 Bypass switch arrangement integral to assembly providing non-regulated bypass around system.

.11 Basic impulse level: 125 kV.

.12 Maximum rms short-circuit: 20 times base current for 120 cycles.

.13 Automatic regulation controller set to maintain preset voltage level.

.14 Sound rating: shall meet average of 62 dB.

.15 Windings: copper.

.16 High Voltage Bushings:

.1 Bushings to EEMACL9-3, cover mounted.

.2 Three high voltage bushings.

.17 Insulating Liquid: Insulating liquid: non-flammable R-Temp or Silicone.

2.2 CONTROL OPERATION

.1 Regulated power supply as controlled by the voltage regulator and associated overcurrent protection devices shall function as follows:

.1 Control panel or software enabled voltage setpoints (440, 460, 480 and 600) will be target voltage settings. System shall operate to regulate the voltage at the system output terminals to maintain these nominal voltages regardless of loading of this system.

.2 System shall automatically adjust taps to maintain closest output to target voltage. A 30 second sampling period shall be used after which the appropriate tap will be selected on any of the three phases.

.3 If the system attempts to regulate the voltage and exceeds the maximum nominal overvoltage setpoint (as set through software) the secondary circuit breaker will open. This setpoint shall be indicated as a percentage of the preset nominal voltage and will apply to any setpoints (I.E. 120%)

.4 An arbitrary voltage target may be selected via software for the system to regulate to within the system output of 430 to 630 volts AC.

.5 Regulator system shall interface to PSS using Ethernet and provide full authority remote access and control to all parameters of the regulator system. The PSS will also monitor status of the system and trend log the output voltage, regulator position, liquid temperature and system health. Alarms will automatically be process through the PSS and recorded.

.6 The regulator shall provide a manual override function that allows for the user to select any regulation step and maintain this as a fixed point. These manual override controls shall be hardwired and accessible at the main control panel.

.2 Regulated power supply be constructed with and integrated to the PSS and low voltage protection system to provide automatic overcurrent adjustments suited to the cables connected to the 2000 amp dock power system.

.1 The dock power connector will incorporate limit switches fed back to the overcurrent protection system to detect the number of parallel cables installed and ensure that the connected cable ampacity meets or exceeds the protection settings. The breaker can only be closed when a complete contingent of cables is connected and will trip automatically if cables are withdrawn prior to opening the circuit breaker.

.2 The overcurrent device will be aware of the nominal voltage setpoint on the regulated power supply system to factor into power quality and voltage protection functions.

2.3 ACCESSORIES

.1 Liquid temperature thermometer (Celsius), drag hand for maximum indication, two sets of contacts: fan start, preset alarm.

.2 Magnetic liquid level gauge with two sets of contacts.

.3 Pressure gauge.

.4 Pressure relief device.

.5 25 mm drain valve.

.6 25 mm filler plug.

2.4 GROUNDING

.1 Copper grounding bus.

.2 Connectors for grounding conductors.

2.5 FINISH

.1 Finish exterior of unit in rust-resistant primer and two coats of finish enamel, grey to EEMAC 2Y-1. Supply two spray cans of touch up paint.

2.6 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with CSA C88.

2.7 WARNING SIGNS

.1 Provide warning signs in accordance with Section 26 05 00 - Common Work Results - Electrical. Include warnings for tap changer operation and automatic operation of fans.

Part 3 Execution

3.1 INSPECTION

.1 Check factory made connections of unit for mechanical security and electrical continuity.

.2 Check insulating liquid for correct quantity and specification according to manufacturer's instructions.

.3 Check correct operation of regulator taps ensuring that all taps are available.

3.2 INSTALLATION

.1 Ensure concrete pad is fully cured before regulator is installed.

.2 Set and secure regulator unit in place, rigid, plumb and square.

.3 Make connections.

.4 Connect unit ground bus to system ground.

.5 Wire one set of contacts on liquid temperature thermometer to SCADA alarm.

.6 Control system for monitoring and remote control.

.7 Program system for operation, alarming, trending and function noted.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Carry out following insulation tests using megger with 20,000 megohm scale and resulting insulation resistance corrected to base of 40 Deg.C.

.1 Primary voltage to ground with secondary grounded for duration of test.

.2 Secondary voltage to ground with primary grounded for duration of test.

.3 Inspect primary and secondary connections for tightness and for signs of overheating.

.4 Inspect and clean bushings and insulators.

.5 Check oil level and temperature indicators.

.6 Inspect for oil leaks and excessive rusting.

.7 Check for grounding and neutral continuity between primary and secondary circuits of regulator.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 Common Work Results – Electrical
.2 Section 26 05 14 Power Cables (1001V – 27kV & 125VDC)
.3 Section 26 05 22 Connectors and Terminations
.4 Section 26 05 27 Grounding - Primary
.5 Section 26 05 30 Seismic Restraints
.6 Section 01 33 00 Submittal Procedures

1.2 REFERENCES

.1 Transformers are to be designed, manufactured, and tested according to the latest revisions of the CSA, EEMAC, NEMA (National Electrical Manufacturers Association) and NETA Standards, including the following:

.1 CSA C9-02(R2007), Dry-Type Transformers.
.2 CAN/CSA-C802.2-12, Minimum Efficiency Values for Dry Type Transformers.
.3 CAN/CSA-C88.1-96(R2011)-Power Transformer and Reactor Bushings
.4 CSA C22.1-12, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations
.5 CSA C802.2-12 Minimum efficiency values for dry-type transformers
.6 EEMAC GL1-3, Transformer and Reactor Bushings.
.7 National Electrical Manufacturers Association (NEMA)
.8 ANSI/NETA Standard for Maintenance Testing Specifications
.9 IEEE C57.150 Guide for the Transportation of Transformers and Reactors

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for cables and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of BC, Canada.
.2 Indicate on drawings:

.1 Dimensions showing enclosure, mounting devices, terminals, taps, internal and external component layout.
.2 Total weight of transformer and individual weights of transformer coil, coil frame, bus, accessories and enclosure.

.3 Transformer Nameplate Technical data:
- .1 kVA rating.
- .2 Primary and secondary voltages.
- .3 Frequency.
- .4 Windings – copper.
- .5 Number and percentage of taps.
- .6 Estimated impedance, engraved on nameplate.
- .7 Cooling designation, natural and/or forced.
- .8 Temperature Class.
- .9 Temperature Rise.
- .10 Three phase.
- .11 Polarity or angular displacement.
- .12 Full load efficiency.
- .13 Regulation at unity pf.
- .14 BIL for HV and LV.
- .15 Insulation type.
- .16 Total weight of core, coils, and enclosure.
- .17 Sound rating.
- .18 Neutral grounding and NGR rating.

.4 Factory Test Submittals: submit standard factory test certificates of each transformer and type test of each transformer in accordance with CSA C9-02.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for medium, dry type transformers for incorporation into O&M manuals.

.3 Operation and maintenance instructions to include:
- .1 Tap changing.
- .2 Recommended environmental conditions.
- .3 Recommended periodic inspection and maintenance.
- .4 Bushing replacement.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off the ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect transformers from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

.4 All transformers shall be shipped with suitable impact recorders; recorders shall provide waveform data and have frequency analysis as per DIN EN 13011. Impact recorders shall be mounted as low as possible on a rigid location. Minimum three recorders per transformer.

Recorders shall be mounted on diagonally opposite positions. Upon delivery to site the data from impact recorders shall be turned over to the Departmental Representative for review.

.5 Notify Departmental Representative two working days prior to expected arrival of equipment on site and/or in storage.

.6 The transformers shall be inspected and tested for integrity prior to acceptance and operation. Acceptance tests shall be according to the latest edition of the NETA standards.

.7 Perform, record and submit results for approval by the Departmental Representative. Inspection and tests shall include, but not be limited to:

.1 Evidence of moisture and corrosion

.2 Bolted mechanical connections, anchorage, alignment, bonding

.3 Evidence of damage to enclosure, fixtures, accessories, electrical apparatus including paint scrapes

.4 Evidence of loose or missing fixtures, bolts, attachments or spare parts

.5 Low-resistance measurements through bolted electrical connections

.6 Insulation tests winding to winding, and each winding to ground, for each primary winding tap setting (25kV and 12.5kV)

.7 Core ground test

.8 Power factor or dissipation factor test

.9 Turns ratio test at each designated tap position and each primary winding tap setting (25kV and 12.5kV)

.10 Verification of control and alarm settings on winding temperature indicators are as specified

.8 Any damages noted or tests failed prior to operation shall constitute sub-standard equipment. Equipment shall be refused by the Departmental Representative and contractor shall be responsible for all costs related to the repair and/or the replacement of defective equipment.

1.6 EXTRA MATERIALS

.1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Dry-type transformers: to CSA C9.

.2 Bushings: to CAN/CSA-C88.1-96.

2.2 TRANSFORMER CHARACTERISTICS

.1 STYLE: 1

.1 Type: ANN/AFF

.2 Rating: 750/1000 kVA, 3 phase, with fan forced air cooling, 60 Hz.

.3 Construction: cast coil.

.4 Copper windings.

.5 220 degree C insulation system class, 150 degrees C temperature rise.

.6 Impedance: 5%.
.7 Primary winding: 12.5/25 kV dual primary, DELTA, BIL 125
.8 Secondary winding: 120/208 V, WYE, BIL 10 kV, four wire.
.9 No load losses: In accordance with CSA C802.2
.10 Full load losses: In accordance with CSA C802.2.
.11 Noise level less than 70dB.
.12 Anti-vibration pads.
.13 Provision for seismic- approved springs and snubber attachments rated for Zone 5.
.14 NEMA 1 enclosure 14 gauge steel painted ASA 61 light grey.
.15 Winding temperature indicator.
.16 Wells for a minimum of two winding temperature probes or thermistors.

.2 STYLE: 2
.1 Type: ANN/AFF.
.2 Rating: 3000/4000kVA, with fan forced air cooling, 60 Hz.
.3 Construction: cast coil.
.4 Copper windings.
.5 220 C insulation system class, 150 degrees C temperature rise.
.6 Impedance: 5%.
.7 Primary winding: 12.5/25 kV dual primary, DELTA, BIL 125 kV
.8 Secondary winding: 480V, WYE, BIL 10 kV, four wire resistance grounded.
.9 No load losses: In accordance with CSA C802.2
.10 Full load losses: In accordance with CSA C802.2
.11 Noise level less than 70dB.
.12 Anti-vibration pads.
.13 Provision for seismic- approved springs and snubber attachments rated for Zone 5.
.14 NEMA 1 enclosure 14 gauge steel painted ASA 61 light grey.
.15 Winding temperature indicator.
.16 Wells for a minimum of two winding temperature probes or thermistors.

.3 STYLE: 3
.1 Type: ANN/AFF.
.2 Rating: 750/1000kVA, with fan forced air cooling, 60 Hz.
.3 Construction: cast coil.
.4 Copper windings.
.5 220 C insulation system class, 150 degrees C temperature rise.
.6 Impedance: 5%.
.7 Primary winding: 12.5/25 kV dual primary, DELTA, BIL 125 kV
.8 Secondary winding: 2400V, WYE, BIL 25 kV, four wire resistance grounded.
.9 No load losses: In accordance with CSA C802.2
.10 Full load losses: In accordance with CSA C802.2
.11 Noise level less than 70dB.
.12 Anti-vibration pads.

.13 Provision for seismic- approved springs and snubber attachments rated for Zone 5.
.14 NEMA 1 enclosure 14 gauge steel painted ASA 61 light grey.
.15 Winding temperature indicator.
.16 Wells for a minimum of two winding temperature probes or thermistors.

.4 STYLE: 4
.1 Type: ANN/AFF.
.2 Rating: 1000/1500 KVA, with fan forced air cooling, 60 Hz.
.3 Construction: cast coil.
.4 Copper windings.
.5 220 C insulation system class, 150 degrees C temperature rise.
.6 Impedance: 5%.
.7 Primary winding: 12.5/25 kV dual primary, DELTA, BIL 125 kV
.8 Secondary winding: 550V, WYE, BIL 10 kV, four wire resistance grounded.
.9 No load losses: In accordance with CSA C802.2
.10 Full load losses: In accordance with CSA C802.2
.11 Noise level less than 70dB.
.12 Anti-vibration pads.
.13 Provision for seismic- approved springs and snubber attachments rated for Zone 5.
.14 NEMA 1 enclosure 14 gauge steel painted ASA 61 light grey.
.15 Winding temperature indicator.
.16 Wells for a minimum of two winding temperature probes or thermistors.

.5 STYLE: 5
.1 Type: ANN/AFF.
.2 Rating: 2250/3000kVA, with fan forced air cooling, 60 Hz.
.3 Construction: cast coil.
.4 Copper windings.
.5 220 C insulation system class, 150 degrees C temperature rise.
.6 Impedance: 5%.
.7 Primary winding: 12.5/25 kV dual primary, DELTA, BIL 125 kV
.8 Secondary winding: 347/600V, WYE, BIL 10 kV, four wire resistance grounded.
.9 No load losses: In accordance with CSA C802.2
.10 Full load losses: In accordance with CSA C802.2
.11 Noise level less than 70dB.
.12 . Anti-vibration pads.
.13 Provision for seismic- approved springs and snubber attachments rated for Zone 5.
.14 NEMA 1 enclosure 14 gauge steel painted ASA 61 light grey.
.15 Winding temperature indicator.
.16 Wells for a minimum of two winding temperature probes or thermistors.

2.3 ENCLOSURE

.1 NEMA 1 enclosure 14 gauge steel painted ASA 61 light grey.

.2 Bolted removable panels for access to tap connections, enclosed terminals and other accessories.

.3 Conductor entry:

.1 Knockouts.

.4 Indoor, ventilated, self cooled type. Temperature of exposed metal parts not to exceed 65 degrees C rise.

2.4 VOLTAGE TAPS

.1 4 equal 2.5% steps, 2 above, 2 below the rated no-load voltage for a range of +/- 5%.

2.5 TAP CHANGER

.1 Bolted-link type, manual, off-load type.

.2 Primary dual 25kV and 12.5kV, off-load type.

2.6 WINDINGS

.1 Primary and secondary coils:

.1 Copper.

.2 Open.

.2 Coil and core assembly:

.1 Taps located at front of coils for accessibility.

.3 Sound level: standard.

.1 Noise level less than 70dB.

2.7 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results-Electrical.

.2 CSA approval certification to be visible at front of enclosure.

.3 Nameplate visible at front of enclosure.

.4 Equipment labels: nameplate size 7, labelled as indicated, at front of enclosure.

2.8 SOURCE QUALITY CONTROL

.1 Factory test each transformer assembly and all accessories. Notify Departmental Representative 7 days in advance of tests and confirm 2 days in advance. Departmental Representative and Engineer will attend/witness tests. Tests must be conducted in the Lower Mainland area of British Columbia. Alternatively, if tests are conducted elsewhere, pay the costs of travel time (at $130/hour) and all travel/living expenses for two attendees (at actual cost) associated with Departmental Representative's and engineer's attendance at factory tests and at repeat tests if necessary.

2.9 WARRANTY

.1 Manufacturer shall warrant equipment free from defects in materials and workmanship for the lessor of one year from the date of installation or 18 months from the date of purchase.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for cable installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Locate, install and ground transformers in accordance with manufacturer's instructions. Provide adequate seismic restraint for transformer installation.

.2 Set and secure transformers in place, rigid plumb and square.

.3 Connect primary terminals as indicated.

.4 Connect secondary terminals as indicated.

.5 Energize transformers and check secondary no-load voltage.

.6 Adjust primary taps as necessary to produce rated secondary voltage at no-load.

.7 Wire one set of contacts on winding temperature detector relay to sound alarm, wire second set of contacts to trip transformer circuit interrupter.

.8 Wire alarm contacts on winding temperature indicator to sound alarm when excessive temperature reached.

.9 Use torque wrench to adjust internal connections in accordance with manufacturers' recommended values.

.10 Check transformer for dryness before putting it into service and if it has not been energized for some considerable time.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results- Electrical.

.2 Energize transformers and apply incremental loads:

.1 0% for 4 hours.

.2 10% for next 1 hour.

.3 25% for next 2 hours.

.4 50% for next 3 hours.

.5 Full load.

.6 At each load change, check temperatures ambient, ventilating air and winding.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused during installation of transformers.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This Section specifies the materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.

1.2 REFERENCES

.1 Use transformers of one manufacturer throughout the project.

.2 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.2 No.47, Air Cooled Transformers (Dry Type).

.2 CSA C9, Dry Type Transformers.

1.3 PRODUCT DATA

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal procedures.

Part 2 Products

2.1 STANDARD TRANSFORMERS (TYPE I)

.1 Type: ANN, 600 volts, 3 phase delta primary.

.2 Primary taps: 2x 2 1/2% full capacity taps above and 2x 2 1/2% taps below the nominal voltage.

.3 Secondary: 3 phase, 60 Hz 120V/208V 4 wire Wye; 277/480V 4 wire Wye (see drawings for kVA rating).

.4 Class H, 220°C insulation with temperature rise not exceeding 150°C maximum in 40°C ambient.

.5 Efficiency: Energy Star rating

.6 Basic Impulse Level (BIL): 10kV.

.7 Hipot: standard.

.8 Windings: High grade copper windings, double dipped, vacuum impregnated high temperature non hygroscopic silicon varnish.

.9 Impedance: Sizes 225 kVA and below to be between 5% and 6%.
Sizes 225 kVA up to 450 kVA to be between 5% and 6%.

.10 Average Sound Level: Noise emission shall not exceed 50 dB at full-load

.11 Impedance at 17 degrees C: standard.

.12 Enclosure: air ventilated EEMAC 1, removable metal front panel "sprinkler-proof" design. Provide angled louvres for ventilation slots to prevent entrance of water from the sprinkler fire protection system. Air cooled type, natural circulation in ventilated enclosure.

.13 Mounting: provide external vibration isolator kit. Provide “Super W Pads” Neoprene.

.14 Finish: in accordance with Section 26 05 00 – Common Work Results - Electrical.

.15 Scott-T connected transformers not acceptable.

.16 Minimum efficiency of 98%.

Part 3 Execution

3.1 MOUNTING

.1 Mount dry type transformers on wall unless otherwise noted on drawings. Provide and install all required mounting hardware, blocking or wall reinforcing required to support transformers as shown on drawings.

.2 Ensure adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

.4 Remove shipping supports only after transformer is installed and just before putting into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Provide noncombustible material when transformer is installed closer than 300mm from any combustible surface.

3.2 CONNECTIONS

.1 Make primary and secondary connections in accordance with the manufactures diagrams.

.2 Check all factory connections for correct tightness before energization.

.3 Torque the building system wiring transformer connections using a torque wrench set to the manufacturers recommended settings. Note the torque setting on the equipment identification label for future maintenance reference.

.4 All external wiring connections to transformer casing shall be enclosed in flexible conduit. Typically minimum 900mm flex to minimize vibration transmission to building structure.

.5 Conduit to only enter transformers within the bottom third of the transformer casing. (to minimize heat transfer to conduit).

.6 Energize transformers immediately after installation is completed, where practicable.

3.3 EQUIPMENT IDENTIFICATION

.1 Size 7 label in accordance with Section 26 05 00.

.2 Include the transformer identification (as indicted on the project drawings), primary power source equipment designation, equipment served and torque setting of connections. E.g. Transformer T1, served from CDPH-1, serving CDPL-1, Cable Connection Torque x Nm.

3.4 GROUNDING

.1 Provide a ground conductor with all feeder runs to dry type transformer installations. The ground shall be either green insulated or identified and connected as a ground to the ground pad in the transformer enclosure and then to the secondary neutral of the transformer. From the transformer ground pad make cable connection to non-current carrying ground of the distribution centre or panel supplied from transformer.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 Common Work Results – Electrical

.2 Section 26 05 14 Power Cables (1001V – 27kV & 125VDC)

.3 Section 26 05 22 Connectors and Terminations

.4 Section 26 05 27 Grounding - Primary

.5 Section 26 05 30 Seismic Restraints

.6 Section 26 29 23.01 Digital Metering

.7 Section 26 41 00.01 Primary Lightning Arresters

1.2 GENERAL REQUIREMENTS

.1 Include in the tender offer the cost for an Independent Testing Agency to assist in the installation, commissioning, and testing of the switchgear on site. Costs shall be inclusive of all living expenses and travel.

.2 Fully coordinate the design, manufacture, and commissioning of the switchgear and the existing computerized monitoring system. Provide detail design of switchgear control and protection system.

.3 Provide all equipment designed and manufactured to withstand Code-specified seismic forces, at the site location, in fully operational condition when installed in accordance with manufacturer's instructions.

.4 Provide a System Protection and Coordination Study and Arc Flash Study complete with warning labels to NFPA recommendations by an independent testing agency for the equipment supplied under this contract. Compute maximum and minimum short circuit levels for phase-to-phase and phase-to-ground faults. **Ensure equipment ratings are compatible with the fault levels and circuit breaker clearing times**. Select and set protective devices to coordinate with existing upstream and downstream protective devices. Provide coordination curves showing all protective devices including 25 kV and 12.5kV utility operating voltages. Each graph shall also include transformer thermal and mechanical withstand curves, transformer magnetizing inrush, transformer full load currents, HV cable maximum short circuit current curve and cable intermediate and short-time overload curves, and ultimate fault levels. Separate graphs shall be produced for all possible variations of power flow for phase overcurrent protection and ground fault protection covering protective devices and all other equipment. The Departmental Representative will provide the relevant existing plant protective device settings and Utility system available fault current levels. The studies shall be submitted to the Departmental Representative for review and approval.

.5 Provide a complete and fully integrated high voltage switchgear system in the substations as per the contract drawings:

.1 25kV metal clad switchgear.

.2 25kV drawout vacuum circuit breakers.

.3 25kV/12.5kV drawout PTs (initial use at 12.5kV supply)

.1 PTs for protective relays to protective accuracy class.

.4 25kV/12.5kV CTs (initial use at 12.5kV supply)

.1 CTs for protective relays to protective accuracy class.

.2 CTs for digital metering to measurement accuracy class.

.5 All protective relays and related wiring.

.6 All metering and related wiring.

.7 Lightning/surge arresters for use at initial 12.5kV supply voltage installed, arresters for use at future 25kV provided as spares. Switchgear must accommodate size of future 25kV arresters.

.8 Live line indicators, lamacoid labels, ground bus with ground balls and isolated neutral bus.

1.3 APPLICATION

.1 The equipment shall be designed and manufactured to resist Code-specified seismic forces at the site location when installed in accordance with the manufacturer's instructions and the requirements of the B.C. Building Code.

.2 25 kV Switchgear supply voltage:

.1 Rated for operation at 25/14.4 kV, 3-phase 3-wire, 60 Hz, solidly grounded neutral, BC Hydro supply source.

.2 Commissioned at 7.2/12.5 kV, 3-phase 3-wire, 60 Hz, solidly grounded neutral, BC Hydro supply source feeder 12F71.

.3 Maximum symmetrical interrupting: 40 kA

.3 5 kV Switchgear supply voltage:

.1 2400V, 3-phase, 3-wire, 60 Hz, resistance grounded neutral from transformer secondary.

.2 Maximum symmetrical interrupting: 31.5 kA

.4 Design switchgear for ultimate fault levels and ensure selective coordination of protective devices for switch-gear operation at maximum present fault levels.

1.4 REFERENCE CODES, STANDARDS AND DESIGN REQUIREMENTS

.1 Design, manufacture and test the switchgear assemblies in accordance with the applicable portions of the latest revisions of the following standards.

.2 CSA International

.1 CSA Standard C22.1 Canadian Electrical Code, Part 1 and B.C. amendments.

.2 CSA C22.2 No.14-13, Industrial Control Equipment.

.3 CSA C22.2 No.31-10, Switchgear Assemblies.

.4 CSA C22.2 No.58-M1989 (R2010), High-Voltage Isolating Switches.

.5 CSA G40-20/G40.21-04 (R2009) General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.3 American National Standards Institute

.1 ANSI Standard C37.10 Application Guide for AC High Voltage Circuit Breakers.

.2 ANSI Standard C37.04 Circuit Breaker Rating Structure.

.3 ANSI Standard C37.06 Preferred Ratings for AC High Voltage Circuit Breakers as Rated on a Symmetrical Basis.

.4 ANSI Standard C37.20 Switchgear Assemblies.

.5 ANSI C37.09 Test Procedure for High Voltage AC Circuit Breakers.

.4 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC G1-1, Indoor and Outdoor Switch and Bus Insulators.

.2 EEMAC G8-3.3, Metal-Enclosed Interrupter Switchgear Assemblies.

.5 National Electrical Manufacturers Association (NEMA).

.6 B.C. Building Code and Revisions including design to resist forces on equipment and component parts and their anchorage to the primary structure. The design basis shall be:

.1 Seismic force Vp = v·I·Sp·Wp where Vp equals the design lateral force of the element under consideration, distributed according to the distribution of mass of the element.

.2 Zonal velocity ratio v = 0.3

.3 Importance factor I = 1.5

.4 Force factor Sp = CpArAx in accordance with Code Clause 4.1.9.1(17) and Table 4.1.9.E. Minimum Sp values shall be 1.0 for equipment rigidly connected to the structure and 2.0 for flexibly mounted equipment. Equipment supplied under this section will be located on the ground floor, and height factor:

$$A_x = 1.0 + \frac{h_x}{h_n} \text{ shall be 1.0.}$$

.5 Equipment or component weight Wp = weight of element under consideration.

.6 Equipment assemblies required to be vibration/noise isolated shall be provided with seismic rated isolators and restraints which are certified as being rated for the specific application requirements.

.7 Seismic design of equipment and their anchorage to the primary structure shall be by a Professional Engineer registered in the Province of British Columbia. Submit signed and sealed Shop Drawings and design calculations to the Departmental Representative for review.

.8 Seismic design of equipment and component parts and their anchorage to the primary structure shall be certified by a **Professional Engineer registered in the Province of British Columbia**. Submit signed and sealed shop drawings and design calculations to the Departmental Representative for review.

.9 Other standards as specified in individual Specification items.

.7 Each switchgear assembly shall be CSA approved for the application described herein, bear an applicable CSA approval label visible on the front of the equipment, and meet the requirements of the local Electrical Inspection Authorities.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for switchgear assembly and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Primary switchgear assembly to include:

.1 Enclosure.

.2 Circuit breakers.

.3 Busbar.

.4 Owner Metering.

.5 Infrared Viewing Windows.

.6 Grounding Studs with insulating boots.

.7 Distribution class arresters. Make provisions for 12.5kV arresters to be replaced in the future with 25kV arresters. Refer to Section 26 41 00.01 Primary Lightning Arresters.

.8 Protection relay interlocks.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of BC, Canada.

.2 Indicate on drawings:

.1 Floor anchoring, seismic restraint method, and dimensioned foundation template.

.2 Dimensioned cable entry and exit locations.

.3 Dimensioned cable termination and pothead height.

.4 Dimensioned position and size of busbars and details of provision for extension.

.5 Dimensioned positions of main connections, including air clearances and support insulators.

.6 Weights of the individual switchgear cells.

.7 Weights of the breakers and instrumentation transformers.

.8 Layout of internal and front panel components suitably identified.

.9 Co-ordinated time-current characteristics curves of protection devices.

.10 One-line diagram showing protective devices, CTs, PTs, etc.

.11 3 Line schematic diagrams showing all wiring connections.

.12 DC protection wiring.

.13 Protection and coordination study for 12kV and 25kV operation.

.14 Proposed mimic diagrams on the front of equipment

.15 Descriptive literature describing the equipment operation and design features.

.16 Performance data for power circuit breakers giving continuous, interrupting, and closing and latching current ratings.

.17 Nameplate data.

.3 Provide technical and performance data for individual equipment.

.4 Include:

.1 Dimensional Drawings of each configuration of switchgear and equipment to be supplied. Indicate mounting/anchoring locations, power and control connection locations, and all installation requirements.

.2 Schematic power and control diagrams showing all 3 phases plus neutral as well as each and every feeder overload protection device, system grounding arrangement, and ground connection points, bus bar size, key interlocking, metering, control, and alarm devices with associated wiring. Provide a written description indicating sequence of operation for each and every control wiring diagram including interfaces with other manufacturers' equipment. The Switchgear Supplier shall coordinate Shop Drawings with the existing equipment and actual site installation requirements. Clearly indicate field connection requirements. Provide a detailed, step-by-step description of the electrical and mechanical interlocking as well as all sensing and control device operations.

.3 Wherever new equipment is required to mate with existing equipment: Shop Drawings shall clearly indicate with appropriate dimensions all existing components to which connections or modifications are to be made in the field.

.4 Make and model of all breakers, meters, control devices, and accessory equipment supplied.

.5 Nameplate schedule including colours.

.6 Mimic bus layout and colours.

.7 Circuit breaker type test data for fault interrupting capacity.

.4 Certificates:

.1 Submit manufacturer's test certificates.

1.6 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for primary switchgear assembly for incorporation into O&M manuals.

.3 Submit three (3) copies of installation, operation, and maintenance manuals for switchgear and accessories. Ensure that information is for specific equipment supplied. Supply manuals in hard-cover, identified, 3-ring binder sized to provide 25% spare space. Provide appropriate section dividers and overall index to contents. Provide one sample copy of manual for review at the time of factory tests.

.4 Include:

.1 Operation and maintenance instructions for breakers, switches, controls, sensing devices, information metering, and all accessories to permit effective operation, maintenance and repair.

.2 As-built schematic wiring diagram of electrical controls. Drawings are to indicate actual set-point of all timers, protective relays, and sensing/control devices.

.3 Bill of materials showing all major components utilized in manufacturer of the switchgear, complete with name, description, and model numbers of original component manufacturer. Data is to be sufficiently complete to permit proper ordering of spare parts. Where required, data is to include serial numbers if pertinent to ordering replacement parts.

.4 Copy of factory inspection and test results.

.5 Space to insert copy of field commissioning records and acceptance test results.

.6 Certified copy of Contract warranty.

.7 Final settings and configuration files for all protective devices.

.5 Provide, with the operation and maintenance manuals, a priced list of recommended spare parts for on-site inventory for 2 years of normal operation of all the switchgear and related systems equipment.

1.7 QUALITY ASSURANCE

.1 Submit manufacturer's type test certificates indicating switchgear cubicles and components tested as integrated assembly.

.2 Submit test procedures, at least 10 days prior to testing.

.3 Submit production test results before equipment is shipped from factory.

.4 Switchgear and accessories shall be manufactured and tested under the manufacturer's standard Quality Assurance Program. Program shall generally comply with the intent of CSA CAN3-Z299.3 or ISO 9001. Provide a copy of the manufacturer's Quality Assurance Procedures Manual upon request.

.5 Prepare factory test record sheets with space to record data. Test records to indicate:

.1 Date

.2 Switchgear: Make, Model, Serial Number

.3 Breakers: Make, Model, Serial Number, and location cell

.4 Digital metering system: Make, Model

.5 Switchgear continuous rating

.6 Check lists and forms for logging of all required quality control inspections and tests. Where Specifications indicate test and record, the test record sheets shall include appropriate provision to do so.

.7 Name of inspector or test operator.

.6 Maintain a set of working records as inspections and tests proceed. Neatly transfer actual results to clean copy for record submissions and manuals.

.7 Departmental representative will review results and prepare a deficiency list and requirements for corrective actions if applicable. Repeat applicable portions or complete tests as directed by departmental representative following completion of deficiencies.

.8 Conduct inspections and tests during the course of manufacture to verify quality control requirements and to comply with requirements of relevant Standards and these Specifications.

.9 Inspections and tests shall include all standard factory acceptance tests per CSA C22.2 No. 31. Record that inspections were conducted. Record test results where appropriate.

.10 Include certified copy of inspection and test results in Operating Manuals.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Ship and store switchgear assembly in upright position.

.2 Keep doors locked and protect instruments from damage and dust.

.3 Ship channel base sills, anchoring devices in advance of switchgear.

.4 Store materials off the ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.5 Store and protect switchgear assembly from nicks, scratches, and blemishes.

.6 Replace defective or damaged materials with new.

.4 Notify Departmental Representative two working days prior to expected arrival of equipment on site and/or in storage.

.5 The switchgear, instrumentation transformers, circuit breakers, protection relays, and metering shall be inspected and tested for integrity prior to acceptance and operation. Acceptance tests shall be according to the latest edition of the NETA standards.

.1 Perform, record and submit results for approval by the Departmental Representative.

.2 Inspection and tests shall include, but not limited to:

.1 Evidence of moisture and corrosion

.2 Bolted mechanical connections, anchorage, alignment, bonding

.3 Evidence of damage to enclosure, fixtures, accessories, electrical apparatus including paint scrapes

.4 Evidence of loose or missing fixtures, bolts, attachments or spare parts

.5 Low-resistance measurements through bolted electrical connections

.6 Insulation tests phase to phase and each phase to ground

.1 Switchgear bus

.2 Breaker open and breaker closed

.6 Any damages noted or tests failed prior to operation shall constitute sub-standard equipment. Equipment shall be refused by the Departmental Representative and contractor shall be responsible for all costs related to the repair and/or the replacement of defective equipment.

1.9 WARRANTY

.1 Manufacturer shall warrant all switchgear enclosures and equipment attached to the switchgear including but not limited to isolation and load break switches, circuit breakers, instrument transformers, protection relays, meters, battery system and charger, etc. free from defects in materials and workmanship for the lesser of one year from date of installation or eighteen months from the date of purchase.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Switchgear assembly: to CSA C22.2 No.31

.2 Steel for cubicles: to CSA G40.21.

.3 Insulators: to CSA C22.2 No.58

2.2 CONFIGURATION

.1 Provide 25 kV rated switchgear assemblies, configured as shown on the Drawings and generally as follows:

.1 Feeder circuit breaker cubicles with incoming cable terminal pads, cable support brackets and with pre-drilled split wooden blocks.

.2 Incoming cable cubicle dimensions, cable termination, cable support blocks, and grounding ball access (with a hot-stick).

.3 Rackable, truck-mounted circuit breakers.

.4 PTs for protection and metering.

.5 CTs for protection and metering.

.6 Breaker controls.

.7 Metering and protection devices.

.8 All steelwork.

.9 Remote and local motorized operation of open, close and breaker truck racking.

.10 Time delay remote operation.

.2 Provide 5 kV rated switchgear assembly, configured as shown on the Drawings and generally as follows:

.1 Circuit breaker cubicles with incoming cable terminal pads, cable support brackets and with pre-drilled split wooden blocks.

.2 Rackable, truck-mounted circuit breakers.

.3 PTs for protection and metering.

.4 CTs for protection and metering.

.5 Breaker controls.

.6 Metering and protection devices.

.7 All steelwork.

.8 Remote and local motorized operation of open, close and breaker truck racking.

.9 Time delay remote operation.

.3 Accessories:

.1 Provide accessory equipment as recommended by the manufacturer for the equipment provided.

.2 Provide a standard breaker lifter on wheels capable of safely installing, removing, and transporting the breakers inside the substation.

2.3 RATINGS

.1 Construct the metal-clad 25 kV switchgear assemblies in accordance with the standards described herein and in compliance with the following minimum ratings:

Voltage, nominal:	25 kV, 3-phase, 3-wire
Voltage, maximum design:	27.6 kV rms
Insulation level, low frequency withstand:	50 kV rms
Insulation level, BIL, impulse:	125 kV crest
Rated voltage range factor:	1.30
Amperage, main bus, continuous	600 A, 60 Hz
Amperage, circuit breaker continuous:	600 A, 50 Hz
Rated short circuit current at rated max. kV:	40 kA, rms symmetrical

.2 Construct the metal-clad 5 kV switchgear assemblies in accordance with the standards described herein and in compliance with the following minimum ratings:

Voltage, nominal:	2.4 kV, 3-phase, 3-wire
Voltage, maximum design:	4.76 kV rms
Insulation level, low frequency withstand	19 kV rms
Insulation level, BIL, impulse:	60 kV crest
Rated voltage range factor, K:	1.30
Amperage, main bus, continuous	600 A, 60 Hz
Amperage, circuit breaker continuous	600 A, 60 Hz
Rated short circuit current at rated max. kV:	31.5 kA, rms symmetrical

2.4 PRIMARY ENCLOSURE

.1 The complete assembly may be the product of different manufacturers, but all components of a similar type shall be of one manufacturer only. The integrated assembly, including power circuit breakers, buswork, and enclosure shall safely withstand the effects of closing and latching, carrying, and interrupting all current levels up to its rated maximum short circuit ratings without sustaining damage.

.2 Primary enclosure: Provide metal-clad freestanding, floor-mounted, dead front, indoor tamper-proof, non-walk-in CSA Enclosure Type 1 cubicle unit, constructed from standard code rolled flat steel sheets. Design and manufacture to withstand seismic forces in accordance with National Building Code requirements for the Site locations as noted in Part 1. Provide separate compartments for each power circuit breaker, incoming cables, and low voltage controls. Size: as indicated.

.3 Enclosures shall incorporate the following wiring features:

.1 Bottom entry of HV cables.

.2 Top entry of protection, control, and metering wiring in rigid steel conduit through a removable gland plate sized to accept a minimum of three 19 mm conduits for each cubicle.

.3 Interior steel-enclosed wireways to facilitate protection, control, and metering wiring within each cubicle and between adjoining cubicles and cells.

.4 Fabricate all enclosures with steel, construct each cubicle on a rigid welded steel frame, and separate each cubicle from the adjacent cubicles with a steel barrier pierced for electrical connections only.

.5 Ventilating louvres: sprinkler proof with easily replaceable fiberglass filters.

.6 Use non-corrosive bolts and hardware.

.7 Access from front and rear.

.8 100 mm steel channel sills for base mounting in single length common to multi-cubicle switchboard.

.9 Full height outer doors, gasketted, hinges on left side, provision for multiple padlocking. Three point latch, stops, to open at least 135 degrees with viewing windows of transparent shatterproof material for inspection of disconnecting switch position.

.10 Hinge doors on same side.

.11 Gaskets on removable covers.

.12 Allow for future extension on west side of cubicle unit as indicated.

.13 Inner door: hinged and bolted mesh steel screens to prevent inadvertent contact with exposed live parts, to open at least 90 degrees.

.14 Storage container on inside surface of compartment capable of accommodating 3 spare fuses.
.1 Include 9 spare fuses.

.15 Metal pocket with weatherproof envelope and 1 set of drawings and diagram prints on inside surface of door.

.16 Provide access control as follows:

.1 Equip doors providing access to interrupter switches with fuses with key interrupter to guard against:

.1 Opening door if interrupter switch on source side of fuse is closed.

.2 Closing interrupter switch if door is open.

.17 Design and manufacture of the switchgear cubicles to facilitate disassembly into individual cubicles for shipment and installation.

2.5 BUS BARS

.1 Three phase and full capacity neutral insulated busbars, continuous current rating as indicated extending full width of multi-cubicle switchboard suitably supported on insulators.

.2 Main connections between busbars, major switching components and fuses of continuous current rating to match major switching components.

.3 High conductivity copper for busbars and main connections.

.4 Provision for extension of bus on west side of cubicle unit as indicated without need for further drilling or field preparation.

.5 Brace busbar system including ground bus to withstand stresses resulting from short circuit currents specified.

.6 Tin surfaced joints, secured with non-corrosive bolts and washers, tightened with torque wrench in accordance with manufacturer's recommendations.

.7 Identify phases of busbars by suitable marking.

.8 Busbar connectors when switchgear shipped in more than one section.

.9 Include full capacity neutral as indicated.

.10 Maximum symmetrical interrupting: 40 kA.

2.6 GROUNDING

.1 Copper ground bus not smaller than 50 x 6 mm extending full width multi-cubicle switchboard and situated at bottom and top row of breakers complete with ball studs in every cell.

.2 Lugs at each end for size 4/0 AWG grounding cable.

.3 Bond non-current carrying parts, including switchgear framework, enclosure and bases to ground bus.

.4 Readily accessible grounding ball studs when opening cabinet to work on High Voltage connection within cabinet.

.5 Switchgear to allow grounding of main bus and/or branch circuit cables with branch circuit breakers in any position (“racked in”, “racked out”, or “Test” and also with breakers removed from cells.

.6 Grounding connectors must be CSA and IEEE 837 station class approved.

.7 Provide one (1) grounding truck for top and bottom, loose.

2.7 VACUUM CIRCUIT BREAKER

.1 Rack-out vacuum style circuit breaker with spring-stored energy type or magnetic type mechanism with motorized-racking and manual racking operation, 125 VDC rated solenoid trip, truck-mounted configuration consisting of a 3-pole, single-throw, and "trip free" design.

.2 Breakers with motor charged, stored energy, closing mechanism with emergency manual spring charging handle and ground switch. The circuit breaker shall be complete with main power contacts, primary disconnecting means and, if shown on the Drawings, secondary disconnecting means, key-interlocks to prevent making or breaking load current on the primary disconnects, auxiliary switch with 6 Type 'a' and 6 Type 'b' contacts, and a contact wear indicator.

.3 Breakers with on-off indicator, spring charged/discharged indicator and mechanical position indicator. The breaker shall be capable of being manually tripped from the front through direct mechanical linkages without use of auxiliary voltage.

.4 Interlocks to prevent breaker drawout when in closed position to prevent closing unless fully engaged or in test position.

.5 Form C, 120VAC, 10 amp rated contacts to indicate open, closed, tripped, and racking position status.

.6 125 VDC rated remote open, close and racking controls for remote operation via SCADA system.

.7 125 VDC rated motorized automatic trip mechanism charging device configured to automatically recharge trip mechanism upon all closing operations.

.8 125 VDC trip circuit shall not be compromised by meter or other device faults.

.9 Provide key interlocks and provision for future key interlocks as shown on the Drawings.

2.8 DIGITAL METERING

.1 Fully integrate digital metering into switchgear assembly, including all instrument transformer wiring, control input/output wiring, fusing, terminals and communications hardware. Refer to Section 26 29 23.01 Digital Metering for communication requirements.

.2 Front panel display of digital meter shall be mounted to correlate with the load that it measures.

2.9 INDICATOR LIGHTS

.1 Include 30 mm long life LED indicator lights rated for control voltage to CSA C22.2 No.14-13.

.2 Include push to test lights with transparent plastic cover.

2.10 LOCKOUT PROVISIONS

.1 Provide breakers with integral lock out means where possible. Reduce the need for separate lock out devices as much as possible.

2.11 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results- Electrical.

.2 Cubicle exteriors: gray.

.3 Cubicle interiors: white.

.4 Supply 2 spray cans touch up paint.

2.12 MIMIC DIAGRAMS

.1 Provide a mimic diagram on the front face of each 25 kV and 5 kV switchgear as follows:

.1 Permanently affix 10 mm x 3 mm black plastic mimic lines to depict the relative locations of the main switchgear buswork and components on the front doors and panels. Manufacture equipment symbols separately, using matching plastic material.

.2 Duplicate the symbols used on the 1-line diagrams and show incoming cables, cable potheads and stress cones, buswork, circuit breakers, PTs, and CTs.

.3 Provide continuity of bus symbols between adjacent cubicles.

.4 Install symbols for equipment contained in each cubicle corresponding to front doors and panels for that cubicle.

.5 Supply loose materials and supervise and direct the Site Contractor to install mimic diagram on the switchgear.

2.13 EQUIPMENT IDENTIFICATION

.1 Identify equipment identification in accordance with Section 26 05 00 - Common Work Results-Electrical.

.2 Nameplates:

.1 Switchgear designation: label - white plate, black letters, size 7, engraved as indicated.

.2 Individual cubicle designations: labels - white plate, black letters, size 7, engraved as indicated.

2.14 WARNING SIGNS

.1 Include warning signs in accordance with Section 26 05 00 - Common Work Results-Electrical.

2.15 SOURCE QUALITY CONTROL

.1 Switchgear and accessories shall be manufactured and tested under the manufacturer's standard Quality Assurance Program. Program shall generally comply with the intent of CSA CAN3-Z299.3 or ISO 9001. Provide a copy of the manufacturer's Quality Assurance Procedures Manual upon request.

.2 Factory test each complete controller assembly and all accessories. Notify Departmental Representative 7 days in advance of tests and confirm 2 days in advance. Departmental Representative and Engineer will attend/witness tests. Tests must be conducted in the Lower Mainland area of British Columbia. Alternatively, if tests are conducted elsewhere, pay the costs of travel time (at $130/hour) and all travel/living expenses for two attendees (at actual cost) associated with Departmental Representative’s and engineer’s attendance at factory tests and at repeat tests if necessary.

.3 Prepare factory test record sheets with space to record data. Test records to indicate:

.1 Date

.2 Switchgear: Make, Model, Serial Number

.3 Breakers: Make, Model, Serial Number, and location cell

.4 Digital metering system: Make, Model

.5 Switchgear continuous rating

.6 Check lists and forms for logging of all required quality control inspections and tests. Where Specifications indicate test and record, the test record sheets shall include appropriate provision to do so.

.7 Name of inspector or test operator.

.4 Maintain a set of working records as inspections and tests proceed. Neatly transfer actual results to clean copy for record submissions and manuals. Provide Departmental Representative with copy of final records.

.5 Departmental Representative will review results and prepare a deficiency list and requirements for corrective actions if applicable. Repeat applicable portions or complete tests as directed by Departmental Representative following completion of deficiencies.

.6 Conduct inspections and tests during the course of manufacture to verify quality control requirements and to comply with requirements of relevant Standards and these Specifications.

.7 Inspections and tests shall include all standard factory acceptance tests per CSA C22.2 No. 31. Record that inspections were conducted. Record test results where appropriate.

.8 Submit certified copy of inspection and test results to Departmental Representative for review and approval before shipment to Site.

.9 Include certified copy of inspection and test results in Operating Manuals.

2.16 FIELD SERVICES

.1 Provide factory-trained technical service personnel as required to supervise the placement and to carry out the field reassembly, testing, and commissioning of the switchgear provided under this contract. Reassemble shipping sections and test all connections prior to commissioning.

.2 Provide third party field testing and commissioning after installation by independent testing agency.

2.17 SHIPMENT

.1 Ship switchgear in pre-assembled sections or as individual cubicles to facilitate installation in the buildings.

.2 Suitably protect equipment for shipment. Coordinate the shipping crating/ wrapping conditions with the shipment method.

.3 Remove and separately package all sensitive equipment or components which may be subject to damage during transit. Anchor, tie, or block components to prevent movement during transit.

.4 Inspect shipment at destination prior to off-loading by the Site Works Contractor. Verify that there is no shipping damage or, if damage is evident, make note of same prior to turning over to the Site Works Contractor for off-loading and placement.

.5 Inspect equipment after uncrating and placement by the Site Works Contractor. Repair or replace any equipment damaged during transit.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for cable installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Set and secure switchgear assembly in place on channel base, rigid, plumb and square. Provide adequate seismic restraints for switchgear.

.2 Make field connections in accordance with manufacturer's recommendations.

.3 Connect ground bus to building system ground.

.4 Render entire assembly rodent and insect proof by means of plates, screens and grouting.

.5 Ensure fixed housing into which circuit breaker moving carriage enters, is plumb.

.6 Check factory made connections for mechanical security and electrical continuity.

.7 Check relay settings against shop drawings.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results- Electrical.

.2 Operate circuit breaker closing and tripping mechanisms, to verify correct functioning.

.3 Check insulation of switchgear assembly with DC Hi-Pot tester in accordance with manufacturer's approved methods. If values are not satisfactory, clean, dry and heat switchgear and repeat tests until readings acceptable to Departmental Representative.

.4 Check insulation of switchgear assembly with appropriate megger. If values not satisfactory, clean, dry and heat switchgear and repeat tests until readings acceptable to Departmental Representative.

.5 Check phase rotation, phasing and sequence of each feeder.

.6 Place primary switchgear in service and check ammeter, voltmeter, wattmeter, power factor meter readings to ensure proper functioning of instruments and satisfactory phase balance and power factor of loads.

.7 Check fuses for correct type and rating.

.8 Check for grounding and neutral continuity between station ground and system neutral.

.9 Check alignment of circuit breakers within cubicles to assure proper connections. Make adjustments as required.

.10 Set protective relays to their required settings. Perform secondary current injection tests to confirm relay operation. Record test results.

.11 Have third party commissioning agency commission final installation and certify proper operation and installation.

.12 Upon completion of all testing and when all systems are ready for use, submit a complete report of all testing results for review.

.13 Prior to undertaking the commissioning work described herein, submit to the departmental representative a complete work list itemizing all testing and commissioning work to be undertaken.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by primary switchgear assembly installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE C37.09 (Current Edition), Standard for Metal-Enclosed Medium-Voltage Power Circuit Breaker Switchgear.

.2 ANSI/IEEE C37.20.2-1999, Standard for Metal-Clad.

.3 ANSI/IEEE C37.35-1995, Guide for the Application, Installation, Operation, and Maintenance of High-voltage Air Disconnecting and Interrupter Switches.

.4 ANSI/IEEE 1015-06, Blue Book IEEE Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

.2 CSA International

.1 CSA C22.2 No.31-10, Switchgear Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for interlock systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry locations and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect interlock systems from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 INTERLOCK SYSTEMS

.1 Kirk key interlocks, Type F for load interrupter switch and Type D for switchgear cubicle door configured as indicated on the single line diagram. Use Type D for interlocking equipment access covers.

.2 Key interlocks mounted in switchgear so that interlocks cannot be removed when operating breaker is in closed position.

.3 Key interlocks to be used to prevent access to transformer enclosures without interruption of upstream isolation device.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for interlock systems installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Departmental Representative.

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.31-M89(R2000), Switchgear Assemblies.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC G8-3.3, Metal Enclosed Interrupter Switchgear Assemblies.

1.2 SHOP DRAWINGS PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate on shop drawings:

.1 Floor anchoring method and foundation template.

.2 Dimensioned bus entry and exit locations.

.3 Dimensioned position and size of bus.

.4 Overall length, height and depth of complete switchgear.

.5 Dimensioned layout of internal and front panel mounted components.

.3 Indicate on product data:

.1 Time-current characteristic curves for air circuit breakers.

1.3 QUALITY ASSURANCE

.1 Submit 4 copies of certified factory test results.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for secondary switchgear for incorporation into manual in accordance with Section 26 05 00 – Common Work Results - Electrical.

1.5 STORAGE AND PROTECTION

.1 Store switchgear on site in protected, dry location. Cover with plastic to keep off dust.

.2 Provide energized strip heater in each cell to maintain dry condition during storage.

Part 2 Products

2.1 MATERIALS

.1 Switchgear assembly: to CAN/CSA-C22.2No.31.

2.2 RATING

.1 Secondary switchgear: indoor, (120/208, 480, 347/600, 430-630) volt, 3 phase, 4 or 3 wire, 60 Hz, minimum short circuit capacity (rms symmetrical) and current carrying capacity as indicated on drawings.

2.3 ENCLOSURE

.1 Main incoming section to contain:
- .1 Draw out air circuit breaker(s) sized as indicated or main lugs as noted in drawings.
- .2 Power metering.
- .3 Interface to SCADA for control and monitoring.
- .4 Bus duct entrance and termination.

.2 Distribution sections to contain:
- .1 Air circuit breaker or moulded case circuit breaker sized as indicated.
- .2 Copper bus, from main section to distribution sections including vertical bussing.
- .3 Power metering.
- .4 Interface to SCADA for control and monitoring.

.3 Blanked off spaces for future units.

.4 Metal enclosed, free standing, floor mounted, dead front, indoor, CSA Enclosure 1 cubicle unit.

.5 Ventilating louvres: vermin, insect proof with easily replaceable fibre glass filters.

.6 Access from front and rear.

.7 Steel channel sills for base mounting in single length common to multi-cubicle switchboard.

.8 Provision for future extension on both sides.

2.4 BUSBARS

.1 Three phase and full capacity neutral busbars, continuous current rating self-cooled, extending full width of multi-cubicle switch board, suitably supported on insulators.

.2 Main connections between bus and major switching components to have continuous current rating to match major switching components.

.3 Busbars and main connections: 99.30% conductivity copper.

.4 Provision for extension of bus on both sides of unit without need for further drilling or preparation in field.

.5 Tin plated joints, secured with non-corrosive bolts and Belleville washers.

.6 Identify phases of busbars by suitable marking.

.7 Busbar connectors, when switchboard shipped in more than one section.

2.5 GROUNDING

.1 Copper ground bus not smaller than 50mm x 6 mm extending full width of multi-cubicle switchboard and situated at bottom.

.2 Lugs at each end for size #3/0 AWG grounding cable.

2.6 AIR CIRCUIT BREAKER

.1 See Section 26 28 16 - Air Circuit Breakers.

.2 All circuit breakers rated 1200 amps or larger OR as called for in the drawings shall be equipped with motor operators to facilitate remote opening and closing of the circuit breaker.

2.7 MOULDED CASE CIRCUIT BREAKERS

.1 See Section 26 28 21 – Moulded Case Circuit Breakers.

.2 All circuit breakers rated 1200 amps or larger OR as called for in the drawings shall be equipped with motor operators to facilitate remote opening and closing of the circuit breaker.

2.8 SWITCHBOARD METERING AND SCADA DEVICES

.1 See Section 26 09 23 – Metering and Switchboard Instruments

2.9 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results - Electrical.

.1 Cubicle exteriors gray.

.2 Cubicle interiors white.

2.10 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

2.11 SOURCE QUALITY CONTROL

.1 Departmental Representative to witness final factory tests.

.2 Notify Departmental Representative in writing 15 days in advance that switchgear assembly is ready for testing.

Part 3 Execution

3.1 INSTALLATION

.1 Locate switchgear assembly as indicated and bolt to base channels.

.2 Connect main secondary power supply to main breaker or lugs.

.3 Connect load side of breakers in distribution cubicles to distribution feeders.

.4 Check factory made connections for mechanical security and electrical continuity.

.5 Check trip unit settings against co-ordination study to ensure proper working and protection of components.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This Section specifies standard and custom panelboards and their installation.

1.2 SCOPE OF WORK

.1 Provide and install panelboards as indicated on the drawings, single line diagram, panel schedules and these specifications.

.2 Types of panelboards in this section include the following:

.1 Lighting and power panelboards

1.3 PRODUCT INFORMATION

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

.3 Shop drawings to include matching tub and trim details for factory installed low voltage relay cabinets where specified.

1.4 PLANT ASSEMBLY

.1 Install circuit breakers in panelboards before shipment from plant.

.2 In addition to CSA requirements, manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.3 All panelboards to be of a common manufacturer.

1.5 FINISH

.1 Apply finishes in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Panel finish in electrical and equipment rooms and closets to be standard ASA Grey baked enamel. Confirm with Departmental Representative prior to shop finishing panels.

Part 2 Products

2.1 PANELBOARDS, DOORS AND TRIMS

.1 Panelboards: to CSA C22.2 No. 29 and product of one manufacturer.

.2 Bus and breakers unless otherwise indicated on the drawings and in the specifications, shall be rated for:

.1 Minimum 10 kA at 208Y/120V.

.2 Minimum 22 kA at 480Y/277 and 600Y/347V.

.3 Tin plated copper bus with full size neutral.

.4 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number.

.5 Mains capacity, number of circuits and number and size of branch circuit breakers as indicated.

.6 Provide all necessary connectors and mounting hardware in every space to facilitate installation of future breakers. Provide blank fillers for all spaces.

.7 Concealed hinges and concealed trim mounting screws, hinged locking door with flush catch.

.8 Panelboards to have flush doors.

.9 Provide two keys for each panelboard and key similar voltage and system panelboards alike.

.10 Panel tubs to be typically 600mm wide.

.11 All surface mounted enclosures to be complete with sprinkler drip cover.

.12 Provide door within door trims where indicated to facilitate ease of service maintenance Each tub trim cover to be hinged and self supporting and to swing out to expose breaker cable terminations and wireways. Hinged trim shall be secured with cover screws on opening side by concealed machine screws. Hinged breaker cover shall be recessed into the hinged overall tub cover. Breaker cover shall have latch type closures. Submit details on shop drawings prior to manufacturing.

2.2 BREAKERS

.1 All breakers to be:

.1 Bolt on type molded case, non-adjustable and non-interchangeable trip, single, two and three pole, 120/208V , 277/480V or 347/600V and with trip free position separate from "On" or "Off" positions.

.2 Two and three pole breakers to have common simultaneous trip and able to be located in any circuit position within the panelboard.

.3 Main breaker (where required) to be separately mounted at top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Provide circuit breakers with indicated trip ratings as shown in the panelboard schedules or the Single Line Diagram.

.5 Provide spare circuit breakers as indicated on panel schedules or single line diagram as applicable.

.6 Provide breaker type Ground Fault Interrupter(s) (GFI) as indicated.

.7 Provide Lock-on devices as indicated and for Fire Alarm circuits, Security Equipment circuits, Exit sign circuits and Emergency Battery Equipment circuits.

2.3 PANELBOARD IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Nameplate for each panelboard size 5 (2 line) engraved as indicated and include panel designation and voltage/phase.

.3 Complete updated circuit directory with typewritten card(s) located in slide-in plastic pocket(s) fixed to the back of the related door. Directory card to indicate the panel designation, mains size, voltage/phase and the location and load controlled of each circuit. Include a “letter sized” paper copy of each directory in the project maintenance manual.

.4 Provide a plasticized typewritten information card fixed to the back of the each panel door. Information card to indicate the panel designation and location, feeder type and size and locations of any controlling contactors and feeder pullboxes. Include a “letter sized” paper copy of each information card in the project maintenance manual.

Part 3 Execution

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb true and square, to adjoining surfaces.

.2 Panelboards located in service rooms, mechanical rooms, and electrical rooms to be mounted on unistrut supports.

.3 Mount panelboards to height given in Section 26 05 00 or as indicated.

.4 Connect loads to circuits as indicated.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

.6 Provide spare breakers as indicated on panelboard schedules and on single line diagram.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This Section specifies switches, receptacles, wiring devices, cover plates and their installation.

1.2 PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

- .1 CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
- .2 CSA-C22.2 No.42.1, Cover Plates for Flush Mounted Wiring Devices.
- .3 CSA-C22.2 No.55, Special Use Switches.
- .4 CSA-C22.2 No.111, General Use Snap Switches.

Part 2 Products

2.1 COLOUR

.1 All devices to be Decora style white.

2.2 SWITCHES

.1 Heavy duty specification grade.

.2 20 A, 120 V, single pole, double pole, three-way, four-way switches as indicated.

.3 Manually-operated general purpose ac switches as indicated and with following features:

- .1 Terminal holes approved for No.10 AWG wire.
- .2 Silver alloy contacts.
- .3 Urea or melamine molding for parts subject to carbon tracking.
- .4 Suitable for back and side wiring.
- .5 White toggle (red toggle for emergency power circuits).

.4 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rating capacity of motor loads.

.5 Switches of one manufacturer throughout project.

2.3 RECEPTACLES – GENERAL

.1 Heavy duty specification grade.

.2 Duplex receptacles, CSA type L5-15 R, 125 V, 15 A, U ground, with following features:

- .1 White nylon molded housing (red for emergency power circuits)
- .2 Suitable for No.10 AWG for back and side wiring.
- .3 Break-off links for use as split receptacles.
- .4 Eight back wired entrances, four side wiring screws.

.5 Triple wipe contacts and non riveted grounding contacts.

.3 Receptacles of one manufacturer throughout project.

2.4 RECEPTACLES – PARTICULAR APPLICATION

.1 Surge Suppression TVSS 15 Amp, 125 volt duplex receptacles to be 2 pole, 3 wire hospital grade, blue face, parallel blade, U ground, impact resistant nylon face audible and LED alarm.

.2 Ground Fault Interrupter type to be 15 Amp, 125 volt duplex receptacles to be 2 pole, 3 wire hospital grade, white face, parallel blade, U ground, impact resistant nylon face, complete with breaker and reset button.

.3 20 Amp Receptacles (Housekeeping) Duplex receptacles – T-slot type CSA type L5-20R 125V. 20 Amp u ground with features matching 15 Amp rated Receptacles.

.4 All other single outlet and special purpose receptacles to be similar to the grade and series indicated above. Confirm ampacity, voltage and pin configuration prior to installation.

2.5 COVER PLATES

.1 Stainless steel: Type 302 or 304, No. 4 finish, 1mm thick, accurately die cut, protective cover for shipping. Outlets in labs or as indicated in the drawings or specifications.

.2 Steel: sheet steel hot dip galvanized with rolled edges for surface mounted utility boxes.

.3 Wall plates to be flush mounting with "positive bow" feature to ensure that all edges of plate are flush with wall or surface box when installed.

.4 All plates to be beveled type with smooth rolled outer edge and smooth face. Exposed sharp edges are not acceptable.

.5 Cast metal: die cast profile, ribbed for strength, flash removed, primed with grey enamel finish and complete with four mounting screws to box for special purpose wiring devices.

.6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for wiring devices as indicated. Double doors for standard duplex receptacles. Cover plates to fasten to box by four screws.

.7 Gaskets: resilient rubber or close cell foam urethane.

.8 Cover plates for all wiring devices to be from one manufacturer throughout project.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Mount wiring devices to height specified in Section 26 05 00 or as indicated.

.2 Upper edge of plates located on separate outlets immediately alongside one another to be at exactly the same height above finished floor.

.3 All plates to be installed parallel or perpendicular to building lines.

3.2 INSTALLATION PARTICULAR

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.2 Receptacles:

.1 Install all receptacles in the vertical plane unless otherwise noted.

.2 Generally install the L5-15/20R U ground pin down unless otherwise noted. Neutral up when receptacle in mounted horizontal.

.3 Install receptacles vertically in gang type outlet box when more than one receptacle is required in one location.

.4 Surge suppression duplex receptacles to be provided for all communication and computer terminal equipment backboards and cabinets including fire alarm, telephone, public address, door security, nurse call, central dictation, RF television, security television, etc. Provide dedicated neutral conductors for each surge suppression receptacle.

.5 Ground fault interrupter duplex receptacles to be used, adjacent sinks or water sources.

.3 Cover plates:

.1 Protect cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This Section specifies the materials, components, operational features and installation for air circuit breakers.

1.2 REFERENCES

.1 American National Standards Institute (ANSI) / Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE C37.13-1993, Low Voltage AC Power Circuit Breakers Used in Enclosures.

.2 Canadian Standards Association (CSA International)

.1 CSA C22.2 No. 5- latest issue, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Include time-current phase protection co- ordination characteristic curves for breakers.

.3 Provide complete wiring diagrams for all auxiliary contacts, controls and communications interfaces.

Part 2 Products

2.1 AIR CIRCUIT BREAKER

.1 Air circuit breaker to: to ANSI/IEEE C37.13 and CSA C22.2 No.5.

.2 Drawout or Fixed type (as noted in drawings), 600 V class or as indicated.

.3 Solid-state tripping system consisting of 1 current sensor per pole, 1 solid state trip unit and self-powered trip actuator. Equipped with long, short, instantaneous, ground fault function and phase overload and ground fault indication. Overcurrent device shall include metering and power quality measurements and shall communicate via Ethernet to the Power System SCADA to provide breaker status and remote open/close control.

.4 Breakers with normal stored energy, motorized closing mechanism to provide quick-make operation for all ratings.

.5 Breakers with on-off indicator and spring charged/discharged indicator.

.6 Interlocks to prevent circuit breaker drawout when in closed position and to prevent closing unless fully engaged or in test position.

.1 All circuit breakers rated 1200 amps and larger OR as called for in the drawings, shall be equipped with motor operators to facilitate remote opening and closing of the circuit breaker.

2.2 ADDITIONAL FEATURES

.1 Shunt trip.

.2 Auxiliary switches: 2 N.O., 2 N.C.

.3 Motor operator for open, closing and charging breaker.

.4 Alarm switch.

.5 Pilot light.

.6 Key interlock (where noted in drawings).

.7 Remote open and close.

.8 Lockout devices.

.9 Padlocking provision.

.10 Operation counter.

.11 Integral energy, harmonics and phase current/voltage metering.

.12 RS485 serial interface using MODbus or compatible communications protocol to integrate air circuit breaker overcurrent, control and metering functions to SCADA using single SCADA software system.

Part 3 Execution

3.1 INSTALLATION

.1 Install air circuit breakers as indicated.

.2 Connect remote open/close signals.

.3 Connect power source to breaker auxiliary controls.

.4 Connect communications interface from SCADA to breaker.

.5 Program SCADA system to tightly integrate breaker functionality and feedback into SCADA system for logging, auditing and monitoring purposes.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 29 23.02 Power System SCADA.

1.2 REFERENCES

.1 CSA International

.1 CAN/CSA C22.2 No. 144-06(R2011), Ground Fault Circuit Interrupters.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA PG 2.2-1999(R2009), Application Guide for Ground Fault Protection Devices for Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Include schematic, wiring, interconnection diagrams.

.2 Include all accessory devices including communication modules, cabling assembly, current transformer/sensors, terminals and displays.

.3 Include all propose programming, modifications or software packages.

.4 Provide Riser Diagrams showing interface of all equipment as well as intermediate wiring, wiring devices, signal conditioners and measuring devices. These diagrams to indicate connection and interface to SCADA system.

1.4 QUALITY ASSURANCE

.1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect control devices from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 EQUIPMENT

.1 Ground fault protective equipment: components of one manufacturer.

.2 Provide ground fault protection on all indicated three phase circuits as noted in drawings.

.3 Ground fault unit to contain:

.1 Ground sensing relay suitable for operation at a user selectable setpoint from 6mA to 20 amps.

.2 Control voltage: 125 VDC. Connect to building DC station service.

.3 Separate monitoring channels per feeder, each with independent alarm, trip and time delay settings and shunt trip contact for each channel.

.4 Digital, backlit display with menu for settings of each channel; graphs of each separate channel as well as display of harmonics. Settings applied in one controller shall populate through all controllers connected to the system.

.5 RS485 or similar serial interface between all ground fault modules to allow for alarm interactions, delays and priority tripping control.

.6 MODbus TCP interface to SCADA system for fault indication, alarm status and real-time indication for all channels.

.7 Push button for testing each channel with simulated ground fault current.

.8 Reset button for contacts and target.

.9 All hardware to be integrated into switchgear or control cabinets with flush, panel mounted controls and displays.

.4 Zero sequence transformer/ sensor with size/shape suitable for feeders, bus or loads being monitored. Range and output signal shall be fully compatible with Ground Fault Protection System.

.5 Neutral:

.1 Use neutral ground resistor unit.

.6 System to constantly scan and monitor ground leakage currents and alarm and/or trip based on magnitude, time delay and priority.

.7 Provide zero sequence transformer/sensor at all spare breakers in panel/switchboard. Sizing of sensor shall correspond to frame size of spare breaker. Wire sensors to local Ground Fault protection module.

2.2 FABRICATION

.1 Install following components in equipment specified in other Sections and as indicated.

.1 Zero sequence transformer/sensor.

.2 Ground fault protection units, communications interface, cabling and terminals.

.3 Ground resistor unit.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for ground fault equipment installation in accordance with manufacturer's written instructions.

3.2 INSTALLATION

.1 Confirm correct and reliable transmission of all data values via ModBUS to SCADA system and ensure that full scale readings are possible and correct. Integrate all Ground Fault information into new SCADA screens for meaningful display of real-time, alarm, status and historical information. All faults and alarms shall be time stamped.

.2 Confirm correct operation of all channels of ground fault system. Ensure correct tripping action of circuit breakers where indicated.

.3 Provide auxiliary power supplies as required for a complete and operation system as described in these documents.

.4 Provide all communications cabling, interface, programming and accessories required for a complete and operating systems as described in these documents.

.5 Priority trip sequence, alarm and trip values will be coordinated with the contractor during construction.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

.5 Perform simulated ground faults on all channels and confirm alarm, trip and realtime information through Ground Fault System and into SCADA system.

.6 Simulate multiple faults and alarms in the system to demonstrate tripping, alarming and priority trip functions.

.7 Coordinate all commissioning and demonstration operations with Departmental Representative.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies equipment and components for ground fault circuit interrupters (GFCIs).

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.144- latest edition, Ground Fault Circuit Interrupters.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA PG 2.2-latest edition, Application Guide for Ground Fault Protection Devices for Equipment.

1.3 PRODUCT DATA

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit product data and shop drawings.

.3 Submit test report for field testing of ground fault equipment to Departmental Representative and a certificate that system as installed meets criteria specified herein.

Part 2 Products

2.1 MATERIALS

.1 Components comprising ground fault protective system to be of same manufacturer.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

.1 Single pole ground fault circuit interrupter for indicated voltage c/w test and reset facilities.

2.3 GROUND FAULT PROTECTOR UNIT

.1 Self-contained with 15 A, 120 V circuit interrupter and duplex receptacle complete with:

.1 Solid state ground sensing device.

.2 Facility for testing and reset.

.3 CSA Enclosure Type 2, flush mounted with face plate, or as indicated.

Part 3 Execution

3.1 INSTALLATION

.1 Do not ground neutral on load side of ground fault relay.

.2 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results – Electrical.

.2 Arrange for field testing of ground fault equipment by ground fault equipment manufacturer before commissioning service.

.3 Demonstrate simulated ground fault tests.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials for moulded-case circuit breakers, circuit breakers, and ground-fault circuit-interrupters.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

.3 Section 26 23 00 - Low Voltage Switchgear.

.4 Section 26 28 20 - Ground Fault Circuit Interrupters - Class ‘A’.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.4 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Include time-current characteristic curves for breakers with ampacity of 100A and over.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

.2 Separate for recycling all waste in accordance with Waste Management Plan.

Part 2 Products

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters to CSA C22.2 No. 5

.2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips as noted.

.5 Circuit breakers with interchangeable trips as indicated.

.6 Circuit breakers to have minimum 10kA symmetrical rms interrupting capacity rating or as noted in drawings or panel schedules.

.7 All circuit breakers rated 1200 amps or larger OR as called for in the drawings shall be equipped with motor operators to facilitate remote opening and closing of the circuit breaker.

2.2 THERMAL MAGNETIC BREAKERS

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 SOLID STATE TRIP BREAKERS

.1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase and/or ground fault short circuit protection.

.2 Overcurrent device shall provide power, current and power quality metering and remove open/close and status functions. Device shall communicate to the Power System SCADA system via Ethernet.

2.4 OPTIONAL FEATURES

.1 Refer to drawings, single lines and panel schedules for features to be included on moulded case breakers.

.2 Required features for all circuit breakers larger than 150 amps OR mounted in any of the main 208V, 480V, 430-630V 600V switchboards:

.1 Shunt trip.
.2 Auxiliary switch.
.3 Motor-operated open/close mechanism
.4 Integral metering device with communications link
.5 On-off locking device.
.6 Handle mechanism.
.7 RS485 serial interface using MODbus or compatible communications protocol to integrate air circuit breaker overcurrent, control and metering functions to SCADA using single SCADA software system.

Part 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers in switchboard or panel board assemblies as noted in drawings.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies materials and installation for fused and non-fused disconnect switches.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA C22.2 No.4-latest edition, Enclosed Switches.

.2 CSA C22.2 No.39-latest edition, Fuseholder Assemblies.

1.3 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure type 2 or as indicated.

.2 Provision for padlocking in off switch position by three locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated.

.5 Fuseholders: suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

.8 Provide auxiliary Form-C contacts on switch operating mechanism where noted in drawings.

.9 Provide mechanical key interlocking scheme were noted in drawings.

.10 Exterior mounted disconnect switches shall be NEMA 4X rated.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This Section specifies contactors for system voltages up to 600 V and normally used to control heating or lighting loads.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.14-latest edition, Industrial Control Equipment.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 CONTACTORS

.1 Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.

.2 Breaker or Fused switch combination contactor as indicated.

.3 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.

.4 Mount in CSA Enclosure type 2 unless otherwise indicated.

.5 Include following options in cover:

.1 Red indicating lamp.

.2 Stop-Start pushbutton.

.3 Hand-Off-Auto selector switch.

.4 On-Off selector switch.

.6 Control transformer: in accordance with Section 26 29 03 - Control Devices, in contactor enclosure.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

Part 3 Execution

3.1 INSTALLATION

.1 Install contactors and connect auxiliary control devices.

END OF SECTION

□

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 29 23.02 Power System SCADA.

1.2 REFERENCES

.1 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 1-2000(R2008), Industrial Control and Systems: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Include schematic, wiring, interconnection diagrams.

.2 Include all propose programming, modifications or software packages.

.3 Provide Riser Diagrams showing interface of all new and existing equipment as well as intermediate wiring, wiring devices, signal conditioners and measuring devices.

.4 Provide propose transition scheme with regards to field panels, devices, PLCs, RID and interface to new PSS from existing controls scheme. Propose a chronological work flow showing proposed time frames, scope of work and expected outcome as well as fail safe actions if required due to unexpected circumstances.

1.4 QUALITY ASSURANCE

.1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect control devices from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 AC CONTROL RELAYS

.1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.

.2 Fixed contact plug-in type: heavy duty 2,3 or 4 poles. Coil rating: 120 VAC or 120VDC as noted. Contact rating: 120V, 3A.

.3 Relays to include indicator LED and tab for manually actuating the relay.

2.2 RELAY ACCESSORIES

.1 Plug in relay bases with vibration clips.

2.3 PUSHBUTTONS

.1 Illuminated and/or Heavy duty. Operator extend type, as indicated, color as noted with 1-NO and 1-NC contacts rated at 120 V, 10 A, AC labels as indicated. Stop pushbuttons coloured red, provision for padlocking in depressed position labelled "emergency stop".

2.4 SELECTOR SWITCHES

.1 Maintained or Spring return to center, positions as indicated heavy duty operators knob contact arrangement as indicated, rated 120 V, 10A, AC.

2.5 INDICATING LIGHTS

.1 Heavy duty full voltage, LED type, push-to-test, lens colour: indicated], supply voltage: 120V AC/DC, lamp voltage: 120V AC/DC, labels as indicated.

2.6 CONTROL AND RELAY PANELS

.1 CSA Type 1 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.7 CONTROL CIRCUIT TRANSFORMERS

.1 Single phase, dry type.

.2 Primary: as noted, 60 Hz ac.

.3 Secondary: 120 V, AC.

.4 Rating: 250VA.

.5 Secondary fuse: amps as required.

Part 3 Execution

3.1 EXAMINATION

.1 Contractor is required to carefully review all documents provided.

3.2 INSTALLATION

.1 Where field devices are connected to new RID devices for tranismission of process data to he PSS, existing signals must be reviewed to ensure that any required scaling factors, offsets or processing is completed and provided to ensure the PSS is reading a viable, and accurate signal.

.2 Confirm correct and reliable transmission of all data values via ModBUS to PSS and ensure that full scale readings are possible and correct.

.3 Confirm that all design performance values for the PSS have been met for inputs provided through the RID.

.4 Relocate existing control devices and equipment as noted in drawings. At completion of project, all redudant cabling and wiring shall be removed. Contractor shall demolish and remove all conduits made redundant during this project, unless specifically noted to remain by Departmental Representative.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

.5 Coordinate all commissioning and demonstration operations with Departmental Representative.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 13 18 – Primary Switchgear Assembly to 27kV

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for interlock systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Record all final settings and configuration files for all protective devices and submit with final Cx report.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry locations and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect interlock systems from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 TRANSFORMER DIFFERENTIAL AND FEEDER PROTECTION

.1 The microprocessor-based relay shall provide protection, monitoring, control, and automation. Relay self-checking functions shall be included. Specific requirements are as follows:

.2 Protection and Control

.1 Differential Protection: Six low-impedance current differential elements.

.2 Directional Element: Phase-comparator directional elements for each zone.

.3 Phase, residual, and negative-sequence overcurrent elements (50P/50G/50Q) with optional directional control

.4 Phase, residual, and negative-sequence inverse time-overcurrent elements (51P/51G/51Q) with optional directional control

.5 Neutral overcurrent and inverse time-overcurrent elements (50N, 51N)

.6 Breaker/contactor failure

.7 Autoreclosing control (79)

.8 Arc-flash detection and arc-flash overcurrent (50PAF, 50NAF)

.9 Over- and undervoltage (59, 59G, 59Q, 27)

.10 Directional power elements (32)

.11 Power factor (55)

.12 Over- and underfrequency (81)

.13 Rate-of-change of frequency (81R)

.14 Loss-of-potential (60)

.15 Transformer, Thermal Relay (49)

.16 Differential Protective Relay (87)

.17 High-impedance fault detection: The relay shall include high-impedance fault detection algorithms capable of detecting HIF signatures without being affected by loads and other system operation conditions. The relay shall make high-impedance fault summary, history, and event information available.

.18 Fault locator: The relay shall include a fault locating algorithm to calculate fault location without communications channels, special instrument transformers, or prefault information.

.19 Synchrophasors: The relay shall include operation as a phasor measurement unit (PMU) following the IEEE C37.118-2005 Standard for Synchrophasors for Power Systems.

.20 Adaptive phase overcurrent elements: The relay shall incorporate adaptive phase overcurrent elements that perform reliably in the presence of current transformer saturation, dc offset, and off-frequency harmonics.

.21 Check Zone: Three dedicated check zones. Each check zone will have its own adaptive differential element and settings.

.22 Analog Inputs: 21 current and 3 voltage inputs.

.23 Current Transformer Inputs: Accept CTs from different classes and a ratio mismatch of 10:1. Measuring quantities shall be on a phase-segregated basis and not from summation CTs.

.24 Minimum CT Requirement: The relay requires primary CTs that shall reproduce the primary current without saturation for at least 2 ms after external fault inception.

.25 Current Transformer Alarm: The relay shall include an element in each zone to detect CT open or short-circuit conditions.

.26 Digital Inputs: As indicated on the drawings.

.27 Outputs: As indicated on the drawings.

.28 Breaker Failure Protection: Internal breaker failure protection with retrip functions for each of the terminals, but be selectable to also accept external breaker failure protection.

.29 Overcurrent Fault Protection: Instantaneous and time-overcurrent elements for each of the 21 current inputs. Torque control capability shall be provided for the inverse-time overcurrent elements.

.30 Voltage Elements: Three phase over- and undervoltage elements as well as negative- and zero-sequence overvoltage elements.

.31 End-Zone Protection: Provide protection for a fault between the open circuit breaker and the CT.

.32 External Faults: Detection of an external fault and enter into a high-security mode but not block the differential protection at any time.

.3 Communications/Integration

.1 Network communications: Ethernet (Dual port) utilising native MODbus or similar protocol compatible with Power System SCADA.

.2 Switchgear integration and status:

.1 Remote component Open/Close

.2 Remote Start/Stop

.3 Open/Close digital Status output

.4 Draw out status

.5 Overcurrent trip output

.6 Ground fault trip output

.7 Thermal overload output

.8 Current imbalance output

.9 Analog outputs for phase current and voltage (A, B, and C)

.10 Motor status output

.11 Motor racking control.

.12 Hand/off/automatic (HOA) control.

.3 Minimum 1 spare digital and 1 spare analog outputs.

.4 SCADA communications shall integrate to protection relay and transmit realtime, trend, waveform and operational data through Ethernet link. All data shall be read to SCADA system for trending, alarming and visualization through GUI.

.4 Front-Panel Visualization

.1 The front panel shall be capable of displaying measured values, calculated values, I/O status, device status, and configuration parameters on a front-panel LCD display.

.2 The display shall have a rotating capability to display custom messages and data. 32 display messages shall be provided.

.3 The front panel shall also have a minimum of 6 user-programmable LEDs and 8 user-programmable pushbutton controls with 16 programmable LEDs.

.4 Hand/off/automatic (HOA) control.

.5 Monitoring and Reporting

.1 Load-profile monitoring: Provide periodic snap-shot (selectable rate from every 5 to 60 minutes) of as many as 17 selectable analog quantities

.2 Metering: The relay shall include metering capabilities for real-time current, voltage, power, energy qualities, and demand and peak demand current and power values. RTD temperature metering, synchrophasor data metering, and minimum/ maximum metering shall also be included. The arc-flash protection shall include light metering.

.3 Event summaries: Fault type and trip data, including time of tripping

.4 Event reports: 15-cycle length (as many as 44 reports) or 64-cycle length (as many as 10 reports) with a 4 or 32 samples/cycle resolution

.5 SER: As many as 1024 time-tagged, most recent input, output, and element transitions

.6 Data stored in nonvolatile, Flash memory

.7 Station battery monitor with two levels of detection

.8 Breaker wear monitoring

.9 Event report with arc-flash light input

2.2 RTD (RESISTANCE TEMPERATURE DETECTOR) MONITORING

.1 RTD (Resistance Temperature Detector) monitoring shall be provided by a microprocessor-based module with the following:

.1 Capable of acquiring RTD data from as many as 12 RTDs.

.2 Accept input from any of four different types of three-wire RTDs (100-ohm platinum, 100-ohm nickel, 120-ohm nickel, and 10-ohm copper) on every RTD input terminal.

.3 Accept a single contact input.

.4 No configuration settings required.

.5 Perform internal self-tests on the power supply and RTD inputs.

.6 Transmit valid RTD data within 25 seconds after power up.

.7 Module shall secure data communications using CRC-16 (Cyclical Redundancy Check) error detection.

.8 Module shall be equipped with a fiber-optic port (V-Pin option or ST option).

.9 LEDs (Light Emitting Diodes) to indicate device self-test status, input contact status, and fiber port transmit status.

.10 Module shall be capable of operating within specifications over a temperature range of –40° to +85°C (–40° to +185°F).

.11 120 VAC or 240 VAC.

.12 RTD signal values shall be transmit to SCADA system from RTD monitoring device where these values shall be displayed, logged and used for alarming and condition analysis.

.13 RTDs used in transformer and room temperature sensors shall be coordinated to ensure correct programming, hardware and connections/wiring is provided.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for interlock systems installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Install equipment in accordance with the drawings.

.2 Test and commission all protection devices and confirm integration/communications with Power System SCADA and remote operations.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Operate circuit breaker closing and tripping mechanisms, to verify correct functioning.

.3 Verify all protection relay settings with Protection and Coordination Study.

.4 Have third party commissioning agency commission final installation and certify proper operation and installation.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This Section describes manual and magnetic motor starters for motors up to 600 volts

1.2 REFERENCES

.1 International Electrotechnical Commission (IEC)

.1 IEC 947-4-1-latest edition, Part 4: Contactors and motor-starters.

.2 CAN/CSA – C22.2 No.14-latest edition, Industrial Control Equipment.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate:

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout of identified internal and front panel components.

.4 Enclosure types.

.5 Wiring diagram for each type of starter.

.6 Interconnection diagrams.

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 26 05 00 – Common Work Results - Electrical.

.2 Include operation and maintenance data for each type and style of starter.

1.5 EXTRA MATERIALS

.1 Provide listed spare parts for each different size and type of starter:

.1 [1] operating coil.

.2 [2] fuses.

Part 2 Products

2.1 FULL VOLTAGE MAGNETIC STARTERS

.1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.

.2 Motor overload protective device in each phase, manually reset from outside enclosure.

.3 Wiring and schematic diagram inside starter enclosure in visible location.

.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starters to include circuit breaker with operating lever on outside of enclosure to control circuit breaker, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:

.1 Selector switches: heavy duty, oil tight, labelled as indicated.

.2 Indicating lights: heavy duty, oil tight, type and color as indicated.

.3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.2 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.3 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results - Electrical.

2.4 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters, connect power and control as indicated.

.2 Ensure correct fuses and overload devices elements installed.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical and manufacturer's instructions.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

.5 Verify actual operating current with that of name plate, shop drawings and ensure correct overload selection.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 09 23.02 - Power Systems SCADA

.2 Section 26 29 03 - Control Devices

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 UL61010B-1 Measuring, Testing and Signal Generation Equipment

.2 CAN3-C17- latest edition, Alternating - Current Electricity Metering

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 1-2000 (R2008), Industrial Control and Systems: General Requirements.

.3 International Electrical Standards (IEC)

.1 IEC62052-11: Electricity metering equipment (AC) – general requirements, tests and test conditions

.2 IEC61010-1 (EN61010-1): Safety requirements for electrical equipment for measurement, control, and laboratory use

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Include schematic, wiring, interconnection diagrams.

.2 Provide certificate of Revenue Canada Approval for devices requiring compliance and sealing.

1.4 QUALITY ASSURANCE

.1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Submittal Procedures.

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.2 Storage and Handling Requirements:

.1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DIGITAL POWER METERS – TYPE 1

.1 Current/Voltage Inputs

.1 Have no less then 4 voltage inputs and 5 current inputs

.2 Shall be able to accept 600VAC LL / 347VAC LN without using potential transformers.

.2 Shall support nominal current ratings of 1A, 2A, 5A, 10A, and/or 20A and an overcurrent rating of 500A for 1s (5A nominal mode) or 200A for 1s (1A nominal mode). Power Supply

.1 95 to 240VAC (±10%) @ 47 to 440Hz / 120 to 310 VDC.

.3 Measured Values

.1 Digital Meter shall provide at minimum the following voltage values:

.1 Voltage L–L Per-Phase

.2 Voltage L-L 3-Phase Avg

.3 Voltage L–N Per-Phase

.4 Voltage 3-Phase Avg

.5 Voltage % unbalanced

.2 Digital Meter shall provide at minimum the following current values:

.1 Current Per-Phase

.2 Current, Neutral (measured)

.3 Current 3-Phase Avg

.4 Current % Unbalanced

.3 Digital Meter shall provide at minimum the following power values:

.1 Real Power (Per-Phase, 3-Phase Total)

.2 Reactive Power (Per-Phase, 3-Phase Total)

.3 Apparent Power (Per-Phase, 3-Phase Total)

.4 Power Factor – True (Per-Phase, 3-Phase Total)

.5 Power Factor – Displacement (Per-Phase, 3-Phase Total)

.4 Digital Meter shall provide at minimum the following energy values:

.1 Accumulated Energy (Real kWh, Reactive kVARh, Apparent kVAh) (Signed/Absolute)

.2 Incremental Energy (Real kWh, Reactive kVARh, Apparent kVAh) (Signed/Absolute)

.3 Conditional Energy (Real kWh, Reactive kVARh, Apparent kVAh) (Signed/Absolute)

.4 Reactive Energy by Quadrant

.5 Digital Meter shall be capable of deriving values for any combination of measured or calculated parameter, using the following arithmetic, trigonometric, and logic functions (or equivalent PLC capabilities):

.1 Arithmetic functions: division, multiplication, addition, subtraction, power, absolute value, square root, average, max, min, RMS, sum, sum-of-squares, unary minus, integer ceiling, integer floor, modulus, exponent, PI.

.2 Trigonometric functions: COS, SIN, TAN, ARCCOS, ARCSIN, ARCTAN, LN, LOG10

.3 Logic functions: =, =>, <=, <>, <, >, AND, OR, NOT, IF

.4 Thermocouple linearization functions: Type J, Type K, Type R, Type RTD, Type T

.5 Temperature conversion functions: C to F, F to C

.4 Demand

.1 Digital Meter shall be able to provide min/max demand, present demand interval, running average demand, and predicted demand on multiple demand channels.

.2 Digital Meter shall be able to perform multiple accepted demand calculation methods including block, rolling block, and thermal demand with user-programmable demand period lengths.

.5 Accuracy

.1 Digital Meter shall meet ANSI C12.20 accuracy class 0.2.

.2 Digital Meter shall provide 4-quadrant metering

.3 Digital Meter shall be certified and sealed to Revenue Canada standard as applicable for devices to be used for reselling of energy.

.6 Sampling

.1 Digital Meter shall sample at 1024 or 512 samples/cycle.

.2 Digital Meter shall be able to perform high speed sag/swell detection of voltage disturbances on a cycle-by-cycle basis, providing the duration of the disturbance, the minimum, maximum, and average value of the voltage for each phase during the disturbance. Disturbances less than one cycle in duration can be detected.

.7 Logging

.1 Digital Meter shall have at least 5MB of user programmable onboard data logging.

.2 Digital Meter will store all critical internal and revenue data upon sudden power loss and shall have non-volatile memory.

.3 Digital Meter shall have a time-stamped event log with the following features:

.1 Supports at least 500 events.

.2 The number of records in the log is programmable.

.3 Each event is recorded with the date and time of the event, the cause and effect of the event, and the priority of the event.

.4 All events relating to setpoint activity, relay operation and self-diagnostics is recorded in the event log.

.5 Time stamps have a resolution of 1 millisecond.

.6 Time stamps can be synchronized to within 100 ms between devices on the same serial communications medium.

.7 Minimum event recording response time is ½ cycle (8.3ms 60Hz, 10ms 50Hz) for high speed events and 1 second for other events.

.8 The priority of setpoint events is programmable.

.4 Digital Meter shall be able to log any parameter in the meter including min/max and waveforms.

.8 Alarming

.1 Digital Meter have setpoint driven alarming capability

.2 Digital Meter shall be able to generate an email on an alarm condition.

.3 Digital Meter shall have millisecond timestamp resolution on alarm entries.

.4 Digital Meter shall be able to readjust alarm setpoints based on the alarm quantity (Alarm Setpoint Learning)

.1 The user can enable the PMS Instrument to learn the characteristics of normal operation of metered values and select alarm setpoints based on this data.

.2 The quantities to be learned shall be user selectable, including standard-speed and high-speed analog alarms, disturbance alarms, and voltage transient alarms.

.3 The user can configure this feature using one of two modes:

.4 Manual: Once the learning is completed, the recommended values are stored for review and manual installation.

.5 Automatic: Once the learning is completed, the recommended values are automatically installed and operational.

.6 The learning period shall be user configurable from 1 to 365 days to insure system stability prior to determining the recommended setpoints

.5 Digital Meter shall support consecutive high-speed alarm conditions which trigger on a cycle-by-cycle basis with no “dead” time between events (i.e. no need for a rearming delay time between events).

.6 Digital Meter shall be able to operate relays on alarm conditions.

.7 Digital Meter shall be able to initiate datalog captures on alarm conditions.

.8 Digital Meter shall be able to control digital output relays in an AND or an OR configuration, using pulse mode or latch mode operation, for control and alarm purposes.

.9 Digital Meter shall be able to combine any logical combination of any number of available setpoint conditions to control any internal or external function or event.

.9 Communications

.1 The PMS Instrument shall be capable of the following communications methods simultaneously and independently:

.1 Ethernet over Fiber or copper media.

.2 Serial

.1 RS-232

.2 RS-485

.3 Serial
  .1 RS-485
.4 Modem
.5 Infra Red

.2 The PMS Instrument shall support any one of the following communications protocols on any one port at any one time:
.1 ION
.2 Ethergate
.3 Modemgate
.4 DNP 3.0
.5 Modbus
  .1 Modbus RTU
  .2 Modbus TCP
  .3 Modbus Mastering of serial RS485 slaves
.6 SMTP
.7 SNTP
.8 MV-90 compatibility
.9 XML compatibility
.10 SNMP
.11 HTTP (web pages)

.3 The PMS Instrument shall support GPS time synchronization

.4 The PMS Instrument can support at least 32 concurrent Modbus TCP connections.

.5 The PMS Instrument has an Modbus TCP gateway for reading Modbus serial devices connected to a serial port on the instrument

.6 The PMS Instruments that are equipped with an Ethernet port are internet enabled and supports the following functions:
.1 Automatically e-mail alarm notifications or scheduled system status updates. E-mail messages sent by the PMS instruments can be received like any ordinary e-mail message. Data logs can also be sent on an event-driven or scheduled basis.
.2 Built in web pages in the PMS instruments enables access to real-time values and basic power quality information using a standard web browser. Basic configuration of the PMS instruments can also be performed through the browser.
.3 Integration with custom reporting, spreadsheet, database and other applications with XML compatible data.
  .1 IEC 61850 compliance with the following features:
    .1 4 concurrent client connections
    .2 File based setup via FTP
    .3 Network time sync via SNTP
    .4 Configurable reports including selectable dataset member and configurable deadband values

.5 Support buffered (4) and unbuffered (20) reports (1 buffered and 5 unbuffered per client)

.6 Map up to 16 analog and/or 16 digital calculated value for reporting in 61850

.7 Fault capture data for 3-phase voltage and current channels in COMTRADE format including:

- At least 1Mb of storage for fault capture files
- The files shall be downloadable via standard ftp client
- The device shall support client notification through IEC 61850 to signal when new fault captures have been created and are available (RDRE logical node)

.2 The following logical nodes shall be supported in addition to LLN0 and LPHD (mandatory):

- MHAI - Harmonics
- MMTR - Metering
- MMXU - Measurement
- MSQI - Sequence and imbalance
- MSTA - Metering Statistics
- GGIO - The ability to view data from and control all I/O points in the meter.
- RDRE - Disturbance recorder function

.10 I/O Options

.1 Digital Meter shall be capable of having 16 digital inputs capable of ½ cycle timing resolution, and shall be fitted with 8 inputs

.2 Digital Meter shall have digital outputs that support pulse output relay operation for kWh total, kWh imported, kWh exported, kVARh total, kVARh imported, kVARh exported, and kVAh values.

.3 Digital Meter shall have 3 Form C relays which are isolated for up to 5000 VAC for 1 minute and 10A continuous for 30VDC and up to 240VAC.

.4 Digital Meter shall have 4 Form A analog inputs which are optically isolated.

.11 Display

.1 Digital Meter shall have two display options: an integral display and a remote mounted display

.1 The integral display shall be a color backlit LCD display

.2 The remotely mounted display shall be a color backlit color LCD display, of similar size as to integral display

.3 The remote display shall be capable of communicating with the Digital Meter via RS485 or Ethernet

.4 The displays shall be suitable for NEMA 12 enclosures.

.2 Digital Meter shall support direct display of all parameters on the front panel.

.3 Digital Meter shall provide a trend display of any parameter internally recorded at regular intervals.

.4 Digital Meter shall have a user programmable custom display that is capable of displaying up to 20 quantities on a single screen.

.5 Digital Meter shall be able to display advanced graphical representations of metering information including at minimum spectral components, phasor diagrams, and trending charts.

.6 Digital Meter shall be able to display measurements in either IEC or IEEE formats.

.7 Digital Meter display shall support multiple languages, including English and French.

.8 Digital Meter shall be able to display the following front panel screens:

.1 Numeric: Display 2, 3, 3 with timestamp, 4, 8, 10 or 20 parameters at a time.

.2 Event Log: Display recent events written to the PMS instrument's event log, including diagnostic events.

.3 Nameplate: Display information in a tabular format (default nameplates show owner, meter and power system details).

.4 Trend Bar: Display up to 4 real time numeric parameters along with their upper and lower extremes.

.5 Histogram: Display harmonics content in histogram format, including 2nd to 63rd harmonic, THD (total, even, odd); current harmonics histogram screens display K Factor and Crest Factor.

.6 Phasor: Display phase information in phasor diagram format, including phase, voltage and current magnitudes; phasors that are too small in magnitude are shown as table entries only.

.12 Field Programmability

.1 Digital Meter is field programmable as follows:

.1 Basic parameters: Voltage input scale, voltage mode (Wye, Delta, single phase), current input scale, auxiliary input and output scales, and communications setup parameters are programmable from the front panel.

.2 All basic parameters described above, plus additional setpoint/relay and data log setup parameters may be programmed via the communications port using a portable or remotely located computer terminal.

.3 Custom configuration of all operating parameters is possible through a graphical, flexible programming language.

.4 The configuration of the device will be done using programmable modules. The modules can be linked together in an arbitrary manner to create arbitrary functionality. Some example module types include min, max, setpoint, digital input, and digital output.

.5 Programming through a computer can be secured by user ID and password.

.6 Programming through the front panel is secured by password.

.7 Programmability shall be sectioned such that when the meter is sealed, the meter shall still be configurable to an extent that does not affect the accumulation of revenue metering related data.

.13 Power Quality

.1 Without the use of separate software, the Digital Meter shall be able to evaluate power quality statistically in accordance with IEC 61000-4-30 Class A Edition 2.

.2 Digital Meter shall be certified by a third party as compliant with IEC 61000-4-30 class A, Edition 2.

.3 Without using separate software, the Digital Meter shall determine statistical indicators of power quality parameters that include but are not limited to flicker, dips and swells, harmonics and interharmonics, in accordance with the EN50160 standards, “Voltage characteristics of electricity supplied by public distribution systems”.

.4 Without the use of separate software, the Digital Meter shall make available the statistical indicators of power quality on the front panel display, or via communications over any supported protocol (ION, Modbus RTU, Modbus TCP, DNP 3.0, IEC870-5), or via an analog transducer interface.

.5 Without the use of separate software, the Digital Meter shall monitor the value of any statistical indicator of power quality (present, predicted, average or otherwise manipulated value) with an absolute or relative setpoint. When such setpoint is exceeded, issue an alert via e-mail or pager, or enable control via a local interface to mitigation equipment or control systems through relays and analog or digital outputs.

.6 Digital Meter supports symmetrical components.

.14 Transients

.1 The Digital Meter shall provide sub-cycle transient detection at 1024 or 512 samples/cycle

.2 The Digital Meter shall be able to perform 17 microsecond transient captures at 60Hz.

.15 Waveform Capture

.1 The Digital Meter shall be able to perform 1024 or 512 samples/cycle waveform capture recording.

.2 The Digital Meter shall have programmable oscillographic waveform recorders. Each waveform recorder has the following features:

.1 Able to record a digitized representation of any phase voltage or current signal with no dead time between such recordings, and the ability to trigger multiple such recordings in continuous succession, and at different resolutions simultaneously.

.2 Enabled and triggered manually or through internal operating conditions, including periodic timer or setpoint activity.

.3 High speed triggering is supported.

.4 The number of records (depth) of each data recorder, and the overflow conditions (stop-when-full or circular) is programmable.

.3 The Digital Meter shall be able to record continuously to capture long duration waveforms. The duration of the waveform capture shall be limited by memory alone.

.16 Advanced Features

.1 The Digital Meter firmware shall be field upgradeable.

.2 Onboard meter clock can be paced by a choice of sources including GPS, power line, or internal clock.

.3 The Digital Meter shall have multi-level security which supports customized access for up to 16 users.

.4 The Digital Meter shall have revenue security capabilities including but not limited to the following:

.1 Password protected, no hardware lock, or

.2 Password protected and hardware locked, or

.3 The following data is protected from alteration when locked:

.1 kWh and kVARh (import, export, net and total)

.2 kVAh (total)

.3 kW, kVAR, kVA demand (thermal and sliding window)

.4 kWh, kVARh, kVAh pulse outputs

.5 The Digital Meter shall have provisions for creating periodic or non-periodic schedules for up to two (2) years. These schedules may be used to perform the following functions:

.1 Time of Use (TOU)

.2 Demand Control

.3 Load Scheduling

.4 Logging

.5 Periodic Resetting

.6 Alarm Gating

.6 Digital Meter shall have multiple tariffs and Time-of-Use (TOU) functionality to store and monitor up to 20 years of seasonal rate schedules. The TOU feature allows four seasons, four day types (each one capable of at least eight switch times, with a resolution of one minute). The TOU feature supports four rate tariffs, and at least twelve holidays per year, and allows periodic self-read capability.

.7 The Digital Meter shall be able to determine (with a level of confidence) whether a disturbance event occurred upstream or downstream of the meter. (Disturbance Direction Detection)

.8 The Digital Meter shall support three languages without having to upgrade its firmware.

.9 The Digital Meter shall support trending and forecasting of logged data values feature both on the meter display and via the webpages.

2.2 DIGITAL POWER METERS – TYPE 2

.1 Current/Voltage Inputs

.1 Have no less than 4 voltage inputs and 4 current inputs

.2 Shall be able to accept 600VAC LL / 347VAC LN without using potential transformers.

.3 Shall support nominal current ratings of 1A, 2A, 5A, 10A, and/or 20A and an overcurrent rating of 500A for 1s (5A nominal mode) or 200A for 1s (1A nominal mode).

.2 Power Supply

.1 95 to 240VAC (±10%) @ 47 to 440Hz / 120 to 310 VDC

.3 Measured Values

.1 Digital Meter shall provide at minimum the following voltage values:

.1 Voltage L–L Per-Phase

.2 Voltage L-L 3-Phase Avg

.3 Voltage L–N Per-Phase

.4 Voltage 3-Phase Avg

.5 Voltage % unbalanced

.2 Digital Meter shall provide at minimum the following current values:

.1 Current Per-Phase

.2 Current, Neutral (measured)

.3 Current 3-Phase Avg

.4 Current % Unbalanced

.3 Digital Meter shall provide at minimum the following power values:

.1 Real Power (Per-Phase, 3-Phase Total)

.2 Reactive Power (Per-Phase, 3-Phase Total)

.3 Apparent Power (Per-Phase, 3-Phase Total)

.4 Power Factor – True (Per-Phase, 3-Phase Total)

.5 Power Factor – Displacement (Per-Phase, 3-Phase Total)

.4 Digital Meter shall provide at minimum the following energy values:

.1 Accumulated Energy (Real kWh, Reactive kVARh, Apparent kVAh) (Signed/Absolute)

.2 Incremental Energy (Real kWh, Reactive kVARh, Apparent kVAh) (Signed/Absolute)

.3 Conditional Energy (Real kWh, Reactive kVARh, Apparent kVAh) (Signed/Absolute)

.4 Reactive Energy by Quadrant

.5 Digital Meter shall be capable of deriving values for any combination of measured or calculated parameter, using the following arithmetic, trigonometric, and logic functions (or equivalent PLC capabilities):

.1 Arithmetic functions: division, multiplication, addition, subtraction, power, absolute value, square root, average, max, min, RMS, sum, sum-of-squares, unary minus, integer ceiling, integer floor, modulus, exponent, PI.

.2 Trigonometric functions: COS, SIN, TAN, ARCCOS, ARCSIN, ARCTAN, LN, LOG10

.3 Logic functions: =, =>, <=, <>, <, >, AND, OR, NOT, IF

.4 Thermocouple linearization functions: Type J, Type K, Type R, Type RTD, Type T

.5 Temperature conversion functions: C to F, F to C

.4 Demand

.1 Digital Meter shall be able to provide min/max demand, present demand interval, running average demand, and predicted demand on multiple demand channels.

.2 Digital Meter shall be able to perform multiple accepted demand calculation methods including block, rolling block, and thermal demand with user-programmable demand period lengths.

.5 Accuracy

.1 Digital Meter shall meet ANSI C12.20 accuracy class 0.2.

.2 Digital Meter shall provide 4-quadrant metering

.3 Digital Meter shall be certified and sealed to Revenue Canada standard as applicable for devices to be used for reselling of energy.

.6 Sampling

.1 Digital Meter shall sample at 64 (or more) samples/cycle.

.2 Digital Meter shall be able to perform high speed sag/swell detection of voltage disturbances on a cycle-by-cycle basis, providing the duration of the disturbance, the minimum, maximum, and average value of the voltage for each phase during the disturbance. Disturbances less than one cycle in duration can be detected.

.7 Logging

.1 Digital Meter will store all critical internal and revenue data upon sudden power loss and shall have non-volatile memory.

.2 Digital Meter shall have a time-stamped event log with the following features:

.1 The number of records in the log is programmable.

.2 Each event is recorded with the date and time of the event, the cause and effect of the event, and the priority of the event.

.3 All events relating to setpoint activity, relay operation and self-diagnostics is recorded in the event log.

.4 Time stamps have a resolution of 1 millisecond.

.5 Time stamps can be synchronized to within 100 ms between devices on the same serial communications medium.

.6 Minimum event recording response time is ½ cycle (8.3ms 60Hz, 10ms 50Hz) for high speed events and 1 second for other events.

.7 The priority of setpoint events is programmable.

.3 Digital Meter shall be able to log any parameter in the meter including min/max and waveforms.

.8 Alarming

.1 Digital Meter have setpoint driven alarming capability

.2 Digital Meter shall be able to generate an email on an alarm condition.

.3 Digital Meter shall have millisecond timestamp resolution on alarm entries.

.4 Digital Meter shall support consecutive high-speed alarm conditions which trigger on a cycle-by-cycle basis with no “dead” time between events (i.e. no need for a rearming delay time between events).

.5 Digital Meter shall be able to operate relays on alarm conditions.

.6 Digital Meter shall be able to initiate datalog captures on alarm conditions.

.7 Digital Meter shall be able to control digital output relays in an AND or an OR configuration, using pulse mode or latch mode operation, for control and alarm purposes.

.8 Digital Meter shall be able to combine any logical combination of any number of available setpoint conditions to control any internal or external function or event.

.9 Communications

.1 The Digital Meter shall be capable of the following communications methods simultaneously and independently:

.1 Ethernet over copper media.

.2 Serial

.1 RS-232

.2 RS-485

.3 Serial

.1 RS-485

.4 Infra Red

.2 The Digital Meter shall support any one of the following communications protocols on any one port at any one time:

.1 ION

.2 Ethergate

.3 Modemgate

.4 DNP 3.0

.5 Modbus

.1 Modbus RTU

.2 Modbus TCP

.3 Modbus Mastering of serial RS485 slaves

.6 SMTP

.7 SNTP

.8 MV-90 compatibility

.9 XML compatibility

.10 SNMP

.11 HTTP (web pages)

.3 The PMS Instrument has an Modbus TCP gateway for reading Modbus serial devices connected to a serial port on the instrument

.4 The PMS Instruments that are equipped with an Ethernet port are internet enabled and supports the following functions:

.1 Automatically e-mail alarm notifications or scheduled system status updates. E-mail messages sent by the PMS instruments can be received like any ordinary e-mail message. Data logs can also be sent on an event-driven or scheduled basis.

.2 Built in web pages in the PMS instruments enables access to real-time values and basic power quality information using a standard web browser. Basic configuration of the PMS instruments can also be performed through the browser.

.3 Integration with custom reporting, spreadsheet, database and other applications with XML compatible data.

.1 The following logical nodes shall be supported in addition to LLN0 and LPHD (mandatory):

- MHAI - Harmonics
- MMTR - Metering
- MMXU - Measurement
- MSQI - Sequence and imbalance
- MSTA - Metering Statistics
- GGIO - The ability to view data from and control all I/O points in the meter.
- RDRE - Disturbance recorder function

.10 I/O Options

.1 Digital Meter shall be capable of having 4 digital inputs capable of ½ cycle timing resolution, and shall be fitted with 4 inputs.

.2 Digital Meter shall have digital outputs that support pulse output relay operation for kWh total, kWh imported, kWh exported, kVARh total, kVARh imported, kVARh exported, and kVAh values.

.3 Digital Meter shall have 4 optically isolated Form A outputs.

.11 Display

.1 Digital Meter shall have two display options: an integral display and a remote mounted display

.1 The integral display shall be a backlit LCD display

.2 The remotely mounted display shall be a color backlit LCD display, of similar size as to integral display

.3 The displays shall be suitable for NEMA 12 enclosures.

.2 Digital Meter shall support direct display of all parameters on the front panel.

.3 Digital Meter display shall support multiple languages, including English and French.

.12 Field Programmability

.1 Digital Meter is field programmable as follows:

.1 Basic parameters: Voltage input scale, voltage mode (Wye, Delta, single phase), current input scale, auxiliary input and output scales, and communications setup parameters are programmable from the front panel.

.2 All basic parameters described above, plus additional setpoint/relay and data log setup parameters may be programmed via the communications port using a portable or remotely located computer terminal.

.3 Custom configuration of all operating parameters is possible through a graphical, flexible programming language.

.4 The configuration of the device will be done using programmable modules. The modules can be linked together in an arbitrary manner to create arbitrary functionality. Some example module types include min, max, setpoint, digital input, and digital output.

.5 Programming through a computer can be secured by user ID and password.

.6 Programming through the front panel is secured by password.

.7 Programmability shall be sectioned such that when the meter is sealed, the meter shall still be configurable to an extent that does not affect the accumulation of revenue metering related data.

.13 Advanced Features

.1 The Digital Meter firmware shall be field upgradeable.

.2 Onboard meter clock can be paced by a choice of sources including GPS or internal clock.

.3 The Digital Meter shall have multi-level security which supports customized access for up to 16 users.

.4 The Digital Meter shall have revenue security capabilities including but not limited to the following:

.1 Password protected, no hardware lock, or

.2 Password protected and hardware locked, or

.3 The following data is protected from alteration when locked:

.1 kWh and kVARh (import, export, net and total)

.2 kVAh (total)

.3 kW, kVAR, kVA demand (thermal and sliding window)

.4 kWh, kVARh, kVAh pulse outputs

.5 The Digital Meter shall have provisions for creating periodic or non-periodic schedules for up to two (2) years. These schedules may be used to perform the following functions:

.1 Time of Use (TOU)

.2 Demand Control

.3 Load Scheduling

.4 Logging

.5 Periodic Resetting

Part 3 Execution

3.1 INSTALLATION

.1 Install Digital Meters in switchgear, motor control centers and control panels/cabinets as noted in drawings. All installations shall be fully integrated to main assemblies at the factory and shall be completely tested for operation prior to shipping to site.

.2 Use of Digital Meters with remote display units is applicable as required to facilitate compliant installation of meters using 600V voltage inputs. The use of potential transformers to permit mounting of metering on swinging doors is not acceptable when remote display is available.

.3 Connect Digital Meters to communications means as noted in drawings, typically copper Ethernet. All patch cables shall be STP (shielded twisted pair), CAT 6 with positively engaging locking tabs.

.4 Where Digital Meters are connected to additional devices using RS 485 twisted shielded media, ensure grounding of shielded cables is done at one end only. Provide end of line resistors as required for reflection/error free communications at the highest transmission speeds the Digital Meters are capable.

.5 Where Digital Meters are indicated as Revenue Sealed, ensure that all current transformer ratios installed coincide with those set in the sealed meter firmware.

.6 Connect Digital Meters to 120VAC UPS Source or 125VDC station service source as noted in drawings. Ensure that power supply on Digital Meter is compatible with connected source.

.7 All potential inputs to Digital Meters shall be fitted with protection fuses. Fuses shall be mounted in flip-open style fuse holder that will also provide isolation means for Digital Meter.

.8 Provide power supply fusing protecting each meter independently. Fuses shall be mounted in flip-open style fuse holder that will also provide isolation means for Digital Meter. Fuse holders shall be rated for disconnecting meter power supply under load.

.9 When Digital Meters use comment current and/or potential transformers with Protection Relays, provide Current Transformer shorting switches to allow removal of Digital Meter without disrupting service to other devices.

.10 When Digital Meters are Revenue Sealed, provide current transformer shorting switch to allow removal of Digital Meter for re-certification without taking circuit off-line. Provide isolation means for all voltage-sensing inputs.

.11 Provide protection or additional isolation when the Digital Meter is controlling circuit breakers or other equipment using contact closure. This protection to include but is not limited to): isolation relays, diodes, optoisolators, fuses, surge arrestors disconnect switches and terminals. Coordinate with all other product suppliers to ensure proper rating for relays with regards to closing/open coil requirements and contact ratings, etc.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

.5 Manufacturer shall coordinate to provide a complete factory demonstration of fully operational equipment prior to disassembly and sending to site.

.1 This demonstration to include primary current/voltage injection proving all metering points as well as operational verification of all digital inputs, analog inputs and digital outputs.

.2 Mockup of SCADA system for proving of Digital Metering communications is expected to facilitate demonstration of correct and satisfactory operation of all remote control functions, alarming, monitoring, trending and signalling.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 09 23.02 - Power Systems SCADA

.2 Section 26 29 03 - Control Devices

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA C22.2 No.14-10, Industrial Control Equipment.

.2 CAN3-C17- latest edition, Alternating - Current Electricity Metering.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 1-2000(R2008), Industrial Control and Systems: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 System riser/block diagram including all hardware, communications links, gateways, converters and computers.

.2 Software packages, including license certificates/quantities. List all applications to be installed on all computers and servers.

.3 Computer/Display Hardware including specifications, monitors, storage devices.

.4 Samples of all HMI screens to be developed as well as those that are to be replicated.

.5 Proposed points list for software level integration to existing and proposed devices included in this contract.

.6 Proposed points list for alarming, trending and alerts.

.7 Changeover procedures for replacing the existing software/server/database including procedures for:

.1 Transfer, storage and reintegration of existing data.

.2 Reconnection/integration of existing metering devices on site to remain.

.3 Transfer of operations from existing system to new, including proposed schedule and phasing transition.

1.4 QUALITY ASSURANCE

.1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Submittal Procedures.

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.2 Storage and Handling Requirements:

.1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL SYSTEM DESCRIPTION

.1 The replacement Power System SCADA (PSS) will be a complete replacement of the existing hardware and software of the system currently installed at the South Side Substation. These devices will connect to the existing server(s).

.2 All metering and control functionality currently in place with the existing system shall be replicated in the new PSS, including all trend logs, calculations, alarming, monitoring of ancillary inputs, automation, waveform capture and data display.

.3 All existing graphical interface screens currently in use with the existing System shall be replicated in the new PSS with modifications to correctly show physically and electrically the new electrical distribution. It is the responsibility of the contractor to ensure that all existing functionality is brought forward and replicated in the new PSS.

.4 Provide new graphical interface screens to summarize power system status, generator operation, ground fault protection system, harmonic filter bank and functionality of the variable voltage system.

.5 Provide new graphical interface screens for each new protective relay or motor control device, including a mimic of the front panel display, readout of all alarms, faults and real-time power data from the device. Operators will be able to remotely reset and control device from this screen.

.6 Provide fully operation touch screen interface at SSSR main floor. This panel will allow for full access and control of devices in the PSS for remote operation of breakers and devices. This device will be a flush mounted, industrial touch screen computer and function as a full node on the PSS SCADA network.

.7 All historical data currently stored on the existing System shall be transferred intact to the new system to ensure seamless historical trending and analysis of all loads that are being refed by these upgrades.

.8 The existing system has extensive custom programming currently in use for alarming, energy monitoring, revenue billing and trending.. Refer also to drawings for layout of existing system, including devices that are to remain in operation. It is the responsibility of the contractor to ensure that all existing functionality is brought forward and replicated in the new PSS.

.9 Existing PSS System Arrangement

.1 The system consists of dual servers, complete with fully redundant RAID storage arrays. One of these servers is located at the PHS control room, the other at the SES control room. These servers will be configured such that in the event of a server failure, complete control will be brought up on the second server. The database for all historical logging and operational logic will be synchronized at both locations.

.2 The digital power meters located in the field will not only monitor standard energy, power quality and breaker status functions, but will also have remote and automated control authority for opening and closing circuit breakers to which they are connected.

.3 Monitoring of electrically related parameters, including transformer winding temperature and electrical room temperatures will be input into digital meters for trending and alarming.

.4 The PSS will provide automated functionality for control of circuit breakers for load control, power factor, priority loading, etc under certain conditions. These automated functions may not be enabled at the conclusion of this project but must be programmed and fully demonstrated in operation.

.5 The PSS will be largely Ethernet based, using direct copper Cat 6 STP (shielded twisted pair) cabling to new devices. New and existing optical fiber cabling will be used to tie into existing equipment on the site, as well as linking in between SES and SSSR.

.6 The PSS will include direct connection to protection relays, motor protection and control devices, and other systems from which information will be read using Ethernet based protocols. This data will include real-time power measurements, as well as alarm data, and general data that will be used for trending. All devices will integrate tightly using native protocols and programming languages.

2.2 PSS - SOFTWARE

.1 General

.1 The Power Management Software shall be a web-enabled monitoring system intended to monitor an entire electrical distribution infrastructure, from incoming utility feeds down to low voltage distribution points as well as interfacing with additional automation and control functions.

.2 The system shall be designed to monitor and manage energy consumption throughout an enterprise across a network of facilities to improve energy availability and reliability, manage and measure energy consumption and provide trending/alarm for fault identification and resolution.

.3 The software shall be a standard product based on a successful, proven software platform.

Key features shall include:

.1 Data acquisition for metering devices, sensors, and other intelligent electronic devices.

.2 Power Quality analysis (including harmonics, and voltage and current sinusoids).

.3 Graphical displays of information.

.4 Reporting tools with standard reports.

.5 Automated (and manually activated) revenue metering reports for electrical energy and water.

.6 Interactive historical data analysis.

.7 Power Factor monitoring and control.

.8 Load monitoring and control.

.9 Third Party Device Integration through Modbus RTU and Modbus TCP protocols.

.10 Support real-time data display and control actions for multiple users for applications such as sub-metering, load monitoring / shedding, real-time pricing and generator control.

.11 Expansion of system through distributed IO servers.

.2 Redundancy

.1 The PSS will have a layer of redundancy as defined in this section. The redundancy will provide a means to run the PSS software from one of two servers. The redundancy software will determine which server is deemed the most fit to host the PSS software at any given time and run the software from that server.

.1 Handled Faults

.2 The system shall be capable of smoothly handling faults of the following nature: Network, Disk, Fan, Power supply, Temperature, Internal voltage, Memory, Motherboard, BMC, Processor and issues with Host software.

.1 Fault notification

.3 In the event of a fault listed above the PSS shall be capable of immediately notifying a pre-registered recipient of the problem.

.1 System Uptime

.4 The PSS shall have an annual uptime of 99.99%.

.3 Performance

.1 The PSS shall provide communications, view screen and event performance according to the specifications in this section.

.2 Real-Time

.1 Communications

Response Time

The response time of devices in the PSS will be less than or equal to the values below:

Ethernet Device: 0.5 seconds

Serial Device: 1 second

.2 Screens

Update Rate

The update rate of any screen in the system shall be less than or equal to the values below:

Update Rate: 5 seconds

Initial Load Time

The update rate of any screen in the system shall be less than or equal to the values below:

Load Time: 5 seconds

Alarming

Alarm Processing Time

The Alarm Processing Time system shall be less than or equal to the values below:

Load Time: 5 seconds

Alarm Notification Time

The Alarm Notification Time system shall be less than or equal to the values below:

Load Time: 10 seconds

.3 Effect of Off-Line Devices

.1 If any device on a serial loop goes off-line for any reason it shall not have any effect on the communications performance of any of the other devices on the same loop.

.4 Events

.1 Data Logs

.1 The Data Log Retrieval Time from any device shall be less than one minute.

.4 Software Components

.1 General

.1 Software shall expand on existing Powerlogic SCADA and datalogging software, including all required licensing and drivers required.

2.3 PSS SYSTEM – HARDWARE

.1 SSSR Main Floor HMI

.1 19" (478 mm) Active matrix LCD TFT LED backlit touchscreen industrial flat screen industrial PC/display) complete with integral LED indicator and piezo alert.

.2 Ethernet interface complete with copper to single mode fiber media convertor

.3 Power supply for connection to local 120VAC system and UPS.

.4 1280x1024 pixels SXGA; 16 million colours.

.5 Processor: Core 2 Duo P8400 2.26 GHz 6MB cache.

.6 Video Controller: Intel GMA 4500MHD, 384 MB RAM

.7 Memory: 4 GB DDR3 RAM; 512kB SRAM.

.8 Fan cooled.

.9 Solid State, SSD Flash disk with >60GB storage.

.10 Touch panel: Analog Resistive.

.11 Ports: USB 2.0 on back and front panel; RS232C serial; DVI-I video; Ethernet.

.12 Windows 7 64 bit operating system.

.13 Flush Mount with NEMA 4X front panel rating.

.14 HMI will be configured to display all PSS screens and all full access and control to PSS operations Password control will be implemented as required.

.2 Industrial Ethernet Switch

.1 Where Ethernet based communications is inside switchgear, control panels or unitized electrical equipment, network cabling shall shielded twisted pair (STP), including all patch cords and terminations.

.2 Ethernet switches shall be industrial quality, suitable for mounting inside an enclosure.

.3 Suitable for temperatures from -40 to 85 degree C.

.4 Fiber uplink ports where noted.

.5 Rack and surface mount.

2.4 PSS SYSTEM – PROGRAM AND OPERATIONS

.1 General Description

.1 The PSS is a tightly integrated SCADA and automation system that collects information, provides alarming, trending and data analysis while also provide specific automatic and remote control of power system equipment.

.2 The PSS will integrate at a software level using ModBUS or similar protocols over Ethernet into motor control/protection relays, power system protection relays, ground fault detection/monitoring systems, air and molded case circuit breakers, power factor controllers, battery chargers, PLC (Programmable Logic Controllers), RID (Remote Input Device) and all existing equipment noted in the drawings.

.3 The existing system layout drawings are provided as a key part of this project is the integration of these existing devices into the new PSS including all existing functions, monitoring, trending and recorded data.

.4 Consistency of GUI between the existing system and the new PSS is important to ensure continuity of operations at the facility as the system is viewed or used by both electrical and non-electrical personnel. Existing GUI screens have been provided as sample for production of new and replacement screens.

.5 The existing system has many custom programming elements providing revenue metering, custom alarms, and trending. These must be replicated in the new PSS for all existing meters that are remaining and for new devices that are effective replacing existing devices. In many instances signals that had been a direct input to the existing system will be replaced with a new software based value read from another device (I.E multifunction protection relay). Full integration and re-implementation of these existing and all new signals must be included in the new PSS.

.6 The Ground Fault Protection System will be fully integrated into the SCADA system for monitoring, logging and display of status, fault and real-time data. New GUI screens shall be developed to effectively display this information. Status and alarm indications will be integrated into general status and alarming screens with automatic callout functions in the event of a trip or exceeding alarm values.

.7 The Harmonic Filter Bank and associated power factor controller shall be fully integrated into the SCADA system for monitoring, logging and display of status, fault and real-time data. New GUI screens shall be developed to effectively display this information. Status and alarm indications will be integrated into general status and alarming screens with automatic callout functions in the event of a trip or fault condition.

.8 The Variable Voltage shore power system shall be shall be fully integrated into the SCADA system for parameter editing; and monitoring, logging and display of status, fault and real-time data. The SCADA system will be used for revising current, voltage and protection settings into the shore power system remotely, with appropriate access control. New GUI screens shall be developed to effectively display this information. Status and alarm indications will be integrated into general status and alarming screens with automatic callout functions in the event of a trip or fault condition.

.9 SCADA system shall be integrated to work with local CCTV cameras used for visualizing occupancy on the upper floor of the SSSR. This will be operating on the same server/computer network and allow for real-time viewing of cameras located on the upper floor via an application running at the HMI display or any workstation on the SCADA network.

Part 3 Execution

3.1 INSTALLATION

.1 Existing System

.1 Review and thoroughly understand all existing programmed logic and installed hardware of the existing digital metering system, including inputs/outputs that are to be relocated to the automation system or that shall be read using software protocols.

.2 New PSS shall be fully operational and commissioned prior to removing or demolished existing digital metering, networking or equipment. All transitions or phased cutovers to existing equipment must be approved by the Owner in advance and must be presented as part of the shop drawing submittals. Approaches or methodologies that compromise the safety of operation of the facility, as determined by the Owner, will be rejected.

.3 All existing functionality will remain in place after the installation of the new PSS. Any modifications to existing equipment, cabling or infrastructure to support the revised system architecture, communications or software requirements is the responsibility of the contractor.

.4 Upon successful demonstration of the new PSS, all equipment made obsolete and noted for removal in these drawings shall be removed. All digital metering equipment shall be carefully removed and handed over to the Owner in the current operational state that is was in, prior to removal. Any equipment determined to be surplus, as decided by the Owner, shall be disposed of by this contractor.

.5 The existing SCADA server located in the pumphouse shall be handed over the owner after all trending data has been transferred to the new PSS.

.6 The existing workstation in the Pumphouse Operators Console shall be retained, and new client viewing software, complete with all required licenses, shall be installed for correct operation with the new PSS.

.2 New PSS

.1 The new PSS shall be fully tested and commissioned, to that extent possible, prior to arriving on site. This testing will include at a minimum all new switchgear, low voltage distribution and motor controls. The equipment and networking will be mocked up and all functions demonstrated to the satisfaction of the Departmental Representative. A minimum of 96 hours notice must be provided as to the initiation of this testing.

.2 Install, test and fully commission all communications cabling to appropriate EIA/TIA Category 6 STP standards prior to connecting to equipment. All communications equipment shall be fully tested and deemed acceptable by manufacturer’s representative prior to connecting to PSS.

.3 All Digital Meters, protection relays, motor controls, circuit breakers and other devices communicating via Ethernet or serial communications shall be configured to use a protocol or language native to both the field devices and the PSS software. Intermediate protocol or language convertors will not be accepted.

.4 All PSS communications equipment shall be grouped together and mounted in the Communications closet co-located at each substation. This equipment shall be arranged to be as compact as possible while not reducing access for maintenance, inspections or additions. Connect to a dedicated UPS circuit.

.5 All PSS server equipment will be located in the control room co-located at each substation. The server will be located free of exposure to physical, environmental or electrical damage. Connect to dedicated UPS circuit.

.6 PSS vendor/integrator/contractor shall provide all required time as need to fully commission, program, test and demonstrate the complete PSS system to the satisfaction of the Departmental Representative. This work phase shall be undertaken early enough such that unexpected delays do not hinder or delay to completion of the project to the schedule provided. Deployment of additional forces by the aforementioned parties to complete this project in a timely fashion is expected.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.4 DEMONSTRATION AND TRAINING

.1 The vendor of the PSS software and integrator shall provide a complete and thorough demonstration of all functionality of the PSS, including simulated alarms, trending, viewing of data, fault finding, waveform capture, sequence of operations, remote equipment operation and navigation around the PSS software.

.2 The demonstration will be conducted three times, with approximately six attendees in each session. Documentation and operational guides shall be provided to all attendees.

.3 Four training sessions shall be provide for four attendees per group. This training would be performed on site, on the actual equipment being operated on, or in meeting room facilities at the site. These sessions, with a duration of approximately 30 hours, upon completion would provide training to give confidence in the operators with regards to the following tasks:

.1 Viewing of data.

.2 Viewing and acknowledging alarms.

.3 Output data/waveforms/alarms to hardcopy or pdf format for export.

.4 Navigation around all standard and custom GUI screens.

.5 Viewing data in protection devices, including fault information and waveform captures.

.6 Basic data manipulation related to trend data (max, min, plotting graphs, etc.).

.7 Use of manual and automatic revenue report generation.

.8 Discussion of basic troubleshooting for normal issues or problems.

.9 Overview of actual installed hardware, servers and software systems, including specification communications topologies and unique operational arrangements.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 Common Work Results - Electrical

.2 Section 26 05 30 Seismic Restraints

1.2 SUMMARY

.1 Section Includes:

.1 Materials and installation for storage batteries and batteries racks.

.2 Provide a complete operating system to provide 125VDC for electrical distribution control operation for a minimum of 8 hours at an expected 12A, 125VDC load.

1.3 REFERENCES

.1 American National Standards Institute (ANSI)/Underwriters Laboratories (UL).

.1 ANSI/UL 94, Tests for Flammability of Plastic Materials for Parts in Devices and Appliances (ANSI Approved November 21, 2003).

.2 Canadian Standards Association (CSA International).

.1 CAN3-Z299.3-85(R2007), Quality Assurance Program - Category 3.

.2 CAN/CSA-G40-20/G40.21-04 (R2009) General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.3 Department of Justice Canada (Jus).

.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.5 Institute of Electrical and Electronic Engineers (IEEE).

.1 IEEE 484-2002, IEEE Recommended Practices for Installation Design and

.2 Implementation of Vented Lead-Acid Batteries for Stationary Applications.

.3 IEEE 485-2010IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications.

.4 IEEE 450-2010 Recommended Practice for Maintenance, Testing and Replacement of Vented Lead-Acid Batteries for Stationary Applications.

.6 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

.3 Submit shop drawings and product data to include:

.1 Dimensioned sketch showing battery rack, individual battery cells, recommended aisle space, headroom, assembly and anchoring of rack.

.2 Shipping weights.

.3 Individual battery cells, type, size, A.h capacity 8 hours discharge rate, electrolyte, materials for container, cover, separators, retainers, posts and inter-cell connectors.

.4 Specific gravity at full charge and 25 degrees C.

.5 Cell charge and discharge curves of voltage, current, time and capacity.

.6 Derating factor for temperature range (minus 10 degrees C to minus 30 degrees C).

.7 Maximum short circuit current.

.8 Maximum charging current recommended for fully discharged condition.

.9 Full charge voltage per cell.

.10 Fully discharged voltage per cell.

.11 Hydrogen generation and ventilation requirements.

.4 Closeout Submittals:

.1 Provide operation and maintenance data for storage batteries and racks for incorporation into O&M manuals specified in Section 01 78 00 - Closeout Submittals.

.2 Operation and maintenance instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operation, maintenance and repair.

.3 Installation details of battery rack, individual cells, inter-cell connectors.

.4 Replacement instructions for individual cells.

.5 Electrolyte handling.

.6 Parts lists with catalogue numbers, and names and addresses of suppliers.

.7 Factory test records.

1.5 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.6 WARRANTY

.1 Contractor hereby warrants battery against defects in material and workmanship for five years.

.1 This warranty is for 100% replacement for first year and prorated replacement value in equal yearly decreasing amounts for remaining 4 years until expiration of warranty at end of 5 years after delivery of battery.

.2 Cells to be warranted for 100% replacement for 60 months against electrolyte leakage and corrosion at post seals.

Part 2 Products

2.1 MATERIALS

.1 Steel for battery racks: to CAN/CSA-G40.20.

2.2 SYSTEM REQUIREMENTS

.1 Capacity:

.1 8 Hours

.2 System to have sufficient reserve capacity at the end of the 8 hour period to provide the capability of accommodating the simultaneous tripping of all breakers.

2.3 BATTERY CHARACTERISTICS

.1 Nominal battery cell voltage, full charge 13.8 V.

.2 Designed to supply load current of 93Ah, 20Hr rate.

.3 Capable of being recharged in period of 4 hours to not less than 95% full charge after supplying rated load for period specified, with no harmful effects on battery, including leaking or foaming of electrolyte.

.4 Battery to deliver specified output at 25 degrees C, in ambient temperature from 20 degrees C to 40 degrees C.

2.4 LEAD ACID BATTERIES

.1 Type: Sealed lead acid.

.2 Cell containers: ABS

.3 Electrolyte level lines: high and low on container surfaces.

.4 Cover: one piece molded plastic, flame retardant to ANSI/UL 94.

.5 Plate separators: fibreglass.

.6 Vents: plastic screw flame arrestor type

.7 Posts: bolted type with 2 stainless steel nuts and bolts per cell.

.8 Inter-cell connectors: lead plated copper, bolted to battery posts.

.1 Bolt holes slightly oversized to facilitate cell replacement.

.2 Connectors, bolts and nuts: corrosion resistant.

.9 Cells: of identical construction and from same production run.

.10 Batteries: in clean state with no evidence of electrolyte on outside of cell containers.

2.5 BATTERY RACK

.1 Size as indicated. Bottom tier minimum 120 mm above floor, top of battery cells on highest tier not more than 2 m above floor.

.2 Frames: angle iron with welded joints ground smooth.

.3 Rails: steel channels, bolted to frames.

.4 Rubber strips to insulate rails from cells.

.5 Insulated from ground and floor.

.6 Primed and epoxy painted to prevent corrosion.

.7 Corrosion resistant bolts and hardware.

.8 Configuration permitting any one cell to be removed without removing any other cell.

.9 Dimensions of space available as indicated.

2.6 DC DISTRIBUTION PANELBOARD

.1 PANELBOARDS, DOORS AND TRIMS

.1 Bus and breakers unless otherwise indicated on the drawings and in the specifications, shall be rated for:

.1 125VDC.

.2 Tin plated copper bus with full size neutral.

.3 Mains capacity, number of circuits and number and size of branch circuit breakers as indicated.

.4 Provide main breaker. Rating as indicated.

.5 Provide all necessary connectors and mounting hardware in every space to facilitate installation of future breakers. Provide blank fillers for all spaces.

.6 Concealed hinges and concealed trim mounting screws, hinged locking door with flush catch.

.7 Panelboards to have flush doors.

.8 Provide two keys for each panelboard and key similar voltage and system panelboards alike.

.9 Panel tubs to be typically 600mm wide.

.10 All surface mounted enclosures to be complete with sprinkler drip cover.

.11 Provide door within door trims where indicated to facilitate ease of service maintenance Each tub trim cover to be hinged and self supporting and to swing out to expose breaker cable terminations and wireways. Hinged trim shall be secured with cover screws on opening side by concealed machine screws. Hinged breaker cover shall be recessed into the hinged overall tub cover. Breaker cover shall have latch type closures. Submit details on shop drawings prior to manufacturing.

.2 BREAKERS

.1 All breakers to be:

.1 Bolt on type molded case double pole, 125VDC and with trip free position separate from "On" or "Off" positions.

.2 Main breaker to be separately mounted at top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.3 Provide circuit breakers as shown in the panelboard schedules or the Single Line Diagram.

.4 Provide spare circuit breakers as indicated on panel schedules or single line diagram as applicable.

.3 PANELBOARD IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Nameplate for each panelboard size 5 (2 line) engraved as indicated and include panel designation and voltage/phase.

.3 Complete updated circuit directory with typewritten card(s) located in slide-in plastic pocket(s) fixed to the back of the related door. Directory card to indicate the panel designation, mains size, voltage/phase and the location and load controlled of each circuit. Include a “letter sized” paper copy of each directory in the project maintenance manual.

.4 Provide a plasticized typewritten information card fixed to the back of the each panel door. Information card to indicate the panel designation and location, feeder type and size and locations of any controlling contactors and feeder pullboxes. Include a “letter sized” paper copy of each information card in the project maintenance manual.

2.7 SOURCE QUALITY CONTROL

.1 To CAN 3-Z299.3.

.2 Complete battery factory testing in presence of Departmental Representative.

.3 Connect load designed to fully discharge battery to rated end voltage in 8 hours.

.4 Install DC indicating voltmeter and ammeter.

.5 Charge battery to ensure cells fully charged. When voltage reaches steady state, record: ambient temperature, temperature of each cell, voltage of each cell, voltage of battery.

.6 Discharge battery by applying load for 8 hours, and record at 85%, 90%, 95% and 100% of rated discharge time: voltage of battery, load current, voltage of each cell, ambient temperature, battery temperature, specific gravity of few random cells (lead acid only).

.7 At completion of discharge test, recharge battery at maximum specified rate, and record at 10 min intervals: battery voltage, charging current.

.8 At start and finish of charging cycle record ambient and battery temperatures, and specific gravity of each cell (lead acid only).

.9 Submit copy of test results to Departmental Representative.

Part 3 Execution

3.1 INSTALLATION

.1 Locate and erect battery rack.

.2 Install battery cells on rack.

.3 Batteries shall not exceed manufacturer’s recommended storage duration prior to installation.

.4 Provide adequate seismic restraints for rack and batteries.

.5 Clean posts and connectors and apply no-oxide grease.

.6 Install inter-cell and inter-tier connectors, and hand tighten nuts in accordance with manufacturer's instructions.

.7 Using torque wrenches, tighten nuts in accordance with manufacturer's recommended value.

.8 Connect battery to load circuit.

.9 Install and connect panelboard and DC branch circuits.

3.2 FIELD QUALITY CONTROL

.1 Check battery voltage of each cell in accordance with manufacturer's instructions.

.2 Float charge battery for 12 hours to ensure battery fully charged and in stable condition.

.3 Discharge battery at rated load as recommended by manufacturer.

.4 Check battery voltage at terminals and voltage of each cell.

.5 Recharge battery to full charge.

.6 Check battery voltage and voltage of each cell.

.7 Leave battery in fully charged state.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 Common Work Results - Electrical

.2 Section 26 05 30 Seismic Restraints

.3 Section 26 33 16 Battery Racks

.4 Section 26 29 23.02 Power System SCADA

1.2 REFERENCES

.1 CSA International

.1 CAN/CSA C22.2 No.107.2-01R2011, Battery Chargers.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for battery chargers and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Charger data: type and capacity, battery charging sequence, current-time data for Silicon Controlled Rectifier (SCR) protective devices, estimated noise level, metering, alarms, controls and efficiency.

.3 Shop drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of BC, Canada.

.2 Include outline schematic diagrams with dimensions showing arrangement of cubicle, components, meters and controls

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for battery chargers for incorporation into O&M manuals specified in.

.3 Operation and maintenance instructions covering design elements, construction features, component functions and maintenance requirements to permit effective operation, maintenance and repair.

.4 Copy of approved shop drawings.

.5 Technical description of components.

.6 Parts lists with catalogue numbers and names and addresses of suppliers.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect battery chargers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

.1 Automatically maintain battery in fully charged state while normal power is available. Maintain DC float voltage within plus or minus 1% of setting.

.2 Float charging rate such that after battery has provided full power output for specified duration, charger returns battery to 95% of fully charged state in 4 hours.

.3 Manually initiated equalize charging feature with automatic timer adjustable from 0 to 24 hours, to return unit to float charge.

.4 Manual adjustment of float charge voltage with range plus or minus 5%.

.5 Manual adjustment of equalizing charge voltage.

.6 Automatic current limiting adjustable between 80 and 120% of normal rating.

.7 Audible noise level not to exceed 65 dBA at 1.5 m.

2.2 CHARGER CHARACTERISTICS

.1 Battery charger: to CAN/CSA C22.2 No.107.2.

.2 Input: 120-240V, 1 phase, 2 or 3 wire, 60Hz.

.3 Output: 30 A, DC at 13.8 V, DC, ripple voltage less than 2 %.

2.3 ACCESSORIES

.1 DC voltmeter: switchboard type, accuracy plus or minus 2 % of full scale, to measure rectifier output voltage.

.2 DC ammeter: switchboard type, accuracy plus or minus 2 % of full scale, to measure rectifier output current.

.3 Relay and alarm for AC power failure with time delay to prevent alarm during short power outages.

.4 Low DC voltage alarm to indicate over discharge and 2 hours emergency time available.

.5 High DC voltage alarm and high DC voltage automatic shutdown.

.6 Ground detector relay and alarm.

.7 Equalizing timer: automatic reset type for unattended stations, 28 day period.

.8 Filter to reduce ripple voltage in rectifier output from 2% to 30 mV.

.9 LEDs mounted on front to indicate: failure AC power low DC voltage high DC voltage and no rectifier output. Steel for battery racks: to CAN/CSA-G40.20.

.10 Alarms: audible alarm when any LED indicates trouble. Silence pushbutton is not to extinguish trouble light.

.11 Common LED test switch and one common Form C alarm contact.

.12 Cables and clips

.13 Temperature compensation system for voltage output, including remote, battery mounted, temperature sensor.

.14 Ethernet based remote monitoring systems providing all information in a native protocol compatible with Power System SCADA. Information to be provided for trending, alarming and real-time display to include: Volts DC, Amps DC, Temperature, Voltage Fault (high/low) and charger fault.

2.4 ENCLOSURE

.1 Dead front Free standing sheet steel, 2.5 mm thick minimum CSA Enclosure Type 1.

.2 Access from front.

.3 Convection ventilated.

.4 Meters, indicating lamps and controls group mounted on front panel.

.5 Allow for handling by forklift or sling.

.6 Apply finish in accordance with Section 26 05 00 - Common Work Results- Electrical.

2.5 EQUIPMENT IDENTIFICATION

.1 Identify equipment in accordance with Section 26 05 00 - Common Work Results- Electrical.

.2 Use size 5 nameplates for major components such as input breakers, output breaker.

.3 Use size 3 nameplates for mode lights alarms, meters.

2.6 SYSTEM REQUIREMENTS

.1 Capacity:

.1 8 Hours

.2 System to have sufficient reserve capacity at the end of the 8 hour period to provide the capability of accommodating the simultaneous tripping of all breakers.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for battery charger installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Locate and install battery charger as indicated.

.2 Connect input terminals to AC mains.

.3 Connect output terminals to battery.

.4 Provide adequate seismic restraints for free standing enclosure.

.5 Connect to SCADA Ethernet network.

3.3 TESTS

.1 Energize battery charger and operate until battery shows full charge.

.2 Discharge battery to full discharge condition.

.3 Recharge battery, recording DC voltage and current once per hour for 8 hours. Test battery to ensure it has reached at least 95% full charge.

.4 Continue charging to ensure charger changes from bulk rate to float charge rate.

.5 Demonstrate that automatic timer controls charging and correctly transfers from equalize to float charge after selected period.

.6 Simulate faults to demonstrate that alarm lights and audible alarms are performing as designed.

.7 At end of tests, with battery in fully charged condition, operate charger on "float" for minimum period of 24 hours to ensure stable condition is reached and held.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by battery installation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This specification describes the operation and functionality of a continuous

.2 duty, single-phase, solid-state, static Uninterruptible Power Supply (UPS) hereafter referred to as the UPS.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI S1.13-1995 (R1999) Measurement of Sound Pressure Levels in Air.

.2 ANSI S1.4-1983 (R2001) with Amd. S1.4A-1995, Specification for Sound Level Meters.

.2 Canadian Standards Association (CSA International)

.1 CSA C813.1-01, Performance Test Method for Uninterruptible Power Supplies.

.3 International Organization for Standardization (ISO):

.1 ISO 9001, "Quality Management Systems - Requirements."

.2 ISO 14001, “Environmental Management Systems - Requirements with Guidance for Use.”

.4 Institute of Electrical and Electronics Engineers, Inc. (IEEE):

.1 ANSI/IEEE 519, "Guide for Harmonic Control and Reactive Compensation of Static Power Converters" (copyrighted by IEEE, ANSI-approved).

1.3 SYSTEM DESCRIPTION

.1 Included Features of the UPS:

.1 The UPS utilizes double conversion online topology.

.2 The UPS features internal bypass and input power factor correction.

.3 The primary sections of the UPS are: input disconnect and filter stage, input PFC power stage, energy storage stage (DC bus capacitor bank), output power stage (inverter), bypass and a battery charger. The control of power module and fault detection logic is microcontroller-based.

.1 The input disconnect and filter stage contains an input back-feed relay (in models with an input wire plug), input filter, transient suppression, and battery select switches (mechanical relay or solid-state).

.2 The input PFC power stage contains non-isolated power factor correcting AC/DC converters. This converter is capable of full power operation over a very wide input voltage range or from a nominal DC battery voltage.

.3 The energy storage stage is a split DC bus capacitor handling seamless transitions from battery to line and vice versa, as well as the low and high frequency power stages ripple.

.4 The output power (inverter) stage operates directly from the DC bus and produces a configurable AC output voltage of 120 V/208 V output. The output of the UPS is connected either to the inverter or through a bypass relay, contactor, or static switch to the filtered input line.

.4 The UPS contains a battery charger, which operates from the DC bus.

.5 The system also includes the following features.

.1 Field-replaceable battery modules

.2 Removable input/output wiring trays

.3 Battery disconnects

.4 Emergency Power Off (EPO)

.5 An integrated UPS Network Management Card 2 with Environmental Monitoring (AP9631).

.2 **Performance, Design, and Configurations:** The UPS and associated equipment operates in conjunction with a primary power supply and an output distribution system to provide quality uninterrupted power for electronic equipment load.

.1 This specification describes the performance, functionality, and design of the UPS, the external Battery Systems, and connectivity solutions.

.2 All programming and miscellaneous components for a fully operational system as described in this section are available as part of the UPS.

1.4 SYSTEM DESCRIPTION

.1 Mechanical Design

.1 The UPS and battery cabinets are rack-mount configurations.

.2 The cabinet dimensions including terminations are listed below for tower, stack or rack-mount configurations. The side rack-mounting brackets increase the overall width to 482 mm.

.2 System Characteristics

.1 System Capacity:

.1 3 kVA or 3000 W 120/208V single phase output, whichever limit is reached first.

.2 **Efficiency:** The UPS efficiency stated here is at full load and without degradation of output regulation and shall meet or exceed 92%.

.3 Input:

.1 AC Input Nominal Voltage:

.1 120/208 VAC, split-phase, hardwired.

.2 AC Input Voltage Window:

.1 160 – 280 VAC (L1-L2) at full load.

.2 100 – 280 VAC (L1-L2) at 50% load.

.3 **Input Frequency Range:** 45-65 Hz, auto-selecting.

.4 **Input Power Factor:** >0.95 @ 100% load

.5 Input Current Distortion:

.1 Maximum 6% at 100% load at nominal voltage.

.4 UPS Output:

.1 AC Output Nominal Voltage:

.2 120/240(208) V single phase with step down transformer.

.3 Output Connectors:

.1 Hardwire: 3-wire (2Ph + G)

.4 AC output voltage distortion:

.1 Maximum 2% @ 100% linear load; Maximum 5% @ 100% non-linear load

.5 AC output static voltage regulation:

.6 +/-1%.

.7 AC output dynamic voltage regulation:

.1 +/-5%, for 10 to 90% load step at <50 ms recovery time:

.8 Output Voltage Harmonic Distortion:

.1 <2% THD maximum for a 100% linear load

.2 <5% THD maximum for a 100% non-linear load

.9 Overload Rating:

.1 Normal Operation (Online):

.1 150% for 30 seconds

.2 125% for 1 minute

.3 105% continuous

.2 **Bypass Operation:** Overload is limited by the external input circuit breaker feeding the UPS:

.1 A supplementary 30/32 A circuit breaker is fitted at the input.

.10 Output Power Factor Rating:

.1 0.5 lagging to 0.5 leading.

.11 Output Frequency:

.1 50/60 +/- 3Hz (Tracking) or 50/60 +/- 0.1 Hz (free-running) or 50/60 +/- 1 Hz (free-running), user-selectable.

.12 Crest Factor: 3:1

1.5 MODES OF OPERATION

.1 **Normal:** The UPS output power stage (inverter) constantly recreates the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT switches. In both online operation and battery operation, the output power stage (inverter) creates an output voltage waveform independent of the mains input voltage waveform. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages do not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave of the output power stage (inverter). The input Power Factor Correction (PFC) power stage and the output power stage (inverter) operate in an on-line manner to continuously regulate power to the critical load. The input PFC stage is capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.

.1 **Overload Capability:** The output power stage (inverter) is capable of withstanding 150% overload for 30 seconds or 125% overload for 1 minute or 105% overload for an indefinite length of time.

.2 **Output Contactor:** The output power stage (inverter) is equipped with an output mechanical relay to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter will be removed from the critical bus.

.3 **Battery Protection:** The inverter is provided with monitoring and control circuits to limit the level of discharge on the battery system.

.2 **Battery:** Upon failure of the AC input source, the critical load continues being supplied by the output inverter, which derives its power from the battery system. There is no interruption in power to the critical load during both transfers to battery operation and retransfers from battery to normal operation. The UPS battery system consists of user-replaceable, hot-swappable cartridges.

.1 A minimum of two battery cartridges must be installed, providing 192 VDC nominal for the DC bus rail.

.2 The batteries of the UPS models in this specification are maintenance-free, leak-proof, valve-regulated lead-acid (VRLA) batteries with suspended electrolyte.

.3 The UPS shall incorporate a battery monitor system to continuously monitor the health of each removable battery module as well as external battery modules installed in extended run battery cabinets. This system shall notify the user in the event that a failed or weak battery module is found.

.4 UPS shall be expandable for additional runtime with additional battery packs. These packs and the modules within them are hot-pluggable, allowing for easy and quick installation or replacement without the need for electrical wiring, electrician services or powering down of the UPS.

.5 Each UPS Battery Module has a means of DC disconnect for transportation and to disconnect the battery module completely from the internal bus while the battery is installed in the UPS system.

.3 **Charging:** Upon restoration of the AC input source, the UPS simultaneously recharges the battery and provides regulated power to the critical load.

.1 The intelligent battery management system contains a temperature monitoring circuit and compensation algorithm that regulates the battery charging voltage and current so as to optimize battery life. The UPS shall monitor the temperature of all battery packs and use the highest one as a reference to adjust the battery float voltage.

.2 The battery charging circuit remains active when in bypass or online states.

.4 **Bypass:** During bypass operation the utility power is connected to the load, bypassing the internal converters. The system automatic bypass provides a transfer of the critical load from the Inverter output to the automatic bypass input source during times when the inverter cannot support the load. The UPS constantly monitors the output current, as well as the bypass source voltage, and inhibits potentially unsuccessful transfers to automatic bypass from taking place. The design of the automatic bypass switch power path consists of a heavy-duty electromechanical bypass relay or contactor.

.1 **Automatic Transfers:** An automatic transfer of load to bypass takes place if the load on the critical bus exceeds the overload rating of the UPS, if both normal and battery operation modes are unavailable, if the UPS has an internal fault, or if for any reason the UPS cannot support the critical bus . Automatic transfers of the critical load from bypass back to normal operation takes place when the overload condition is removed from the critical bus output of the system or when other causes are corrected. If the bypass mode becomes unavailable the UPS will automatically switch to mains power. In the event that mains power is unavailable the system will switch to battery power.

.2 **Manual Transfers:** Manually initiated transfers to and from bypass may be initiated through the UPS computer interface (via serial or USB communications) or by engaging the bypass switch on the rear panel of the unit.

1.6 INPUT PFC POWER STAGE

.1 **General:** The input Power Factor Correction (PFC) power stage of the UPS constantly rectifies the power imported from the mains input of the system, converting input mains AC power to DC power for precise regulation of the DC bus voltage, battery charging, and output power stage (inverter) regulated output power

.2 **Input Current Total Harmonic Distortion:** The input current THD_I at full system load will be held to the following percentages while providing conditioned power to the critical load bus, and charging the batteries under steady-state operating conditions. This is true while supporting loads of both a linear or nonlinear type. This will be accomplished with no additional filters, magnetic devices, or other components.

.1 Input THD current shall be 6% or less

.3 Input Current Limit:

.1 The input converter shall control and limit the input current drawn from the utility supply to150% of the UPS output.

.2 During conditions where input current limit is active, the UPS shall be able to support 100% load, charge batteries at 10% of the UPS output rating, and provide voltage regulation with mains deviation of up to +/-20% of the nominal input voltage.

.3 In cases where the source voltage to the UPS is nominal and the applied UPS load is equal to or less than 100% of UPS capacity, input current shall not exceed 130% of UPS output current, while providing full battery recharge power and importing necessary power for system losses.

.4 Charging:

.1 The battery charging circuit contains a temperature monitoring circuit, which regulates the battery charging current to optimize battery life.

.2 The battery charging circuit remains active when the UPS is in automatic bypass and in normal operation.

.3 The battery charging system adjusts the charging current according to the number of battery modules and by monitoring the individual battery current.

1.7 OUTPUT POWER STAGE (INVERTER)

.1 **General:** The UPS output power stage (inverter) constantly recreates the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT-driven power converters. In both normal operation and battery operation, the output power stage (inverter) creates an output voltage independent of the mains input voltage. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages, shall not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave of the output power stage (inverter).

.2 **Overload Capability:** The output power stage (inverter) is capable of withstanding 150% overload for 30 seconds or 125% overload for 1 minute or 105% overload for indefinite length of time.

.3 **Output Contactor:** The output power stage (inverter) is equipped with an output mechanical contactor to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter will be removed from the critical bus.

.4 **Battery Protection:** The inverter is provided with monitoring and control circuits to limit the level of discharge on the battery system.

1.8 DISPLAY AND CONTROLS

.1 Control Logic: The UPS is controlled by an embedded microcontroller which performs the following functions:

.1 Monitoring the quality of the output voltage
.2 Monitoring vital parameters of the UPS
.3 Executing the state machine
.4 Intelligent battery management
.5 Controlling the input and output power stage
.6 Remaining runtime calculation
.7 Self-diagnostics, self-test, and proactive fault detection
.8 Communication to the host server via a serial port
.9 Communication to the Network Management Card or another SmartSlot accessory card, if the UPS is equipped with such a card

.2 **Display/Control Unit**: Located on the front of the UPS is a display/control unit.

.1 **Control Functions for All Models:** The following controls functions can be accomplished by use of the pushbutton switches or LCD display:

.1 Turn the UPS on
.2 Turn the UPS off
.3 Initiate a self-test to test the battery condition
.4 Silence an audible alarm
.5 Cold-start the UPS
.6 Display the input RMS voltage

.3 **Display Data:** The following indicators are available on the Display/Control Unit:

.1 The UPS load LED bar
.2 The UPS is online
.3 The UPS is on battery
.4 The UPS is in bypass
.5 The UPS is overloaded
.6 The UPS is in fault state
.7 The battery needs to be replaced
.8 The battery capacity/utility voltage LED bar

.4 **Communication Interface:** The following are contained within the UPS for remote communications with a network via web browser or SNMP.

.1 An RJ-45 serial interface port.
.2 A pre-installed Network Management Card 2 with Environmental Monitoring (AP9631).

.5 **Bypass switch:** On the rear panel of the UPS there shall be a switch that when engaged forces the UPS into bypass state provided the input voltage and frequency are within acceptable limits.

.6 **EPO switch:** UPS shall be equipped with an Emergency Power Off (EPO) terminal that can be wired so as to provide the means to instantaneously de-energize the UPS and its load from a remote location in case of emergency.

.7 **Audible Alarms:** Using audio signal, the UPS will notify the user about important events. The following is the list of distinct audio alarms:

.1 The UPS is on battery

.2 The UPS is on battery and the remaining battery capacity is low

.3 The UPS has shut down due to low battery capacity

.4 The battery needs to be replaced

.5 The UPS is overloaded

.6 The UPS is in fault state

.8 **Potential Free (Dry) Contacts:** The following dry alarm contacts shall be available on the UPS:

.1 The UPS is on battery

.2 The UPS is on battery and the remaining battery capacity is low

.3 The UPS is off

.4 The battery needs to be replaced

.5 The UPS is in bypass

.6 The UPS is overloaded;

.7 The UPS is in fault state.

1.9 BATTERY

.1 The UPS battery is of modular construction made up of owner-replaceable, hot-swappable, fused, battery modules. Each battery module is monitored to determine the highest battery unit temperature for use by the UPS battery diagnostic, and temperature compensated charger circuitry.

.2 The batteries are of the valve regulated lead acid (VRLA) type.

Part 2 ACCESSORIES

.1 Software and Connectivity:

.1 **Network Management Card:** The Network Management Card allows one or more network management systems (NMSs) to monitor and manage the UPS in TCP/IP network environments, are equipped with a Network Management Card with Environmental Monitoring (AP9631) pre-installed.

.2 **Unattended Shutdown:** The UPS, in conjunction with a network interface card, is capable of gracefully shutting down one or more operating systems during the time when the UPS is on battery mode. The UPS is also capable of using an RS-232 port to communicate.

.2 **Remote UPS Monitoring:** The following methods of remote UPS monitoring shall be available:

.1 **Web Monitoring:** Remote monitoring is available via a web browser such as Internet Explorer.

.2 **Dry Contact Monitoring and Control:** The UPS must be equipped dry contact monitoring.

2.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Include:

.1 Outline sketch showing arrangement of meters, controls, recommended aisle spaces, battery rack, battery arrangement and dimensions.

.2 Shipping weight

.3 Schematic diagram showing interconnection of rectifier, inverter, battery, bypass switch, meters, controls and indicating lamps.

.4 Description of system operation, referenced to schematic diagram, for:

.1 Manual control during initial start-up and load transfer to bypass and back to inverter output;

.2 Inverter;

.5 System performance and reliability:

.1 Consider any deviation from the required output power waveform as failure in UPS and include estimate, with supporting calculations, of the Mean Time Between Failures (MTBF) expressed in hours.

.2 Provide estimate with supporting data for Mean Time to Repair factor (MTTR).

.6 Full load kVA output at unity power factor.

.7 Efficiency of system at 25%, 50%, 75% and 100% rated load.

.8 Type of ventilation: natural or forced.

.9 Battery:

.1 Number of cells;

.2 Maximum and minimum voltages;

.3 Type of battery;

.4 Type of plates;

.5 Catalogue data with cell trade name and type;

.6 Size and weight of each cell;

.7 Cell charge and discharge curves of voltage, current, time and capacity;

.8 Derating factor for specified temperature range;

.9 Nominal ampere hour capacity of each cell;

.10 Maximum short circuit current;

.11 Maximum charging current expected for fully discharged condition;

.12 Recommended low voltage limit for fully discharged condition;

.13 Expected life.

.10 Heat losses at no load, 25%, 50%, 75% and 100% of rated output, in kW.

.11 Cooling air required in m^3/s.

.12 List of recommended spare parts, tools and instruments with catalogue numbers and current prices.

.13 Typical operation and maintenance manual.

.14 Description of factory test facilities.

.15 Manufacturer's maintenance capabilities including:

.1 Willingness to undertake maintenance contract;

.2 Number of trained personnel available;

.3 Location of trained personnel and repair facilities.

2.3 QUALITY ASSURANCE

.1 Submit for approval to Departmental Representative, indicating and recording instruments calibration certificates, including meters installed as part of system, in accordance with Section 01 33 00 - Submittal Procedures.

2.4 CLOSEOUT SUBMITTALS

.1 Provide data for incorporation into operation and maintenance manual specified in Section 26 05 00 – Common Work Results - Electrical.

.2 Submit interim, draft final, and final Operation and Maintenance (OM) Manual. Final manual approved by Departmental Representative. Submit interim copies to Departmental Representative prior to notification of factory test date.

.3 Operation and Maintenance Manual to include:

.1 Operation and maintenance instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operations maintenance and repair.

.2 Technical data:

.1 Approved shop drawings;

.2 Characteristic curves for automatic circuit breakers and protective devices;

.3 Project data;

.4 Technical description of components;

.5 Parts lists with names and addresses of suppliers.

2.5 DELIVERY, STORAGE AND HANDLING

.1 Crating:

.1 Adequately enclosed and protected from weather and shipping damage by use of minimum 12 mm plywood with vapour barrier inside.

.2 For tractor train or sea shipment use double layer of vapour barrier and 19 mm plywood covering.

.3 Subassemblies may be packed separately.

.4 Label crates:

.1 Shipping address.

.2 Weight and dimensions

.3 Serial number of unit and brief description of contents.

.4 Stencilled with durable paint on at least two sides of each crate.

.5 List of contents:

.1 In weatherproof envelope stapled on outside of each crate;

.2 Copy placed inside each crate.

2.6 SYSTEM START-UP

.1 Provide for:

.1 For factory service engineer to supervise start-up of system, checking, adjusting and testing on site;

.2 For instruction of Departmental personnel on theory, construction, installation, operation and maintenance of system:

.1 After installation and during site testing;

.2 Advise on:

.1 Expected failure rate of equipment;

.2 Type of expected failures;

.3 Estimated time between major overhauls based on 20 year equipment life;

.4 Estimated cost of major overhaul based on current costs and excluding travelling expenses;

.5 Type and cost of test equipment needed for fault isolating and performing preventive maintenance.

Part 3 Products

3.1 UNINTERRUPTIBLE POWER SYSTEM

.1 Input power:

.1 120/208 V, single phase, 3 wire or 208V single phase, grounded neutral as applicable, 60 Hz.

.2 Normal supply from ac mains.

.3 Emergency supply from standby automatic diesel-electric unit.

.2 Output power:

.1 120/208 V, single phase, 3 wire, grounded neutral, 60 Hz.

.2 Full load output at 1.0, Unity power factor.

.3 Overload capability: 125% of rated full load current at 1.0 power factor and rated voltage for 10 min.

.4 Frequency - nominal 60 Hz:

.1 Adjustable from 58.5 to 61.5 Hz.

.2 Maximum variation from set value under load changes, including transients, not to exceed 0.3 Hz.

.3 Drift from set value - after two months normal operation within ambient temperature range of 0 degrees to 40 degrees C, not to exceed 0.6 Hz.

.5 Duration of full load output after mains failure not less than 15 min.

.6 Output voltage control:

.1 Continuously adjustable on load at least 5% from rated value.

.2 Voltage regulation: voltage not to change by more than 2% as load increases gradually from zero to 100%, or for specified duration of full load after mains failure.

.3 Transient voltage change not to exceed +/-10% of rated voltage upon 50% sudden load change, loss or return of ac input voltage to system when fully loaded or transfer of full load from inverter to bypass and vice versa, and return to normal within 3 Hz.

.4 Harmonics over entire load range:

.1 Total rms value not to exceed 3% rms value of total output voltage.

.2 Single harmonic not to exceed 1.9% of total output voltage.

.5 Proper angular phase relation maintained within 2 electrical degrees at up to 80% load unbalance.

.7 Efficiency: Overall system efficiency at rated 100% load with battery fully charged not less than 95%. Overall system efficiency at rated 25% load with battery fully charged not less than 94%.

.8 Interference suppression:

.1 If UPS equipment generates electromagnetic rf interference at levels which adversely affects other equipment in vicinity, install suppression circuits or shielding as required to eliminate such interference.

.2 If harmonics reflected back to mains from rectifier adversely affect other loads connected to same bus, install suppression circuits to prevent that condition.

.3 Single Phase rack mounted UPS systems shall be 5kVA total output power each with battery extender modules to provide a full 60 minutes of runtime at full load. Input voltage shall be 208V single phase; output shall be 120/208V single phase, grounded neutral.

3.2 ELECTRICAL REQUIREMENTS

.1 In accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 No battery, other than main battery incorporated in design.

.3 Wires number tagged or colour coded with same designation on drawings. Tags: non deteriorating type.

.4 Variable resistors: fine adjustment, rheostat type.

.5 Indicator lamps: long life LED, rated for continuous duty, with sockets having adequate heat dissipation of lamps and dropping resistor if used.

.6 Solid state circuits used where more reliable than mechanical timers or control relays.

.7 Standard components available from commercial sources used throughout, with 10 years minimum shelf life.

.8 Arrangement to permit easy removal of defective components to facilitate servicing, by replacing with stock spares.

.9 Small components, related to specific function, removable plug-in modular sub- assembly or printed circuit card.

.10 Heavy sub-assemblies easily accessible, or slide on runners of anti-friction material, and have flexible leads and bolted connections.

.11 Components and sub-assemblies accurately made for interchangeability.

3.3 ENCLOSURE

.1 Dead front free rack mounting minimum 2.5 mm thick, CSA Enclosure 1.

.2 Service Access from **front** only.

.3 Meters, indicating lamps and controls group mounted in panel front.

.4 Panel front enclosed by hinged doors to prevent tampering and to protect instruments and controls during shipping. Doors formed wrap-around type, rigid, to open and close smoothly, locking type handle with 2 keys. Hinges to permit doors to be lifted off cubicle.

.5 Module sizes not to exceed number of rack units indicated in drawings for main module and battery modules.

.6 External cable connections at top or side of cubicle through bolted plate for drilling at site to suit.

.7 Ambient temperature range during operation -20 degrees C to +40 degrees C. Natural or forced ventilation as required. For forced ventilation power from inverter output and fan directly driven by motor mounted on vibration isolators. Each enclosure to have redundant fans, with fan failures alarmed. Air inlet and outlet openings protected with screens and metal guards.

.8 Disposable air filters on fan cooled enclosures. Method of attachment and opening locations to make removal convenient and safe.

.9 Maximum operating sound level not to exceed 73 dbA as measured on sound level meter with A weighting and slow response, at distance of 1 meter.

.10 Enclosure frames interconnected by ground bus with ground lug for connection to ground.

3.4 RECTIFIER

.1 Input power supply from:

.1 Ac mains;

.2 Automatic diesel engine driven generating unit.

.2 Input disconnect: bolt-on moulded case three pole air circuit breaker, quick make, quick break type for manual or automatic operation, temperature compensated for 40 degrees C ambient, magnetic instantaneous trip element.

.3 Input transformer: connected between ac input and rectifier input

.4 Surge suppressor: to protect equipment from supply voltage switching transients.

.5 Rectifier:

.1 Solid-state Pulse Width Modulation (PWM) rectifier utilizing Insulated Gate Bipolar Transister (IGBT)

.6 Filter: for rectifier dc output.

.7 Fuse: to protect dc output.

.8 Adjustments and controls:

.1 Line voltage adjusting taps to allow for +/-10% variation from nominal.

.2 Manual adjustment of float voltage with range of +/-5%.

.3 Manual adjustment of equalizing voltage.

.4 Automatic current limiting on rectifier adjustable between 80 and 120% of normal rating.

.5 Provision to disconnect rectifier from inverter and battery if rectifier dc output exceeds safe voltage limits of battery.

.9 Performance of rectifier:

.1 Automatically maintain battery in fully charged state while mains power available, and maintain dc float voltage within +/-1% of setting, no load to full load, during mains voltage variations up to +15% to -20%.

.2 Battery charging rate such that after battery has provided full load power output for specified duration, charger returns battery to 95% of fully charged state in 4 hours.

.3 Programmable Automatic equalize charging circuit to initiate equalize charging of battery.

.4 Manually initiated equalize charging feature with automatic timer adjustable from 0 to 24 hours to return unit to float charge.

3.5 INVERTER

.1 Input power supply from:

.1 Rectifier dc output;

.2 Battery dc output.

.2 Input disconnect: bolt-on moulded case, single pole, circuit breaker, quick make, quick break type, for manual or automatic operation, temperature compensated for 40 degrees C ambient, magnetic instantaneous trip element.

.3 Input filter: with separately fused computer grade capacitor banks and indicator lights, to eliminate inverter source noise and restrictions on input cable length.

.4 Power stage: High efficiency Solid-state Pulse Width Modulation (PWM) rectifier utilizing Insulated Gate Bipolar Transistor (IGBT). Components, solid state devices capable of satisfactory operation under ambient conditions of -20 degrees C to +40 degrees C.

.5 Output filter: output of high frequency switching stage contains elements of carrier frequency which are filtered to low harmonic sine wave.

.6 Output disconnect: bolt-on, moulded case, three pole circuit breaker or magnetic contactor, quick make, quick break type, for manual or automatic operation, temperature compensated for 40 degrees C ambient, magnetic instantaneous trip element.

3.6 BATTERY

.1 Battery to be sealed type.

.1 Discharge current to supply inverter at full load output, for 15 min.

.2 Battery modules and trays are replaceable without shutting down UPS or going into bypass.

3.7 STATIC BYPASS SWITCH

.1 Two solid state closed circuit automatic transfer switches.

.2 Logic unit with three normal source voltage sensors, which monitor overvoltage undervoltage and loss of voltage.

.3 High speed automatic transfer from normal voltage to alternate source when:

.1 Normal source voltage lost: transfer time and sensing 1/4 cycle;

.2 Normal source: undervoltage at 80% of nominal value; adjustable.

.3 Normal source: over voltage at 115% of nominal value.

.4 Loss of normal source static switch continuity.

.5 Short circuit on normal source trips normal source breaker.

.4 Return to normal source:

.1 When normal source remains within return voltage limits of 95% to 110% of nominal value (adjustable) for approximately 1 s timing interval, circuit checks voltage balance and phase synchronization, then initiates return with zero switching time.

.5 Switch position lights and contacts.

.6 Synchronizing verification light.

.7 Manual reset pushbutton.

.8 Transfer test switch.

.9 Alternate power source monitor light.

.10 Accessories:

.1 Manual bypass switch for maintenance and testing without load disturbance.

.2 Continuity monitor: automatic transfer to alternate source in event of static switch discontinuity.

.3 Alternate power source loss alarm contacts.

3.8 OPERATING DEVICES

.1 Operating accessories:

.1 Counter for number of failures of normal mains ac power: non-reset type, zero to 99,999 operations.

.2 Elapsed time meter indicating accumulated time of battery discharge in minutes non-reset type, zero to 99,999.9 minutes.

.3 Elapsed time meter indicating accumulated time of inverter operation in hours, non-reset type, zero to 99,999.9 hours.

.2 Mode lights mounted on front panel to indicate:

.1 Ac output on inverter - green;

.2 Ac input available - green;

.3 Inverter and ac input synchronized - green;

.4 Inverter and ac input not synchronized - amber;

.5 Static bypass switch in bypass position - red;

.6 Overtemperature alarms:

.1 Rectifier - red;

.2 Inverter - red;

.3 Bypass switch - red;

.7 Cooling fan fuse open - red;

.8 Inverter output over voltage - red;

.9 Inverter output under voltage - red;

.10 Battery over voltage - red;

.11 Battery under voltage - red;

.12 Inverter fuse/breaker open - red;

.13 Rectifier fuse/breaker open - red;

.14 Static bypass switch fuse/breaker open - red;

.15 UPS on battery operation - red;

.16 Rectifier in equalize mode - amber;

.17 Battery discharging indicator - red, to change from steady to flashing during final 5 to 10 min of battery duration.

.3 Alarms: audible alarm when any mode light shows red. Silence pushbutton not to extinguish trouble light.

3.9 FABRICATION

.1 Shop assemble:

.1 Rectifier unit;

.2 Inverter unit;

.3 Bypass switch unit;

.2 Interconnect units, and add remote mode lights, alarms and controls to produce complete uninterruptible power system before requesting Departmental Representative to witness factory tests.

3.10 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Cubicles:

.1 Inside finish: White or Beige;

.2 Exterior finish: manufacturers standard colour;

.3 Exterior hardware and trim: corrosion resistant and not requiring painting such as stainless steel or aluminum.

3.11 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 For major components such as ac input breaker, inverter breakers, bypass switch: size 5 nameplates.

.3 For mode lights, alarms, meters: size 3 nameplates.

3.12 SOURCE QUALITY CONTROL

.1 Complete system including rectifier, inverter, bypass switch, remote annunciator panel, controls and battery factory tested in presence of Departmental Representative.

.2 Notify Departmental Representative:

.1 One week in advance of date of factory test;

.2 That system has had preliminary testing and has met design requirements satisfactorily.

.3 Test procedures:

.4 Prepare blank forms and check sheet with spaces for recording data.

.5 Mark check sheet and record test data on forms in duplicate as test proceeds. Attach meter recordings.

.6 Provide Departmental Representative’s signature on form to indicate concurrence in results reported.

.7 Duplicate given to Departmental Representative at end of test.

.8 Information from original presented as part of O&M Manual.

.3 Test equipment:

.1 Instruments used during test, including indicating meters installed as part of system to have recent calibration certificate.

.2 Dummy load for testing, adjustable to 150% of system rated output at 0.8 power factor lagging. Load on each phase adjustable from zero to 100 % so that unbalanced output maybe tested for 3 phase systems.

.4 Tests:

.1 Visual inspection to determine:

.1 Materials, workmanship, and assembly conform with design requirements;

.2 Parts are new and free of defects;

.3 Battery and components are not damaged;

.4 Battery cells are of identical construction;

.5 Electrolyte in each cell is at manufacturer's recommended full level;

.6 Each battery cell polarity and polarity of connections to inverter are correct;

.7 Proper size fuses are installed;

.8 Metres have suitable range;

.9 Accessories are present;

.10 Portable metres for acceptance tests are suitable and instrument transformers connected correctly.

.2 Demonstrate:

.1 System start-up and shut down;

.2 Operation during mains power failure, recording output during failure and return of mains power, using oscilloscope and camera attachment. Repeat several times;

.3 Adjustable settings;

.4 Record values measured at test points using oscilloscope, digital multimetre, and camera attachment;

.5 Protective devices and indications function as designed. Record actual settings, and note operation of remote indications and transfer to bypass. Tests to include:

.1 Annunciator lights correct indication;

.2 Overcurrent on inverter output;

.3 Over voltage and under voltage of inverter output;

.4 Dc input voltage to inverter too low. Gradually reduce dc input voltage to inverter while delivering full load output and load to transfer automatically to bypass and inverter shut down. Record input and output values.

.5 Simulate over temperature by applying heat to sensor with hot air blower.

.6 Simulate fuse blowing to test indication response.

.7 Simulate fan failure.

.8 Bypass switch automatic operations. Record with camera/oscilloscope absence of load disturbance during automatic bypass switching.

.9 Over voltage of rectifier dc output.

.3 Harmonic test:

.1 With system fully loaded, one-half loaded, and at no load, determine total harmonic content with harmonic distortion meter at output terminals.

.2 Determine each harmonic magnitude with harmonic wave analyzer.

.3 Measure phase to neutral at 0.8 lagging power factor.

.4 Transients:

.1 With normal power input, apply full load to system.

.2 Remove one half load from each phase.

.3 Reapply one half load instantly.

.4 Record voltages and currents using oscilloscopes.

.5 Steady load:

.1 Switch system onto ac mains, start inverter and connect dummy 1.0, Unity power factor load.

.2 Operate system at full rated load for 24 hours and at 125% load for 10 min in ambient temperature of 40 degrees C.

.3 Record data at start of test and at half hour intervals thereafter; including:

.1 Input frequency;

.2 Input voltage;

.3 Input current;

.4 Input kW;

.5 Output voltage phase to phase, phase to neutral;

.6 Output current each phase;

.7 Output kW;

.8 Temperature of ventilating air-in;

.9 Temperature of ventilating air-out;

.10 Temperature at critical zones;

.6 Varying loads:

.1 Take one set of readings as above of no load, 25% load, 50% load, 75% load and 125% load.

.2 Calculate efficiencies of rectifier, inverter, and complete system.

.7 Unbalanced loads:

.1 Adjust loads on inverter to full load on two phases, 80% load on third phase.

.2 Adjust loads on inverter to zero load on two phases, 20% load on third phase.

.3 For both cases, record phase and line voltages and currents with phase angles to prove that phase relation remains unchanged with unbalanced loads.

.8 Battery:

.1 Charge battery to ensure cells fully charged. When voltage reaches steady value at end of charge, record:

.1 Ambient temperature;

.2 Voltage of battery;

.3 Charging current;

.2 Discharge battery by operating uninterruptible power system with ac mains open, at full rated output for duration quoted in design requirements. Record, at 5 min intervals:

.1 Voltage of battery;

.2 Current;

.3 Ambient temperature;

.4 Battery temperature;

.3 Recharge battery automatically by closing ac mains supply to system for 4 hours period, with dummy load connected. Record at 15 min intervals.

.1 Battery voltage;

.2 Charging current.

.4 Repeat discharge test and readings to prove battery was at least 95% recharged in 4 hours charge period.

.5 Recharge battery.

.9 Operating sound level:

.1 Measure sound level according to ANSI S1.13 using sound level meter with A weighting and slow response, conforming to ANSI S1.4.

.2 Operator to take reading by placing meter in front of him with microphone pointed at right angles to path of travel of generated sound, positioned at height of 1.5 m and distance of 1 m from equipment to be tested.

.3 Measure sound level during low ambient sound level.

Part 4 Execution

4.1 INSTALLATION

.1 Locate UPS cubicles modules and battery modules as indicated.

.2 Assemble and interconnect components to provide complete UPS as specified.

.3 Connect ac mains to main input terminal.

.4 Connect UPS output to load.

.5 Start-up UPS and make preliminary tests to ensure satisfactory performance.

4.2 TESTING

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical and CSA-C813.1.

.2 Provide:

.1 Competent field personnel to perform test, adjustments and instruction on UPS equipment.

.2 Dummy load adjustable to 150% of system rated output.

.3 Notify Departmental Representative 10 working days in advance of test date.

.4 Tests:

.1 Inspection of cubicles, battery rack and battery.

.2 Inspection of electrical connections.

.3 Inspection of installation of remote mode lights and alarms.

.4 Demonstration of system start-up and shut-down.

.5 Run UPS for minimum period of 4 hours at full rated load to demonstrate proper operation with ac mains input, emergency generator input, no ac input.

.6 Discharge battery by operating UPS with ac mains open for specified duration of full load. Record readings of temperature of each cell.

.7 Recharge battery automatically with full rated load on UPS for 4 hours and record readings of voltage of each cell.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 29 23.02 Power System SCADA.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Include schematic, wiring, interconnection diagrams.

.2 Include all proposed programming, modifications.

.3 Provide Riser Diagrams showing interface of all new and existing equipment as well as intermediate wiring, wiring devices, signal conditioners and measuring devices.

1.3 QUALITY ASSURANCE

.1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect control devices from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 HARMONIC FILTER BANK

.1 Existing Harmonic Filter Bank relocated from SSS shall be upgraded/modified as noted herein.

.2 Replace existing ESTAmat power factor controller with new, providing similar functionality, increased reliability, and improved operation.

2.2 POWER FACTOR CONTROLLER

.1 Replacement power factor controller shall take the place of the existing unit, wiring and control scheme. Modify existing wiring and mounting as required to suit new device.

.2 Controller shall be flush mounted in door of existing enclosure to provide full access to pushbuttons and display indicating operational parameters and status.

.3 Controller shall sense 480V transformer load side currents and voltage vectors and provide complementary correction for targeted power factor level or harmonic threshold.

.4 Current transformers shall be remote mounted at location noted in drawings. Voltage sensing shall be local to the unit, and modified from the existing to suit new requirements.

.5 Control power shall be derived from 125 VDC station service. If a differing voltage is required at the controller, appropriate power supplies shall be provided.

.6 Controller shall include the following features:

.1 Control of 12 steps of capacitance.

.2 Operation in all four vector quadrants.

.3 Digital alarm outputs

.4 Flush mount for operation of controls and viewing of status display.

.5 Ethernet connection for MODbus communications of realtime and status information.

.6 External temperate probe.

.7 Variable stepping scheme including: circular, linear, normal and optimal.

.7 Controller shall integrate closely with the Power System SCADA system via MODbus TCP on copper Ethernet. Provide graphical display screens indicating operational status, level of correction, status of correction steps and realtime power readings. Any faults driven by the controller shall be time stamped and logged for further review.

2.3 DIGITAL METERING

.1 Existing digital metering shall be replaced with new, with the type as noted in the drawings. Communications shall be via copper Ethernet and this replacement meter shall be fully integrated into the SCADA system.

.2 Existing meters is a PML 7700 with remote flush mounted display. Replacement meter shall utilize as similar flush mounted display at the current location.

.3 Connect all existing digital and analog inputs and outputs.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Disconnect, relocate and reconnect existing Harmonic Filter Bank from SSS to SSSR.

.2 Replace existing power factor controller with new.

.3 Replace existing digital meter with new.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Commission and verify correct operation of entire system, on and off line. Inject simulated voltage/currents to verify correct phase vector relationships and correct operation of power factor controller with varying levels of load power factor.

.3 Test all existing capacitors in the harmonic filter. Provide test results and recommendations to Departmental Representative for further action as required.

.4 Provide certified test results to Departmental Representative and Commissioning Agent.

.5 Coordinate all commissioning and demonstration operations with Departmental Representative.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 Common Work Results - Electrical.

1.2 REFERENCES

.1 CSA International

.1 CSA C22.2 No.5-09, Moulded-Case Circuit Breakers, Moulded--Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, NMX-J-266-ANCE-2010).

.2 CSA C22.2 No.178.1-2007, Automatic Transfer Switches.

.3 CAN/CSA C60044-1-07, Instrument Transformers.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 2-1996(R2009), Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC, Part 8: Disconnect Devices for Use in Industrial Control Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for transfer switches and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of BC, Canada.

.1 Indicate on drawings:

.1 Make, model and type.

.2 Load classification.

.3 Single line diagram showing controls and relays.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for transfer switches for incorporation into manual.

.3 Detailed instructions to permit effective operation, maintenance and repair.

.4 Technical data:

.1 Schematic diagram of components, controls and relays.

.2 Illustrated parts lists with parts catalogue numbers.

.3 Certified copy of factory test results.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.2 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect transfer switches from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Manual transfer equipment to:

.1 Allow for manual transfer of loads from normal to standby using hand operated or manually controlled device.

.2 Mechanical (key) and electrical interlocks shall prevent inappropriate operation of transfer switch.

.3 Auxiliary contacts in transfer switch shall provide feedback to SCADA on all positions of the switch, indicating power flow through the switch.

2.2 CIRCUIT BREAKER TYPE TRANSFER EQUIPMENT

.1 Circuit Breaker Type Transfer Equipment: to CSA C22.2 No.5.

.2 Rated: 600 V, 60Hz, 400 (or as noted) A, 3 wire, solid neutral.

.1 Fault withstand rating: 22kA symmetrical for 3 cycles.

.2 One normal-single 3 pole moulded-case circuit breaker mounted on common base, designed for double throw action, motor operated, mechanically held and interlocked, wall mounted in a CSA enclosure.

.3 One standby -single 3 pole moulded-case circuit breaker with trip, motor operated, and interlocked.

.4 Circuit breakers:

.1 Trip free in closed position.

.2 Interrupting rating: 22kA symmetrical.

.5 Dead front construction with access to relays and controls for inspection and maintenance, and manual operating lever for transfer switch.

.6 Auxiliary contacts: to initiate emergency generator start-up on failure of normal power; fault in control system; transfer switch in ‘normal’; transfer switch in ‘standby’

.7 Solid neutral bar, fully rated.

.3

2.3 EQUIPMENT IDENTIFICATION

.1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Control panel:

.1 For selector switch and manual switch: size 5 nameplates.

2.4 SOURCE QUALITY CONTROL

.1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested in presence of Departmental Representative

.2 Tests:

.1 Operate equipment both mechanically and electrically to ensure proper performance.

.2 Check:

.1 Operation of all remote monitoring contacts.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for transfer switches installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Locate, install and connect transfer equipment as indicated.

.2 Check solid state monitors and adjust as required to ensure correct operation.

.3 Install and connect remote alarms.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Energize transfer equipment from normal power supply.

.3 Manually transfer to standby power source.

.4 Confirm correct voltage/ phase rotation in both sources.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 Common Work Results - Electrical.

1.2 REFERENCES

.1 CSA International

.1 CSA C22.2 No.5-09, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, NMX-J-266-ANCE-2010).

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 2-1996 (R2009), Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC, Part 8: Disconnect Devices for Use in Industrial Control Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for transfer switches and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Make, model and type.

.2 Enclosure ratings and approvals

.3 Load classification.

.4 Single line diagram showing controls and connections.

.5 Description of equipment operation including:

.1 Interlocks

.2 Auxiliary contacts and status outputs

.3 Cable connectors and type

.4 Enclosure locking

.5 Lockout procedures

.6 Operating modes

.7 Mounting template.

1.4 QUALITY ASSURANCE

.1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for transfer switches for incorporation into manual.

.3 Detailed instructions to permit effective operation, maintenance and repair.

.4 Technical data:

.1 Schematic diagram of components, controls and relays.

.2 Illustrated parts lists with parts catalogue numbers.

.3 Certified copy of factory test results.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.2 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect transfer switches from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

.1 Entire assembly, including all internal wiring, receptacles, disconnects, breakers and enclosure shall bear a single mark of certification or inspection to CSA or equivalent certification, as accepted by the BC Safety Authority. Product must be assembled in an approved facility. Local special inspection will not be accepted.

2.2 ENCLOSURE

.1 Enclosure shall be constructed from fully welded Marine Grade aluminium (5000 series alloy), suitable for continuous exterior installation in marine environment,

.2 Doors will be arranged with hydraulic hold-opens holding doors at 180 degrees to closed position.

.3 Enclosure doors will have continuous gasketting made from neoprene rubber or similar providing a durable weather seal.

.4 Mounting tabs shall be provided such that all mounting hardware will not penetrate and/or compromise the weather resistant integrity of the enclosure.

2.3 RECEPTACLES

.1 Receptacles shall be sized and rated as noted in drawings and as noted herein. Terminations and connections shall be suitable for terminating using wire sizes as noted in drawings.

.1 120/208V temporary power outlet

.1 50 amps, 3 phase 4 wire with ground

.2 Male, pin and sleeve, reverse configuration, interlocked to prevent removal or connect under load

.3 NEMA 3R enclosure complete with interlocking disconnect

.4 Provide corresponding straight style female end.

.2 600V Temporary Power Connection

.1 400 total amps, 3 phase 4 wire with ground (parallel cabling, 8 connections and ground total)

.2 'Cam Lock' style single conductor DLO connectors, reverse pinning for ground and neutral positions. Connection arrangement suitable for feeding power into connection box from portable generator.

.3 NEMA 3R enclosure.

2.4 MATERIALS

.1 Instrument transformers: to CAN/CSA C60044-1.

.2 Contactors: to NEMA ICS2.

.3 Circuit Breakers: to CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures.

2.5 EQUIPMENT IDENTIFICATION

.1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Control panel:

.1 For selector switch and manual switch: size 5 nameplates.

Part 3 Execution

3.1 INSTALLATION

.1 Securely mount Temporary Power Connection Box to south exterior wall of Pumphouse as noted in drawings. Coordinate precise final location on site with Departmental Representative.

.2 Terminate all cabling and conduits into enclosure using weather proof connections suitable for location and wiring method.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 41 13 – Lightning Protection for Structures

.2 Section 26 05 00 Common Work Results - Electrical

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE C62.11-2012, Standard for Metal-Oxide Surge Arresters for AC Power Circuits.

.2 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.3 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for primary lighting arresters and include product characteristics, performance criteria, physical size, finish and limitations.

.4 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of BC, Canada.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for battery chargers for incorporation into O&M manuals specified in.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect battery chargers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Arrester component parts: to ANSI/IEEE-C62.11-2005.

.2 12.5kV Arrester characteristics:

.1 Distribution class arrester.

.2 System highest voltage line to line: 15 kV.

.3 MCOV (maximum continuous operating voltage): 15 kV.

.4 Indoor type. Radio influence voltage: maximum at 250 microVolts x MCOV.

.5 Housing: polymer.

.3 25kV Arrester characteristics:

.1 Distribution class arrester.

.2 System highest voltage line to line: 30 kV.

.3 MCOV (maximum continuous operating voltage): 30 kV.

.4 Indoor type. Radio influence voltage: maximum at 250 microVolts x MCOV.

.5 Housing: polymer.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for battery charger installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Connect line terminals to phase conductors in primary switchgear as indicated on drawings.

.2 Install 12.5kV arresters in switchgear as indicated.

.3 Provide 25kV arresters to PWGSC as spares for future replacement.

.4 25kV arresters shall fit in place of 12.5kV arresters.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 41 00.01 Primary Lightning Arresters

.2 Section 26 05 00 Common Work Results - Electrical

1.2 REFERENCES

.1 Institute of Electrical and Electronics Engineers, Inc. (IEEE)

.1 IEEE 837-2002, Standard for Qualifying Permanent Connections Used in Substation Grounding.

.2 CSA International

.1 CAN/CSA-B72-M87, Installation Code for Lightning Protection Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

.1 Submit design criteria, calculations and drawings stamped and signed by professional engineer registered or licensed in the Province of BC, Canada.

.2 Indicate materials and methods of attachment of conductors to air terminals and electrodes.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect battery chargers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Lightning Rods: solid copper or copper alloy

.2 Conductor: copper stranded, minimum #2 AWG gauge.

.3 Fastenings and attachment straps: Copper. Coordinate with Structural to ensure no metallic galvanic reaction if aluminum roof or siding is used where conductors are being fastened to.

.4 Ground electrodes: minimum 19 m x 3048 mm diameter copper or copper coated steel.

.5 Use aluminum conductors, terminals, connectors and fastenings for aluminum sheathed buildings and copper conductors, terminals, connectors and fastenings for buildings sheathed in other than aluminum.

.6 Connections: connections formed by thermit process and/or using IEEE 837 approved type compression connectors.

2.2 DESCRIPTION

.1 System to consist of metallic air terminals, lightning conductors connecting air terminals to ground and interconnected ground electrodes, and/or ground cables as indicated.

2.3 REGULATORY REQUIREMENTS

.1 System subject to: approval by authority having jurisdiction.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for battery charger installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Install lightning protection to CAN/CSA-B72.

.2 Bond discharge conductors to service mast or other non-current-carrying electrical parts.

.3 Lightning protection system to be tested to ensure resistance to ground of less than 50 ohms when measured at any point between the intercepting system and the ground system as per CAN/CSA-B72 requirement. Formal signed and certified test report shall be submitted to Departmental Representative.

.4 Submit certificate of installation to Departmental Representative.

3.3 INSPECTION

.1 Obtain inspection certificate from Departmental Representative for discharge conductor passing through any fire supporting membrane.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by lightning protection installation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies the materials and installation for luminaires for the entire project including exterior lighting fixtures.

.2 Refer to the Luminaire Schedule on the electrical drawings.

1.2 REFERENCES

.1 CAN/CSA C22.1-09, Canadian Electrical Code, Part I.

.2 CAN/CSA C22.2 No.9.0, General Requirements for Luminaires.

1.3 PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit complete photometric and heat dissipation data prepared by independent testing laboratory for proposed luminaires.

1.4 INTENT

.1 Provide lighting fixtures and accessories for all outlets as listed in the Luminaire Schedule and as shown on drawings.

.2 Lighting fixtures shall be structurally well designed and constructed, using new parts and materials of the highest commercial grade available.

.3 Ground all lighting equipment to grounding system.

.4 Verify all ceiling types and finishes before ordering fixtures and provide fixtures suitable for mounting in or on ceilings being installed in each area, as specified. Where fixture types specified are not suitable for ceiling being installed, obtain written instructions from the Departmental Representative before ordering fixtures.

.5 Fixtures of the same or similar type shall be supplied by the same manufacturer.

Part 2 Products

2.1 BALLASTS

.1 All ballasts shall be supplied with a rated voltage matching the supply voltage indicated on the drawings. Ballast output current and voltage shall match the current and voltage ratings of the lamp or lamps they are designed to operate. All ballasts to be built to CSA Standard C22.2 No.74.

.2 Ballasts shall comply with FCC and NEMA limits covering EMI and RFI and shall not interfere with operation of other normal electrical equipment.

.3 Minimum requirements for electronic ballasts:

.1 Sound rating of ‘A’.

.2 High frequency operation (25 KHz or higher).

.3 Total harmonic distortion to be less than 10%.

.4 Current crest factor to be less than 1.7.

.5 Rated lamp life shall be maintained.

.6 High power factor of 90% or higher.

.7 High efficiency ballasts for linear fluorescent lamps.

.8 Input voltage as indicated on drawings.

.9 Ballasts used in exterior luminaires to have minimum starting temperature of -18°C.

.4 Minimum requirements for electromagnetic ballasts:

.1 Pulse start type for metal halide.

.2 Current crest factor to be less than 1.7.

.3 Epoxy encased "super quiet" ballast assemblies for all interior fixtures ballast.

.4 Ballasts used in exterior luminaires to have minimum starting temperature of -30°C.

2.2 LAMPS

.1 Provide and install lamps in all fixtures in the project.

.2 Install fluorescent lamps with the same Watt rating as indicated. Refer to schedule for lamp colour and colour rendering index.

.3 High Pressure Sodium lamps to be coated. Metal Halide lamps to be coated unless otherwise noted.

.4 Compact fluorescent lamps shall be 3000K colour temperature or as indicated.

2.3 SOLID STATE LIGHTING

.1 Solid state lighting rated correlated colour temperature (CCT) shall be with four (4) MacAdam ellipses of the specified CCT in the luminaire schedule. Colour consistency between lamps in the same fixture type shall be within four (4) MacAdam ellipses of the rated CCT.

.2 Solid state lighting shall have a CRI greater or equal to the value listed in the luminaire schedule. In addition the lamps shall have an R9 value greater then 50 measured under the same conditions as the CRI.

.3 Solid state lighting systems (including required drivers) shall have a power factor greaten then 90 at full rated output.

.4 Solid state lighting lumen maintenance data shall be provided for L70 testing.

2.4 SOCKETS

.1 Sockets for incandescent fixtures shall be standard medium base.

.2 Sockets for fluorescent fixtures shall be standard medium bi-pin unless otherwise noted.

2.5 FIXTURES

.1 Accessories and components shall comply with relevant CSA Standards.

.2 Except where otherwise noted in the Luminaire Schedule, depth of recessed fluorescent fixtures shall not exceed 150 mm, including mounting yokes, or bridges. Design of reflector and lamp position shall be to provide high efficiency, even brightness and lack of lamp lines.

.3 All metal parts shall be thoroughly cleaned and finished in high reflectance baked enamel over corrosion-resistant primer. Finish as indicated in luminaire schedule.

.4 All internal fixture diffusers, lens panels, lens frames, etc., shall be securely and adequately supported and shall be removable without the use of tools for cleaning.

.5 Fixtures shall incorporate adequate gasketting, stops and barriers to form light traps and prevent light leaks.

.6 Fixtures shall be designed for adequate dissipation of ballast and lamp heat to avoid short ballast life, nuisance thermal tripping and decreased lamp output. Heat test reports by independent laboratories shall be provided where required by the Departmental Representative.

.7 Construction of all fixtures shall be such as to provide a rigid well aligned fixture. Formed or ribbed backplates, end plates, reinforcing channel, heavy gauge sockets, straps, etc., shall be used where required to accomplish this.

.8 The construction and performance of all fluorescent fixtures shall be subject to the acceptance of the Departmental Representative.

2.6 Luminaire Schedule

.1 **Type 'A'** - Chain/cable suspended linear fluorescent industrial luminaire, complete with wireguard and white reflector assembly. 1 x T5HO, 54 watt lamping per fixture. Tandem ballast arrangements for multiple fixture assemblies. Where single fixtures exist, provide 2 x T5 28 watt lamping. High efficiency, instant start, electronic ballast with less than 10% THD. Review fixture mounting elevation with architectural and electrical elevations. Coordinate with tray, duct work and switchgear.

.2 **Type 'LA'** - Small exterior wall mount fixture, complete with 22 watt LED source; 3500K color. Dark sky compliant, full cut-off. Natural aluminum in color. Overall dimension not to exceed 270mm high, 300mm wide, 250mm deep.

.3 **Type 'LB'** - Large exterior wall mount fixture, complete with 42 watt LED source; 3500K color. Dark sky compliant, full cut-off, flood light pattern. Natural aluminum in color. Overall dimension not to exceed 400mm high, 440mm wide, 270mm deep.

Part 3 Execution

3.1 INSTALLATION AND SUPPORTS

.1 Provide complete and proper support for all fixtures, fixture hangers, etc., including headers in ceiling space, where required, for proper support of outlet boxes and fixture hanger assemblies.

.2 Support fixtures as shown on the drawings, level, plumb and true with the structure and other equipment in a horizontal or vertical position as intended. Wall or side bracket mounted fixture housings shall be rigidly installed and adjusted to give a neat flush fit to the surface on which it is mounted.

.3 All hangers, supports, fastenings or accessory fittings shall be protected against corrosion. Care shall be taken during the installation to assure that insulation and corrosion protection is not damaged.

.4 The suspension length of all ceiling mounted suspended types of lighting fixtures as listed in the Fixture Schedule shall be the overall length from the ceiling to the lowest point of the fixture body, reflector or glassware in its hanging position.

.5 Metal inserts, expansion bolts or toggle bolts in concrete slabs for stems which do not carry wiring must be accurately located in relation to the outlet boxes, to allow perfect alignment and spacing of suspension stems.

.6 Where fixtures are surface mounted on the underside of an inverted tee bar ceiling, the fixture shall be supported either directly from the building structure by means of rod hangers and inserts or by means of metal angle headers, supported from the tee bar framing structure above the tile. Fixtures shall be supported from the quarter points.

.7 Wiring from outlet boxes to fluorescent fixtures and wiring through fluorescent fixture channels shall be rated for 90 degrees C.

.8 Install fixture lenses as late as possible to protect from dirt and dust. Remove and clean or replace lenses to the satisfaction of the Departmental Representative.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies materials and installation for emergency lighting systems.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.141-M1985(R1999), Unit Equipment for Emergency Lighting.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Data to indicate system components, mounting method, source of power and special attachments.

Part 2 Products

2.1 EQUIPMENT

.1 Emergency lighting equipment: to CSA C22.2 No.141.

.2 Supply voltage: 120VAC.

.3 Output voltage: 24 V dc.

.4 Operating time: **120** min.

.5 Battery: sealed, maintenance free.

.6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% input variations.

.7 Solid state transfer circuit.

.8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

.9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.

.10 Lamp heads: integral on unit remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED 5 W.

.11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.

.12 Finish: white.

.13 Auxiliary equipment:

.1 Test switch.

.2 Battery disconnect device.

.3 AC input and DC output terminal blocks inside cabinet.

.4 Bracket.

.5 Hardwire connection for AC.

.6 RFI suppressors.

Part 3 Execution

3.1 INSTALLATION

.1 Install unit equipment.

.2 Direct heads.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies materials and installation for exit signs complete with directional arrows.

1.2 PRODUCT DATA

.1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data: submit manufacturer's product data sheets indicating dimensions, materials, and finishes, including classifications and certifications.

Part 2 Products

2.1 EXIT SIGN TYPES

.1 All exit signs shall comply with CAN/CSA C860 (latest edition), CSA 22.2 #141 and National Building Code, 2010.

.2 Exit signs shall be complete with 10 year warranty.

.3 Exit signs shall have a complaint green “Running Man” pictogram complete with directional arrows as noted on drawings.

2.2 MOUNTING TYPE

.1 Exit signs to be suitable for universal mounting. Allow for exit signs to be mounted as to best suit ceiling/wall type and architectural features:

- .1 Surface wall mounted
- .2 End wall mounted double face
- .3 Ceiling mounted single face
- .4 Ceiling mounted double face

.2 Exit signs to have direction arrows where indicated.

Part 3 Execution

3.1 INSTALLATION

.1 Install exit signs as shown on plans complete with double face units where indicated.

.2 Connect to dedicated circuit as indicated on the plans.

.3 Exit signs must be clear of all visual obstruction.

.4 Contractor to confirm locations before final installation.

3.2 LOCATION

.1 Review locations of exit signs with engineer and Departmental Representative to ensure effectiveness and compatibility with decor before rough in. Failure to do so may result in relocation at no extra charge to the project.

3.3 MOUNTING HEIGHT

.1 Wall mounted signs shall be clear above doors and, if space allows, 2.4 metres to centre, but with 25mm clearance of ceiling.

.2 Ceiling mounted signs shall be mounted directly on ceiling, unless it is obstructed from view. Stem mount using two fixture rods (9.5mm white smooth type).

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies the materials and installation for communication cables inside buildings including shielded and unshielded twisted pair (STP and UTP) copper cables as well as supporting infrastructure.

1.2 SCOPE

.1 Supply and installation of a data/communication cabling system, complete with complete with provision of cables, connectors, and patch panels as indicated on the drawings and as required for a complete and fully functioning system.

.2 Fibre Optic System to be in accordance with Section 27 05 15.

.3 Communication Room fit-out including racks, cable management, grounding and copper/fiber cable termination.

.4 The complete data/communications system installation is to be in accordance with EIA/TIA-568 Standards.

.5 All cables made redundant by new installation or as noted in drawings for demolition, are to be removed. All existing abandoned cables are also to be removed back to the source.

1.3 REFERENCES

.1 Canadian Standards Association, (CSA International)

.1 CSA-T529-latest edition, Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/EIA TIA 568a with modifications).

.2 CSA-C22.2 No. 214-latest edition, Communications Cables (Bi-national Standard, with UL 444).

.3 CAN/CSA-C22.2 No. 182.4-latest edition, Plugs, Receptacles, and Connectors for Communication Systems.

.2 Telecommunications Industry Association (TIA)

.1 TIA/EIA-568-latest edition, Commercial Building Telecommunications Cabling Standards Set.

1.4 SYSTEM DESCRIPTION

.1 Structured system of telecommunications cables (copper) installed within buildings for distributing voice and data, including video signals.

.2 Installed in physical star configuration with separate horizontal and backbone sub-systems. Horizontal cables link work areas to telecommunications closet located on same floor. Telecommunications rooms linked to central equipment room by backbone cables.

Part 2 Products

2.1 CABLE AND CONNECTORS

.1 Each UTP and STP cable shall meet the requirements of will consist of four unshielded twisted pairs of 24 AWG (0.5mm) 100-ohm nominal characteristic impedance, solid round annealed copper conductors insulated with flame retardant polymer.

.2 All cables will be certified/approved by CSA Standard PCC FT4 flammability test and UL CMR.

.3 UTP cables will meet or exceed the requirements in the proposed National Electrical Manufacturers Association (NEMA) Standard for Low-Loss Extended Frequency Premises Telecommunication Cable. The cable will meet the performance requirements of Category cable of the Underwriters Laboratories Inc. specifications and cable surface markings shall indicate this classification.

.4 STP and UTP cabling indicated for data communications shall be Cat 6 rated.

.5 UTP cabling indicated for telephone only shall be Cat 5e.

2.2 COMMUNICATION OUTLETS AND TERMINAL CONNECTIONS

.1 Data/communications outlets are to consist of 100 x 100 box c/w single gang plaster ring and flush mounted into walls unless indicated otherwise. Outlets to be complete with quantity of modular RJ45 jacks as indicated on plans.

.2 Cable runs will have 300mm length of cable left coiled up inside outlet box for termination of RJ45 jacks.

.3 All cables shall have all pares connected using the EIA.TIA standard pin configuration 568A. When combined, telephone jacks are to mount in the top position of outlets, and data jacks in the lower position.

2.3 COVERPLATES

.1 Coverplates are to be brushed stainless steel in accordance with Section 26 27 26 complete with provision for data/communication jacks as indicated on plans.

.2 Cover plates to have 2, 4 or 6 cutouts for jacks.

.3 Provide blank filler plugs for all unused ports.

.4 The wall plates shall be clearly and permanently marked with icon identification for both service types as well as with clear identification of cable/termination numbers.

2.4 PATCH PANELS AND PATCH CORDS

.1 Provide wall or rack mounted horizontal path panels as noted in drawings. Patch panels are to be loose loaded, but fully fitted out with all jacks for the full capacity of the panel. 48 port high density in 2 Rack units (RU).

.2 Provide cable management rings for wall mounted patch panels.

.3 Provide horizontal wire management for rack mounted patch panels (1U in height).

.4 Provide hinged wall mounted blades for wall mounted patch panels.

.5 Label patch panel ports, indicating room locations of all outlets.

.6 Cross-connect ports shall be labelled to correspond to work station address and riser cable number.

.7 Provide cable support bars for wall mounted patch panels.

.8 Based on the functionality, the patch panels will be clearly labeled

2.5 IDC MOUNTING BLOCKS

.1 Voice horizontal cables shall be terminated onto Category 5e “BIX: style mounting blocks complete with BIX distribution connectors in telecommunications room.

.2 Provide BIX mounting blocks complete with BIX distribution connectors for termination of telephone inter-building cable, each end, for cross-connect to telephone horizontal field equipment.

.3 Label BIX connectors, indicating room locations of all outlets.

.4 Label riser cables.

2.6 GROUND BAR

.1 Label bus bar connections.

.2 All patch panels, racks, and cable trays must be bonded to ground with #6 Cu. green insulated ground wire.

.3 Ground bar shall be a factory assembled unit complete with mounting feet, lugs and predrilled holes, not fabricated on site.

2.7 LABELLING

.1 Labels on wall plates and patch panels computer printed, black lettering on white tape. Labelling identification numbering to be as directed by Owner's representative.

.2 All raceways shall be clearly and permanently marked at both ends to indicate destination and function. The markings shall be clearly visible after construction is completed.

.3 All empty raceways shall be clearly and permanently marked at both ends to indicate destination and function. The markings shall be clearly visible after construction is completed.

.4 Each cable shall be clearly marked with a permanent sequential identifier at each end of the cable. All horizontal cable terminations will be labelled at patch panels and at data/comm. outlets. Label of wiring to be the same identifier as the label at the termination point.

2.8 PERFORMANCE REQUIREMENTS

.1 The complete end-to-end installation, including jacks, cables, patch panels, and patch cords shall meet the industry standard performance parameters for enhanced Category 6 as recommended by CAN/CSA-T529, latest revision. Test parameters shall include: Attenuation, Return Loss, NEXT, Power Sum NEXT, ELNEXT, Power Sum NEXT, ELFEXT, ACR, Power Sum ACR, Propagation Delay, and Delay Skew.

2.9 RACKING AND CABLE MANAGEMENT

.1 Provide 4 post, fully welded standard depth 19" nominal rack assemblies for termination of copper and fiber cabling and support of UPS equipment.

.2 Provide vertical and horizontal cable management on all racks. Management to be 150mm wide, 100mm deep with finger openings on back and sides to allow for cable distribution; hinged door with latching closures.

.3 Provide basket tray over top of all rack assemblies crossing from wall to wall. Basket tray to be 300mm wide and supported from ceiling, 450mm up from racks.

Part 3 Execution

3.1 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

.1 Communications raceway shall be minimum 20mm EMT conduit stubbed into accessible ceiling space. All cables shall be installed in conduit or cable tray and as indicated on the drawings.

.2 Wires and cable shall be as short as practical except that sufficient slack shall be provided to:

.3 Prevent undue stress on cable forms, wires, and connections.

.4 Enable network components to be removed and replaced during servicing without disconnecting other parts.

.5 Facilitate movement of equipment for maintenance purposes.

.6 Wires and cables shall be placed and protected to avoid contact with rough surfaces or sharp edges. Where wires or cables run through holes in metal, they shall be protected by suitable grommets or bushings.

.7 Clearance between cables and heat emitting or interference generating devices shall be such as to avoid deterioration of these wires and cables due to heat dissipation from these devices, and to comply with industry standards. In particular cables shall have a minimum separation of 150mm from unshielded power lines and 600mm from fluorescent lighting.

.8 The horizontal wiring shall be continuous with no splice points. Bridged taps are not permitted and there will be no cross-connects between the outlet and the patch panel.

.9 The maximum cable length for each run is 90 metres and will allow for 3 extra metres at the work station end and 7 extra metres for the patch cord/cross-connect end.

.10 Each cable shall be clearly marked with a permanent sequential identifier at each end of the cable. All horizontal cable terminations will be labelled at cross-connects and at telecommunications outlets. Labelling will include room number or patch panel as per labelling requirements reference.

.11 Horizontal conduit fill must comply with the Canadian Electrical Code requirements.

3.2 INSTALLATION OF BACKBONE CABLES

.1 Install wiring and devices as indicated on plans

.2 Provide 20mm G.1.S. painted plywood for equipment mounting.

.3 The cabling components installed in the structured cabling system shall be warranted for a minimum of 25 years from the date of installation against defects in materials and workmanship.

.4 Leave a pullstring in each data/communications outlet conduit.

.5 Provide bushings on all conduit ends.

3.3 RACKING AND CABLE MANAGEMENT

.1 Install racking securely to floor. Provide seismic sign off for fastening scheme.

.2 Install cable management on all racking. Horizontal management across all racks; vertical on all sides, single management where racking is side by side.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Test intra-building telephone cable for continuity.

.3 All data/communications cables shall be tested using testing equipment approved for Category 5e installations.

.4 Testing shall be conducted by authorized representative of cable and hardware manufacturer.

.5 Tests shall be performed from termination block to wall outlet jack on horizontal cables.

.6 Testing set-up shall be for a channel test, maximum length of 95m.

.7 Testing shall include verification of labelling integrity.

.8 Test results shall be documented and shall include the following information in addition to the cable parameters:

- .1 Cable ID
- .2 Transmit and Receive locations
- .3 Test Equipment used to complete the test
- .4 Contractor's name
- .5 Technician's name and signature
- .6 Date test was performed
- .7 Relevant additional comments

.9 The complete end-to-end installation, including jacks, cables and patch panels shall meet or exceed industry standard performance requirements for Category 6. Cable test parameters are to include: Attenuation, Return Loss, NEXT, Power Sum NEXT, ELFEXT, Power Sum ELFEXT, ACR, Power Sum ACR, Propagation Delay, and Delay Skew. Permanent Link Test is required.

.10 Provide verification of the pin outs to CSA T529, ISDN (T568A) configuration.

.11 Test results must include the Telecommunication Room number from which the cables terminate and indicate the following information:

- .1 Telecommunication Room
- .2 Room number of outlet box location
- .3 Communication jack number.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies materials and installation for fibre optic cable systems

1.2 SCOPE

.1 Installation of a complete fiber optic cabling system, complete with provision of cables, connectors, and patch panels as indicated on plans.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-T529-latest edition, Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/EIA TIA 568a with modifications).

.2 CAN/CSA-C22.2 No. 182.4-latest edition, Plugs, Receptacles, and Connectors for Communication Systems.

.2 Telecommunications Industry Association (TIA)

.1 TIA/EIA-568-latest edition, Commercial Building Telecommunications Cabling Standards Set.

1.4 DESCRIPTION OF SYSTEM

.1 Install a complete fiber optic data cabling system as defined on the drawings and in these specifications.

.2 The contract includes the supply and installation of cabling for a complete system, including but not limited to:

.1 Raceways and wireway systems as indicated on plans.

.2 Supply of fiber optic interconnect patch panels and components.

.3 Installation of connectors and terminations for all fibers.

.4 Testing of all fibers.

1.5 WARRANTY

.1 There shall be a minimum one year vendor warranty on all cables, components and equipment including installation. The one year warranty period begins upon substantial performance or when the system is fully functional, whichever is later.

1.6 PRODUCT DATA AND SHOP DRAWINGS

.1 Submit product data and shop drawings in accordance with Section 01 33 00 – Submittal Procedures. This includes any test results provided by the cable manufacturer, and cable test results as specified herein.

.2 Shop drawings to include dimensions and performance characteristics of equipment and cable routing diagrams.

1.7 MAINTENANCE AND OPERATIONAL DATA

.1 Provide maintenance data for all fiber optic cables and equipment for insertion into the project Operations and Maintenance Manual.

.2 Contractor shall supply the Departmental Representative with a complete, up-dated, and accurate set of “As-built” drawings at job completion. These drawings will form part of the project Operations and Maintenance Manual.

Part 2 Products

2.1 CONNECTORS

.1 All fiber connectivity components are to be included in contract.

.2 All fibers will be terminated using LC style epoxy connectors for multimode, and SC style 8º angle polished pigtails fusion spliced for single mode fibers.

2.2 FIBER OPTIC CABLES

.1 Fiber optic cables will be provided and installed by the electrical contractor.

.2 Fibre optic cables shall be:

.1 Singlemode: (strands as noted in drawings) 9µm/125µm indoor/outdoor distribution fibre.

.2 Multimode: (strands as noted in drawings) multimode 50µm/125µm indoor/outdoor distribution fibre.

.3 Provide WHMIS sheets for fiber cable supplied, showing characteristics of cable construction, etc.

2.3 PATCH PANELS

.1 All fibers will be terminated onto patch panels wall or rack mounted as noted.

.2 Electrical contractor is responsible for the supply of all required equipment and components including but not limited to the following:

.1 Cabinets and patch panels

.2 Splice trays

.3 Adapters, connectors, and pigtails

.4 Cable guides as part of an integrated cable management system

.5 Heat shrink sleeves

.3 Fiber splice panels shall be wall mounted.

.4 Fiber patch panels and splice trays shall be rack mounted.

Part 3 Execution

3.1 FIBER OPTIC CABLING – OTDR TESTING

.1 Test all fibers prior to and after installation to ensure fiber integrity.

.2 Arrange to obtain all required fiber optic cabling. This contractor is to terminate as necessary, and to perform optical time-domain reflectometer (OTDR) tests on cables intended for use on this project, prior to proceeding with, and after completion of installation, to ensure that the fiber optic cables are free from faults. Submit all test results to Departmental Representative.

.3 Transmission testing performance parameters:

Wavelength (nm)	Maximum Attenuation (dB/km)	Min. Information Transmission Capacity (MHz-km)
Multimode 850	3.2	1500
Multimode 1300	1.5	500
Single Mode 1310	1.0	N/A
Single Mode 1550	1.0	N/A

3.2 FIBER OPTIC CABLING – INSTALLATION

.1 Install all runs, terminations and patch panels in strict accordance with industry standards, grouped together by type and in sequence; top down and/or left to right.

.2 All fiber optic cables are to be installed in conduit or cable trays, for protection of cables.

.3 Do not apply excessive tension to the cable. Pulling tension shall be less than the cable manufacturer's recommendation.

.4 The cable shall be installed such that it will not be crushed or damaged during or after installation.

.5 Any damaged cable, or cable installed with excessive force will be replaced by the electrical contractor at no cost to the project.

.6 Do not exceed the minimum bend radius of 20 times cable outer diameter for installation, and 10 times cable outer diameter upon completion of the installation.

.7 Vertical run cables will be supported using intermediate tension relief as recommended by the manufacturer. Use a split wire mesh grip and install the cable from the top down. Vertical cables should be installed using a pulling grip to ensure the stress is placed on the cable itself and not the fiber.

.8 Cabling shall not be installed in 90º elbows or junction boxes unless the minimum bend radius requirements for the cable are met.

.9 If lubricant is used, ensure it meets the manufacturer's recommendations.

.10 Bushings and grommets shall be used on all metal ends, edges, and openings where cables pass through to ensure the cable is not damaged.

.11 Leave a minimum of 1.5m service loop each end of each cable at each point of termination.

.12 Cables will be continuous with no splice points.

.13 Label all individual cables.

.14 Install all fibre runs in separate conduits for other systems cables. Do not install fibre optic cables in conduits with copper cables.

.15 Terminate vertical cabling fibre at the top of each communications rack using LC terminations in a front serviceable fibre patch panel.

.16 Building entry fibre to terminate at the main communications rack using LC terminations in a front serviceable fibre patch panel.

3.3 INSTALLATION INSPECTION

.1 The completed installation will be inspected visually by the Departmental Representative prior to the commencement of functional and electrical performance testing. The installation will be inspected for compliance with the industry standards referenced above, and particular attention will be given to the following criteria:

- .1 Neatness, clamping and harnessing of cables and wiring.
- .2 Wire and cable management, identification, and labeling.
- .3 Overall system completeness.
- .4 Nameplates, identification plates and markings.
- .5 Construction and finishes.
- .6 System grounding
- .7 Mechanical installation including compliance with seismic restraint requirements.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies empty telecommunications raceway systems with either overhead, cabletrough or cellular distribution system.

1.2 SYSTEM DESCRIPTION

.1 Empty telecommunications raceways system consists of outlet boxes, cover plates, conduits, cabletrays, pull boxes, sleeves and caps, fish wires, concrete encased ducts.

Part 2 Products

2.1 MATERIAL

.1 Conduits: in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 Underground cable ducts: in accordance with Section 33 65 73 - Concrete Encased Ductbanks and Manholes.

.3 Cabletrays: in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.

.4 Junction boxes and cabinets: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

.5 Outlet boxes, conduit boxes, and fittings: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

.6 Fish wire: polypropylene type.

Part 3 Execution

3.1 INSTALLATION

.1 Install empty raceway system, including distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cabletroughs, service poles, miscellaneous and positioning material to constitute complete system.

.2 All conduits left as empty or space must be marked at each end with the termination location.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies the components for a complete card access control system, including door locking, control/release and answering to form a complete and operating door release system.

.2 Door release panel and controllers.

.3 Electronic locksets with integral reader, keypad and request-to-exit sensor.

.4 Pushbuttons.

.5 Power supplies.

.6 Electrical supervision circuits.

.7 Wiring.

.8 Card readers.

.9 Keypads.

.10 Accessory software upgrades and re-programming.

1.2 REFERENCE STANDARDS

.1 Underwriters' Laboratories (UL)

.1 UL 294, Standard for Safety for Access Control System Units.

.2 UL 1981-1994, Standard for Central-Station Automation Systems.

1.3 DEFINITIONS

.1 Electronic Access Control (EAC): The control of people through entrances and exits of a controlled area. An aspect of security that utilizes hardware systems and specialized procedures to control and monitor movements into, out of, or within a controlled area. Access to various areas may be a function of authorized level or time or a combination or both.

.2 DRS: Door Release System.

.3 PIN: Personal Identification Number.

1.4 DESIGN PERFORMANCE REQUIREMENTS

.1 Design access control and security access systems using only ULC/UL Listed products.

.2 Design security access system using company specializing in security access systems.

.3 Design security access system as a ULC/UL Certified Alarm System alarm system

.4 Central System: Design operation of electrical protection circuits and devices for signaled automatically to, recorded in, maintained and supervised from central station with arming and disarming supervised by central station.

.1 Remote monitoring:

.1 Monitoring location: Commissionaire Gatehouse.

.2 System with no investigator response.

.3 Primary signal transmission method.

.4 Standard line security employed.

.5 Monitor for fault or alarm.

.6 Identify fault location.

.7 Monitor all power.

.5 Design access control systems to meet safety requirements specified in accordance with UL 294.

.6 Design system to provide door manual and automatic control functions from locations indicated to central monitoring system.

.7 Each activation unit must have door panel control function/equipment item located as indicated.

.8 Door activation units

.1 Fully complement and function and match door manufacturer’s magnetic controls and hardware.

.2 Fully function with OEM supplied door controls and hardware to activate system in routine and emergency conditions.

.3 Fully function within supplied electrical supervision circuits as specified.

.9 Control Panel

.1 Fully compatible, compliment and operate door magnets provided by door manufacturer of system or OEM supplied door-operating hardware.

.2 Complete with card reader or electronic key pad to release and secure each door, as indicated.

.3 Permanently label (paper labels are not acceptable) or electronically identified each door location on panel or associated display unit

.4 Fully function within supplied electrical supervision circuits as specified.

1.5 SUBMITTALS

.1 Product Data: Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit manufacture's literature for each system component.

.3 Submit:

.1 Functional description of equipment.

.2 Technical data for all devices.

.3 Device location plans and cable lists.

.4 Devices mounting location detail drawings.

.5 Typical devices connection detail drawings.

.2 Shop Drawings: Submit in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit shop drawings to indicate project layout, including details as follows:

.1 Indicate mounting heights and locations.

.2 Zone layout drawing indicating number and location of zones and areas covered.

.3 Wiring diagrams.

.4 Complete equipment list.

.3 Quality Assurance Submittals: Submit the following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.1 Submit ULC/UL Product Safety Certificates.

.2 Submit verification Certificate that service company is ULC/UL List alarm service company.

.3 Submit verification Certificate that monitoring facility is ULC/UL "Listed central station".

.4 Submit verification Certificate that security access system is "Certified alarm system".

.3 Instructions: Submit manufacturer's installation instructions.

.4 Manufacturer's Field Services: Submit copies of manufacturer's field reports.

.4 Maintenance Data: Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.1 Include:

.1 System configuration and equipment physical layout.

.2 Functional description of equipment.

.3 Instructions of operation of equipment.

.4 Illustrations and diagrams to supplement procedures.

.5 Operation instructions provided by manufacturer.

.6 Cleaning instructions.

Part 2 Products

2.1 MATERIALS

.1 Door controls Items and panels

.1 Provide standard "off the shelf" equipment items to form a complete and operating DRS system.

.2 Provide as required: Equipment cabinets, equipment panels, AC power strips, power line conditioner, uninterrupted power supplies, system power supply, junction box, door control panels, door activation units, electronic supervising master panel, electronic supervising remote panels, system connectors, and system cables.

.2 Provide system cables including multi-conductor control cable, fibre optic, RS-485, and AC power cable required.

.3 Power supplies: to CAN/ULC-S318 or UL 603.

.4 Connectors and switches: to ORD-C634.

.5 Basic System Criteria

.1 Card Readers:

.1 Type: Weigand proximity.

.2 Quantity of card readers required: as indicated on plans.

.3 Proximity technology.

.4 Fitted with LED indicator light.

.5 Reading distance 50 - 200 mm.

.6 Compatible with access card model.

.7 PIN number access: 4 user codes.

.2 Keypads:

.1 Quantity of keypads required: as indicated on plans.

.2 Fitted with LED indicator light.

.3 Weatherproof where located outside.

.3 Combination Card Readers, Keypad, Request-To-Exit Locksets:

.1 Quantity of units required: as indicated on plans.

.2 Proximity technology.

.3 Fitted with LED indicator light.

.4 Reading range: 300mm.

.5 Compatible with existing access cards system.

.6 Open Architecture platform.

.7 Full electronic lockset with integral card reader and keypad on non-secure side and request-to-exit sensor on secure site. Lockset to have key cylinder matching keys at the Esquimalt Graving Doc site.

.8 Standard of Acceptance: Ingersoll-Rand Schlage AD-300 hard wired electronic lock Cat. # AD-300-CY-70-MTK-SPA-626-PD-C123-RH-10-O25-XX, where “XX” door thickness varies, Contractor to confirm door thickness in each location prior to ordering lockset.

.4 Electromagnetic Locks:

.1 Bayonet mount style.

.2 Hold force: 1500 lb.

.3 UL1034 and BHMA Grade 1 Certified.

.4 Integral door position switch.

.5 LED indication of magnetic bond.

.6 Automatic dual voltage 12/24 Volt DC.

.7 UL 1034, UL 10C and ANSI/BHMA156.3 Certified.

.8 Temperature range: 0° – 49°C.

.9 Standard of Acceptance: Ingersoll-Rand Schlage M49OP.

.5 Door Contacts:

.1 Recessed/concealed style.

.2 Suitable for door type being installed (steel).

.3 Three wire with supervision resistors in place.

.4 All wiring fully concealed.

.6 System Accessories:

.1 Request to Exit Motion Detector Device:

.1 Infrared detection.

.2 Continuous low voltage operation.

.3 Fitted with indicator light.

.4 Integrated with local audio alarm.

.5 Adjustable coverage.

.2 Power Supplies:

.1 Continuous low voltage operation output.

.2 Equipped with secondary protection for each output.

.3 Individual outputs for connection of devices.

.4 AC power failure output.

.5 DC power failure output and low battery output.

.6 Fitted with tamper contact.

.7 Wall mounted cabinet with locked door complete with 2 keys.

.7 Car Reader Interface:

.1 Card reader interfaces to be compatible with existing LENEL system on site.

.2 Communications: Wiregard Data1/Data0 or clock communication.

.3 Bidirectional RS-485 open supervised device protocol.

.4 Standard of Acceptance: LENEL LNL-1320 Series 2.

.8 System Software:

.1 Existing OnGuard access control system software. Re-program to accommodate new door control devices.

.9 Uninterrupted Power Supplies (UPS):

.1 Provide a UPS inside door card reader control panels to maintain system functionality during a power outage.

.2 UPS to be 350VA, 120 Volt input and output.

.3 Standard of Acceptance: APC BE600-BR.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and datasheet.

3.2 INSTALLATION: SECURITY ACCESS

.1 Install components in accordance with manufacturer's written installation instructions to locations, heights and surfaces shown on reviewed shop drawings.

.2 Install components secure to walls, ceilings or other substrates.

.3 Install required boxes in inconspicuous accessible locations.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Services:

.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.

.2 Manufacturer's Field Services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.4 VERIFICATION

.1 Perform verification inspections and test in the presence of Departmental Representative.

.1 Provide all necessary tools, ladders and equipment.

.2 Ensure appropriate subcontractors, manufacturer's representatives are present for verification.

.2 Pretesting Procedure

.1 Verify that System is fully operational and meets all System performance requirements of this specification.

.2 Measure and record, control carrier levels of every System channel at each of following points in the system:

.1 Door located actuating devices.

.2 Door control panel functions.

.3 Electronic supervisory control units inputs and outputs.

.4 Distribution system input and output.

.3 Provide and submit to Departmental Representative two copies of recorded system pre-test measurements, along with pre-test certification.

.3 Performance Testing

.1 Test Procedure: perform test on a "go-no-go" basis.

.1 Make only operator adjustments required to show proof of performance.

.2 Test to demonstrate and verify that installed System complies with installation and technical requirements of this specification under operating conditions.

.3 Test results to be evaluated by Departmental Representative as either acceptable or unacceptable using following procedures.

.2 Documentation Review

.1 This review will determine if information provided is sufficient to meet requirements of this specification.

.2 Provide for review all System manuals, as installed drawings, pre-test forms, equipment cabinet pictorials, video and audio equipment details.

.3 Mechanical Inspection

.1 Departmental Representative and Contractor to tour all areas to insure that all Systems and Subsystems are installed in place for proof of performance testing.

.2 Take system inventory at this time. Verify following items before beginning proof of performance tests:

.1 All electrical power circuits designated for system equipment are properly labelled, wired, phased, protected and grounded.

.2 Conductor ends are protected by heat shrink wrap; audio spade lugs, barrier strips and punch blocks are used.

.3 Dust, debris, solder splatter, etc. are cleaned and removed from site.

.4 All equipment is properly labelled.

.5 All equipment identified in System's equipment list[s] are in place and properly installed.

.6 Each system ground is installed in accordance with manufacturer's instructions and this specification.

.4 Subsystem Functional Test

.1 Conduct operational testing after review of documentation and mechanical inspection completed. Proceed as follows.

.1 Perform operational test of each Subsystem to verify that all equipment is properly connected, interfaced and is functionally operational to meet requirements of this specification.

.2 Control Units

.1 Take S/N readings from control unit's input and output in manual and/or automatic mode. Check output of DC/Data converter for S/N. Evaluate entire signal quality at baseband connector output of control unit and remote equipment.

.3 Distribution (or Interface) System

.1 Check each door utilizing a volt/ohm or signal level meter to confirm each function and to insure that System meets all performance requirements.

.2 Test each interconnection point (i.e: Door unit, junction box "cross connection", control unit, etc.) to ensure compliance with this specification.

.4 Total System Test

.1 Proceed with testing when System and Subsystems are functionally tested and accepted. Total System tests to verify that requirements have been met for DC and/or audio, sub carrier, and control signals in accordance with this specification.

.5 Safety

.1 Demonstrate with documentation that access control system meets safety requirements specified in UL 294.

.5 Visual Verification: Objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:

.1 Sturdiness of equipment fastening.

.2 Non-existence of installation related damages.

.3 Compliance of device locations with reviewed shop drawings.

.4 Compatibility of equipment installation with physical environment.

.5 Inclusion of all accessories.

.6 Device and cabling identification.

.7 Application and location of ULC approval decals.

.6 Technical Verification: Purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:

.1 Validate sensitivity of readers and applicability and application of cards.

.2 Connecting joints and equipment fastening.

.3 Compliance with manufacturer's specification, product literature and installation instructions.

.7 Operational Verification: Purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:

.1 Operation of each device individually and within its environment.

.2 Operation of each device in relation with programmable schedule and or/specific functions.

3.5 CLEANING

.1 Remove protective coverings from accessories and components.

.2 Adjust all components for correct function.

.3 Clean housings and system components, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.

.4 Clean all components free from dirt and fingerprints.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies video components configured as a system, which performs functions related to image acquisition, video display and recording images.

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1- latest edition, Canadian Electrical Code, Part 1 Safety Standard for Electrical Installations.

1.3 SCOPE OF WORK

.1 Supply and installation of an empty conduit system for support of video surveillance system.

.2 Supply and installation of CCTV, Ethernet based local cameras and monitoring software.

Part 2 Products

2.1 CONDUIT

.1 Conduits: to Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 Pullboxes at terminus of conduits shall be 103mm square flush mounted pullbox complete with blank coverplate.

.3 Provide blank covers for all junction boxes and future camera locations.

.4 All conduits are minimum 27mm (1") unless noted otherwise.

2.2 JUNCTION BOX

.1 Metal, sized to handle all system conduit interconnections with appropriate expansion.

2.3 CCTV CAMERA

.1 Ethernet based, POE (Power over Ethernet) powered digital video camera providing coverage of local spaces within the SSSR.

.2 Camera shall be wall mounted as noted in the drawings.

.3 Wall mount, fixed focus dome camera with 1080p video up to 60 fps; Electronic image stabilization; 3-9mm lens, F1.3 with horizontal viewing angle of 105-35 degrees. 0.18 Minimum lux;

.4 Ethernet connection via POE midspan injector.

.5 Standard software application allowing local viewing of video camera at SCADA workstation or hand-held device without central PC or server. Fully compatible with all camera Codecs.

Part 3 Execution

.1 Install conduits and pullboxes for rough-in in accordance with instructions in drawings.

.2 Install, test and focus CCTV camera to ensure an acceptable image as approved by Departmental Representative. Ensure correct and satisfactory operation on SCADA display terminal.

.3 All conduits shall be installed from indicated rough-in points to Communications Room complete with pullbox at field end of run. Conduits in Communications rooms shall be terminated with connecters and bushings.

.4 Provide labelling on all conduits.

.5 Install pullstrings in all conduits.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section specifies materials and installation for fire detection and fire alarm systems.

1.2 REFERENCES

.1 NBC-latest edition, National Building Code of Canada.

.2 Government of Canada

.1 TB OSH Chapter 3-03, latest edition, Treasury Board of Canada, Occupational Safety (Use as a Guideline) and Health, Chapter 3-03, Standard for Fire protection Electronic Data Processing Equipment.

.2 TB OSH Chapter 3-04, latest edition, Treasury Board of Canada, Occupational Safety (Use as a Guidleline) and Health, Chapter 3-04, Standard for Fire Alarm Systems.

.3 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S524-latest edition, Installation of Fire Alarm Systems.

.2 ULC-S525- latest edition, Audible Signal Appliances.

.3 CAN/ULC-S526- latest edition, Visual Signal Appliances, Fire Alarm.

.4 CAN/ULC-S527- latest edition, Control Units.

.5 CAN/ULC-S528- latest edition, Manual Pull Stations.

.6 CAN/ULC-S529- latest edition, Smoke Detectors.

.7 CAN/ULC-S530- latest edition, Heat Actuated Fire Detectors.

.8 CAN/ULC-S531- latest edition, Smoke Alarms.

.9 CAN/ULC-S536- latest edition, Inspection and Testing of Fire Alarm Systems. .10 CAN/ULC-S537- latest edition, Verification of Fire Alarm Systems.

1.3 DESCRIPTION OF SYSTEM

.1 Existing fire alarm system is Edwards EST3 with addressable zones and adequate capacity for the additional zones required.

.2 System shall be fully supervised, microprocessor-based, fire alarm system, utilizing digital techniques for data control and digital and multiplexing techniques for data transmission.

.3 System to carry out fire alarm and protection functions; including receiving alarm signals; initiating general alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signalling to fire department.

.4 The system shall be fully addressable, zoned, non-coded single stage.

.5 System to be modular in design to allow for future expansion.

.6 Operation of system shall not require personnel with special computer skills.

.7 Existing system includes:

.1 Central Control Unit in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signalling.

.2 Power supplies.

.3 Initiating/input circuits.

.4 Output circuits.
.5 Auxiliary circuits.
.6 Wiring.
.7 Manual and automatic initiating devices.
.8 Audible and visual signalling devices.
.9 End-of-line resistors.
.10 Local and Remote annunciators and displays.

1.4 SCOPE OF WORK

.1 Supply and install new fire alarm subpanel and associated wiring in SSSR. Provide all required zone isolators, modules, etc to connect to existing main fire alarm panel.
.2 Update existing graphic annunciator at main gate with revised site plan showing new zones, buildings and indicators. Appropriate drawings will be provided to the contractor for fabrication of this panel.
.3 Subpanel in SSSR shall have 6 spare zones to support future growth.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

.1 System:
.1 To TB OSH Chapter 3-04.
.2 Subject to approval by PWGSC.
.3 Subject to final acceptance by PWGSC.

1.6 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
.2 Include:
.1 Layout of equipment.
.2 Zoning.
.3 Complete wiring diagram, including schematics of modules.

1.7 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for Fire Alarm System for incorporation into manual.
.2 Include:
.1 Operation and maintenance instructions for complete fire alarm system to permit effective operation and maintenance.
.2 Technical data - illustrated parts lists with parts catalogue numbers.
.3 Copy of approved shop drawings.
.4 List of recommended spare parts for system.

1.8 EXTRA MATERIALS

.1 Include four (4) spare glass rods for manual pull box stations if applicable.
.2 Provide one spare device of each type used on site as part of this project.

1.9 MAINTENANCE

.1 Provide one year's free maintenance with two inspections by manufacturer during warranty period. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to Departmental Representative.

Part 2 Products

2.1 MATERIALS

.1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.

.2 In accordance with applicable CAN/ULC standards.

2.2 SYSTEM OPERATION

.1 Single stage operation. Operation of any alarm initiating device to:

.1 Cause audible signal devices to sound throughout building.

.2 Transmit signal to fire department via fire alarm transmitter.

.3 Cause zone of alarm device to be indicated on control panel and remote annunciator.

.4 Cause air conditioning and ventilating fans to shut down or to function so as to provide required control of smoke movement.

.5 Cause fire doors and smoke control doors if normally held open, to close automatically.

.2 Capability to program smoke detector status change confirmation on any or all zones in accordance with CAN/ULC-S527, Appendix C.

2.3 CONTROL PANEL

.1 Connect new zones to existing control panel.

2.4 BELL CIRCUIT POWER SUPPLY/BOOSTER

.1 120V, ac, 60Hz input, 24Vdc output from rectifier to operate alarm circuits, with standby power of gell cell batteries minimum expected life of 4 years, sized in accordance with BC Building Code.

2.5 MANUAL ALARM STATIONS

.1 Manual alarm stations: pull lever, glass rod, wall mounted surface type, non-coded single pole normally open contact for single stage English signage.

.2 Provide steel protective guards for pull stations installed where noted.

.3 Edwards – “SIGA-270“

2.6 AUTOMATIC ALARM INITIATING DEVICES

.1 Heat detectors, fixed temperature, non-restorable, rated 57°C. Edwards – “SIGA-HFS”

.2 Thermal detectors, addressable, Rate of Rise 8°C/min. Edwards – “SIGA-HRS”.

2.7 AUDIBLE SIGNAL DEVICES

.1 Signal chimes: heavy duty, single stroke, 24Vdc, with solid striking plunger and resonating chamber, 95dB.

.2 Bells: vibrating type, gongs of special alloy steel, 24Vdc, 150mm, 95dB.

.3 Horns: 95dB, weatherproof mounting, 24Vdc.

.4 Mini-horns: 95dB, surface mounting, red colour, 24Vdc.

.5 All audible devices must be programmed to a temporal pattern 3, as required by the BC Building Code.

2.8 END-OF-LINE DEVICES

.1 End-of-line devices to control supervisory current in alarm circuits and signalling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

2.9 REMOTE ANNUNCIATOR PANELS

.1 LED type with designation cards to indicate zone.

.2 LEDs to annunciate alarm and trouble.

.3 Wired in multiple with main control panel.

.4 Supervised, including trouble signal for open circuit.

.5 LED test button.

.6 Size and format to replace existing with updated and additional zones and layout.

2.10 GRAPHIC DISPLAY

.1 Update existing graphic display to support new zones added.

2.11 VISUAL ALARM SIGNAL DEVICES

.1 Strobe type: flashing red, 24Vdc.

.2 Designed for surface mounting on ceiling or walls as indicated.

2.12 ISOLATION MODULES

.1 Addressable zone isolation modules.

.2 Edwards – “SIGA-IM”

2.13 RELAY MODULES

.1 Addressable relay modules.

.2 Edwards – “SIGA-CR”

2.14 WIRE AND CABLE

.1 Conductor Insulation: Minimum rating 300 volts. Single conductor RW90XLPE (X-link).

.2 Multi-conductor cables 105°C with outer PVC jacket, colour coded, FAS rated.

.3 Conductor sizes as follows:

.1 To initiating circuits: #18 AWG minimum, and in accordance with manufacturer's requirements.

.2 To signal circuits: #16 AWG minimum, and in accordance with manufacturer's requirements.

.3 To control circuits: #12 AWG minimum, and in accordance with manufacturer's requirements.

.4 Size all fire alarm wiring for maximum 3% voltage drop at maximum load at last device in run.

.4 All wiring to be copper.

.5 All wiring to be tag identified at the points of connection.

.6 Provide a ground conductor with all system wiring and bond all metal parts including device boxes.

.7 All fire alarm system wiring to be in conduit except short drops from ceiling junction box to detectors mounted in T-Bar ceiling may be rated fire alarm system cable.

Part 3 Execution

3.1 INSTALLATION

.1 Install systems in accordance with CAN/ULC-S524 and TB OSH Chapter 3-04.

.2 Locate and install manual alarm stations and connect to alarm circuit wiring.

.3 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors.

.4 Connect alarm circuits to main control panel.

.5 Locate and install signal devices, bells, chimes, horns and visual signal devices and connect to signalling circuits.

.6 Connect signalling circuits to main control panel.

.7 Install end-of-line devices at end of alarm and signalling circuits.

.8 Install remote annunciator panels and connect to annunciator circuit wiring.

.9 Sprinkler system: wire alarm and supervisory switches and connect to control panel.

.10 Provide “SIGA-IM” isolation module at point where fire alarm cabling enters buildings.

.11 All initiating device wiring shall be Class ‘A’.

3.2 FIELD QUALITY CONTROL

.1 Perform tests as described herein and in accordance CAN/ULC-S537.

.2 Fire alarm system:

.1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors, and sprinkler system transmit alarm to control panel and actuate general alarm ancillary devices.

.2 Check annunciator panels to ensure zones are shown correctly.

.3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.

.4 Manufacturer's technician to verify all new devices and reconnected existing fire alarm system equipment and components in accordance with ULC Standard S537.

.5 Provide a Certification of Verification.

.6 After verification, demonstrate and spot test system as required by Departmental Representative and Fire Commissioner.

.7 Class A circuits.

.1 Test each conductor on all circuits for capability of providing alarm signal on each side of single open-circuit fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.2 Test each conductor on all circuits for capability of providing alarm signal during ground-fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

3.3 TRAINING

.1 Arrange and pay for on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 35 13.43 Special Procedures for Contaminated Sites.

.3 Section 01 35 33 – Health and Safety Requirements.

.4 Section 01 35 43 – Environmental Procedures.

.5 Section 01 45 00 – Quality Control.

.6 Section 01 56 00 – Temporary Barriers and Enclosures

.7 Section 01 74 19 – Waste Management and Disposal.

.8 Section 02 41 16 – Structure Demolition.

.9 Section 31 23 16.26 – Rock Removal.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM C117- 04 , Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C136- 05 , Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D422-63 2002 , Standard Test Method for Particle-Size Analysis of Soils.

.4 ASTM D698- 00ae1 , Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ;) (600 kN-m/m ;).

.5 ASTM D1557- 02e1 , Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ;) (2,700 kN-m/m ;).

.6 ASTM D4318- 05 , Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1- 88 , Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2- M88 , Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA-A3000- 03 , Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.1 CSA-A3001- 03 , Cementitious Materials for Use in Concrete.

.2 CSA-A23.1/A23.2- 04 , Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.4 U.S. Environmental Protection Agency (EPA)/Office of Water

.1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 DEFINITIONS

.1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.

.1 Rock : solid material in excess of 1.00 m ; and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 to 1.15 m; bucket . Frozen material not classified as rock.

.2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.

.2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.

.3 Topsoil:

.1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

.2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimeters in any dimension.

.4 Waste material: excavated material unsuitable for use in Work or surplus to requirements.

.5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.

.6 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.

.7 Unsuitable materials:

.1 Weak, chemically unstable, and compressible materials.

.2 Frost susceptible materials:

.1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422 and ASTM C136 : Sieve sizes to CAN/CGSB-8.1 CAN/CGSB-8.2 .

.2 Table:

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45 - 100
0.02 mm	10 - 80
0.005 mm	0 - 45

.3 Coarse grained soils containing more than 20 % by mass passing 0.075 mm sieve.

.8 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Quality Control: in accordance with Section 01 45 00 - Quality Control:

.1 Submit for review by Departmental Representative proposed dewatering methods as described in PART 3 of this Section.

.2 Submit to Departmental Representative written notice when bottom of excavation is reached.

.3 Submit to Departmental Representative testing and inspection results, and report as described in PART 3 of this Section.

.3 Preconstruction Submittals:

.1 Submit construction equipment list for major equipment to be used in this section prior to start of Work.

.2 Submit records of underground utility locates, indicating: location plan of existing utilities as found in field.

.4 Samples:

.1 Submit samples in accordance with Section 01 33 00 Submittal Procedures.

.2 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of fill materials and provide access for sampling.

.3 Submit 70 kg samples of type of fill.

.4 Ship samples to Departmental Representative, in tightly closed containers to prevent contamination and exposure to elements.

.5 At least 4 weeks prior to beginning Work, inform Departmental Representative source of fly ash and submit samples to Departmental.

.1 Do not change source of Fly Ash without written approval of Departmental Representative.

1.5 QUALITY ASSURANCE

.1 Qualification Statement: submit proof of insurance coverage for professional liability.

.2 Submit design and supporting data at least 2 weeks prior to beginning Work.

.3 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of British Columbia, Canada.

.4 Keep design and supporting data on site.

.5 Engage services of qualified professional Engineer who is registered or licensed in Province of British Columbia, Canada in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.

.6 Do not use soil material until written report of soil test results are reviewed and approved by Departmental Representative.

.7 Excavated materials are not permitted to be used for backfill.

.8 Health and Safety Requirements:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.2 Divert materials from landfill to local facility for reuse

.3 All excavated material is to be stockpiled as per Item 3.5 of this Section.

1.7 EXISTING CONDITIONS

.1 Examine soil report prepared by Geotechnical Engineer in Appendix B of specifications.

.2 Buried services:

.1 Before commencing work verify location of buried services on and adjacent to site.

.2 Contact utilities, Municipality, BC One Call, Public Works and Government Services Canada, and a utility locate company to help identify locations of underground services.

.3 Conduct Ground Penetrating Radar (GPR) in all areas of excavation to identify location and approximate depth of services.

.4 Conduct a “Hydro-Vac” excavation of all utilities identified on the design drawings and by way of the GPR investigation.

.1 Conduct a survey and record vertical and horizontal location in UTM-10 NAD 86 coordinates and geodetic elevation format.

.2 Record the diameter of piping, width and depth of concrete ducting, and size of structures.

.3 Submit points list of survey to Departmental Representative in test format, with the survey format in text

.5 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.

.6 Remove obsolete buried services within 2 m of foundations: cap cut offs.

.7 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.8 Prior to beginning excavation Work, notify applicable Departmental establish location and state of use of buried utilities and structures. Clearly mark such locations to prevent disturbance during Work.

.9 Confirm locations of buried utilities by careful test excavations or soil hydrovac methods.

.10 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

.11 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing or re routing.

.12 Record location of maintained, re routed and abandoned underground lines.

.13 Confirm locations of recent excavations adjacent to area of excavation.

.3 Existing buildings and surface features:

.1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.

.2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.

.3 Where required for excavation, cut roots or branches as directed by Departmental Representative.

Part 2 Products

2.1 MATERIALS

.1 Type 1 and Type 2 fill: properties in accordance with the following requirements:

.1 Crushed, pit run or screened stone, gravel or sand.

.2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117 . Sieve sizes to CAN/CGSB-8.1 CAN/CGSB-8.2 .

.3 Table:

Sieve Designation	% Passing	
	Type 1	Type 2
75 mm	-	100
50 mm	-	-
37.5 mm	-	-
25 mm	100	-
19 mm	75-100	-
12.5 mm	-	-
9.5 mm	50-100	-
4.75 mm	30-70	22-85
2.00 mm	20-45	-
0.425 mm	10-25	5-30
0.180 mm	-	-
0.075 mm	3-8	0-10

.2 Type 3 fill: selected material from excavation or other sources, approved by Departmental Representative for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.

.3 Unshrinkable fill: proportioned and mixed to provide:

.1 Maximum compressive strength of 0.4 MPa at 28 days.

.2 Maximum cement content of 25 kg/m ; to CSA A3001, Type GU.

.3 Minimum strength of 0.07MPa at 24 h.

.4 Concrete aggregates: to CSA A23.1/A23.2.

.5 Cement: Type GU.

.6 Slump: 160 to 200 mm.

.4 Shearmat: honeycomb type bio-degradable cardboard 100 mm thick, treated to provide sufficient structural support for poured concrete until concrete cured.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control drawings, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 SITE PREPARATION

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.3 PREPARATION/PROTECTION

.1 Protect existing features in accordance with Section 01 56 00 Temporary Barriers and Enclosures and applicable local regulations.

.2 Keep excavations clean, free of standing water, and loose soil.

.3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative.

.4 Protect natural and man made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.

.5 Protect buried services that are required to remain undisturbed.

3.4 STRIPPING OF TOPSOIL

.1 Begin topsoil stripping of areas as indicated after area has been cleared of brush, weeds and grasses and removed from site.

.2 Strip topsoil to depths as indicated.

.1 Do not mix topsoil with subsoil.

.3 Stockpile in locations as directed by Departmental Representative.

.1 Stockpile height not to exceed 2 m and should be protected from erosion.

.4 Dispose of unused topsoil as directed by Departmental Representative off site upon completion of testing.

3.5 STOCKPILING

.1 All excavated material is to be stockpiled as per below.

.2 Stockpile area is located on Maplebank Road. Access from the Esquimalt Graving Dock is via Admirals Road to Maplebank Road.

.3 Stockpile fill materials in areas designated by Departmental Representative.

.1 Stockpile granular materials in manner to prevent segregation.

.4 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies and as per Section 01 35 13.43.

3.6 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

.1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Section 01 35 33 - Health and Safety Requirements and WorkSafeBC.

.1 Where conditions are unstable, Departmental Representative to verify and advise methods.

.2 Obtain permit from authority having jurisdiction for temporary diversion of drainage course.

.3 Construct temporary Works to depths, heights and locations as indicated by Departmental Representative.

.4 During backfill operation:

.1 Unless otherwise indicated or directed by Departmental Representative, remove sheeting and shoring from excavations.

.2 Do not remove bracing until backfilling has reached respective levels of such bracing.

.3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500 mm above toe of sheeting.

.5 When sheeting is required to remain in place, cut off tops at elevations as indicated.

.6 Upon completion of substructure construction:

.1 Remove cofferdams, shoring and bracing.

3.7 DEWATERING AND HEAVE PREVENTION

.1 Keep excavations free of water while Work is in progress.

.2 Provide for Departmental Representative review details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut offs.

.3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.

.1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut offs, or other means.

.4 Protect open excavations against flooding and damage due to surface run off.

.5 Dispose of water in accordance with Section 01 35 43 Environmental Procedures and Section 01 35 13.43 Special Procedures for Contaminated Site, to approved runoff areas and in manner not detrimental to public and private property, or portion of Work completed or under construction.

.1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

.6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

3.8 EXCAVATION

.1 All excavated material is to be stockpiled as per item 3.5 in this Section.

.2 Advise Departmental Representative at least 7 days in advance of excavation operations. Excavate to lines, grades, elevations and dimensions as indicated.

.3 Limit work area to a maximum of 3 meters from the edge of the excavation unless authorized in writing from Departmental Representative.

.4 Maintain at least one lane of traffic open at all times to ensure the uninterrupted operation of the graving dock facility and for access of emergency vehicles.

.5 Maintain active traffic control as per WorkSafe BC and section 01 35 33.

.6 Remove concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation offsite.

.7 Excavation must not interfere with bearing capacity of adjacent foundations or structures.

.8 Do not disturb soil within branch spread of trees or shrubs that are to remain.

.1 If excavating through roots:

.1 Engage a professional arborist, certified in the province of British Columbia.

.2 Have the arborist prepare a written report on how to proceed with excavation.

.3 Submit report to Departmental Representative for review and information.

.4 Follow the arborist’s recommendations for excavating through the root zone.

.9 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 5 m at end of day's operation.

.10 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.

.11 Restrict vehicle operations directly adjacent to open trenches.

.12 Dispose of surplus and unsuitable excavated material in approved location on site for testing for contamination.

.13 Do not obstruct flow of surface drainage or natural watercourses. Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.14 Notify Departmental Representative when bottom of excavation is reached.

.15 Obtain Departmental Representative approval of completed excavation.

.16 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.

.17 Correct unauthorized over-excavation as follows:

.1 Fill under bearing surfaces and footings with concrete specified for footings Type 2 fill compacted to not less than 100% of corrected Standard Proctor maximum dry density.

.2 Fill under other areas with Type 2 fill compacted to not less than 95 % of corrected Standard Proctor maximum dry density.

.18 Hand trim, make firm and remove loose material and debris from excavations.

.1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.

.2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.

3.9 FILL TYPES AND COMPACTION

.1 Use types of fill as indicated or specified below. Compaction densities are percentages of maximum densities obtained from ASTM D698 ASTM D1557.

.1 Exterior side of perimeter walls: use Type 3 fill to subgrade level. Compact to 95% of corrected maximum dry density.

.2 Within building area: use Type 2 to underside of base course for floor slabs. Compact to 100 % of corrected maximum dry density.

.3 Under concrete slabs: provide 150 mm compacted thickness base course of Type 1 fill topped with shearmat filler as indicated to underside of slab. Compact base course to 100 %.

.4 Retaining walls: use Type 2 fill to subgrade level on high side for minimum 500 mm from wall and compact to 95 %. For remaining portion, use Type 3 fill compacted to 9 %.

.5 Place unshrinkable fill in areas as indicated.

3.10 BEDDING AND SURROUND OF UNDERGROUND SERVICES

.1 Place and compact granular material for bedding and surround of underground services as indicated.

.2 Place bedding and surround material in unfrozen condition.

3.11 BACKFILLING

.1 Excavated materials are not permitted to be used for backfill.

.2 Do not proceed with backfilling operations until completion of following:

.1 Departmental Representative has inspected and approved installations.

.2 Departmental Representative has inspected and approved of construction below finish grade.

.3 Inspection, testing, approval, and recording location of underground utilities.

.4 Removal of concrete formwork.

.5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.

.3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.4 Do not use backfill material which is frozen or contains ice, snow or debris.

.5 Place backfill material in uniform layers not exceeding 300 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

.6 Backfilling around installations:

.1 Do not backfill around or over cast in place concrete within 24 hours after placing of concrete.

.2 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 0.150 m.

.3 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:

.1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Departmental Representative.

.7 Place unshrinkable fill in areas as indicated.

.8 Consolidate and level unshrinkable fill with internal vibrators.

.9 Install drainage system in backfill as indicated.

3.12 RESTORATION

.1 Upon completion of Work, remove waste materials and debris in accordance to Section 01 74 19 Waste Management and Disposal, trim slopes, and correct defects as directed by Departmental Representative.

.2 Replace topsoil as indicated.

.3 Reinstate lawns to elevation which existed before excavation.

.4 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.

.5 Clean and reinstate areas affected by Work as directed by Departmental Representative.

.6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.

.7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 74 19 - Waste Management and Disposal

1.2 REFERENCES

.1 ASTM International

.1 ASTM C117- 04 , Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C131- 06 , Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.3 ASTM C136- 06 , Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.4 ASTM D698- 07e1 , Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft;) (600kN-m/m;).

.5 ASTM D1557- 09 , Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft;) (2,700kN-m/m;).

.6 ASTM D1883- 07e2 , Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.

.7 ASTM D4318- 10 , Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

.2 Canada Green Building Council (CaGBC)

.1 LEED Canada-NC Version 1.0- 2004 , LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum 2007).

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1- 88 , Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2- M88 , Sieves, Testing, Woven Wire, Metric.

.4 U.S. Environmental Protection Agency (EPA) / Office of Water

.1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures .

1.4 DELIVERY, STORAGE AND HANDLING

.1 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

Part 2 Products

2.1 MATERIALS

.1 Granular base: material in accordance with the following requirements:

.1 Crushed stone or gravel.

.2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.

.1 Gradation Method #1 to:

Sieve Designation	% Passing		
	(1)	(2)	(3)
100 mm	-	-	-
75 mm	-	-	-
50 mm	100	-	-
37.5 mm	70-100	-	-
25 mm	-	100	-
19 mm	50-75	-	100
12.5 mm	-	65-100	70-100
9.5 mm	40-65	-	-
4.75 mm	30-50	35-60	40-70
2.00 mm	-	22-45	23-50
0.425 mm	10-30	10-25	7-25
0.180 mm	-	-	-
0.075 mm	3-8	3-8	3-8

.2 Gradation Method #2 to: insert name of agency and material type except that percentage finer than 0.075 mm not to exceed 8%.

.3 Material to level surface depressions to meet gradation (2) limits in accordance with Method #1.

.4 Liquid limit: to ASTM D4318, maximum 25

.5 Plasticity index: to ASTM D4318, maximum 6.

.6 Los Angeles degradation: to ASTM C131. Max. % loss by weight: 4]

.7 Crushed particles: at least 60% of particles by mass within each of following sieve designation ranges to have at least 1 freshly fractured face. Material to be divided into ranges using methods of ASTM C136.

Passing		Retained on
50 mm	to	25 mm
25 mm	to	19.0 mm
19.0 mm	to	4.75 mm

.8 Soaked CBR: to ASTM D1883, minimum 100, when compacted to 100% of ASTM D1557.

Part 3 Execution

3.1 PREPARATION

.1 Temporary Erosion and Sedimentation Control:

.1 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.2 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 PLACEMENT AND INSTALLATION

.1 Place granular base after sub-base and subgrade surface is inspected and approved in writing by Departmental Representative.

.2 Placing:

.1 Construct granular base to depth and grade in areas indicated.

.2 Ensure no frozen material is placed.

.3 Place material only on clean unfrozen surface, free from snow and ice.

.4 Begin spreading base material on crown line or on high side of one-way slope.

.5 Place material using methods which do not lead to segregation or degradation of aggregate.

.6 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.

.7 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.

.1 Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.

.8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.9 Remove and replace that portion of layer in which material becomes segregated during spreading.

.3 Compaction Equipment:

.1 Ensure compaction equipment is capable of obtaining required material densities.

.2 Efficiency of equipment not specified to be proved at least as efficient as specified equipment at no extra cost and written approval must be received from Departmental Representative before use.

.3 Equipped with device that records hours of actual work, not motor running hours.

.4 Compacting:

.1 Compact to density not less than 100% corrected maximum dry density maximum dry density to ASTM D698 ASTM D1557.

.2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.

.3 Apply water as necessary during compacting to obtain specified density.

.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved in writing Departmental Representative.

.5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.3 SITE TOLERANCES

.1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

3.4 CLEANING

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal

3.5 PROTECTION

.1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 01 35 33 Health and Safety Requirements

.3 Section 01 74 19 - Waste Management and Disposal

.4 Section 01 74 11 - Cleaning

.5 Section 03 20 00 - Concrete Reinforcing

.6 Section 03 30 00 - Cast-in-Place Concrete

.7 Section 03 35 00 Concrete Finishing

.8 Section 31 23 33.01 - Excavating, Trenching and Backfilling

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM C117- 04 , Standard Test Method for Materials Finer than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C136- 05 , Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D260- 86(2001) , Standard Specification for Boiled Linseed Oil.

.4 ASTM D698- 00ae1 , Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft^3) (600 kN-m/m^3).

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-3.3- 99(March 2004) , Kerosene, Amend. No. 1, National Standard of Canada.

.2 CAN/CGSB-8.1- 88 , Sieves, Testing, Woven Wire, Inch Series.

.3 Canadian Standards Association (CSA International)

.1 CSA-A23.1- 04 /A23.2- 04 , Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data: submit WHMIS MSDS in accordance with Section 01 35 33 Health and Safety Requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

.1 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete

.2 Reinforcing steel: in accordance with Section 03 20 00 - Concrete Reinforcing

.3 Joint filler and Curing Compound: in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.4 Granular base: material to the following requirements:

.1 Type 1, 2 or 3 fill

.2 Crushed stone or gravel.

.3 Gradations: within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.

.5 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water-soluble soap.

.6 Fill material: to the following requirements:

.1 Type 1, 2 or 3 fill

.2 Crushed stone or gravel.

.3 Gradations: within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.

.7 Boiled linseed oil: to ASTM D260

.8 Kerosene: to CAN/CGSB-3.3.

Part 3 Execution

3.1 GRADE PREPARATION

.1 Do grade preparation work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling

.2 Construct embankments using excavated material free from organic matter or other objectionable materials.

.1 Dispose of surplus and unsuitable excavated material in approved location off site.

.3 Place fill in maximum 300mm layers and compact to at least 95% of maximum dry density to ASTM D698.

3.2 GRANULAR BASE

.1 Obtain Departmental Representative's approval of subgrade before placing granular base.

.2 Place granular base material to lines, widths, and depths as indicated.

.3 Compact granular base in maximum 300mm layers to at least 95% of maximum density to ASTM D698.

3.3 CONCRETE

.1 Obtain Departmental Representative approval of granular base prior to placing concrete.

.2 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.3 Immediately after floating, give sidewalk surface uniform broom finish to produce regular corrugations not exceeding 2mm deep, by drawing broom in direction normal to centre line.

.4 Provide edging as indicated with 10mm radius edging tool.

3.4 TOLERANCES

.1 Finish surfaces to within 3mm in 3 m as measured with 3 m straightedge placed on surface.

3.5 EXPANSION AND CONTRACTION JOINTS

.1 Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, at intervals of 3 m.

.2 Install expansion joints at intervals of 9 m.

.3 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.

3.6 ISOLATION JOINTS

.1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.

.2 Install joint filler in isolation joints in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.3 Seal isolation joints with sealant approved by Departmental Representative.

3.7 CURING

.1 Cure concrete by adding moisture continuously in accordance with CSA-A23.1/A23.2 to exposed finished surfaces for at least 1day after placing, or sealing moisture in by curing compound as directed by Departmental Representative.

.2 Where burlap is used for moist curing, place two prewetted layers on concrete surface and keep continuously wet during curing period.

.3 Apply curing compound evenly to form continuous film, in accordance with manufacturer's requirements.

3.8 BACKFILL

.1 Allow concrete to cure for 7 days prior to backfilling.

.2 Backfill to designated elevations with material as directed by Departmental Representative.

.1 Compact and shape to required contours as indicated.

3.9 LINSEED OIL TREATMENT

.1 Apply two coats of linseed oil mixture uniformly to surfaces of curbs, walks and gutters, after concrete has cured for specified curing time and when surface of concrete is clean and dry.

.2 Linseed oil mixture to consist of 50% boiled linseed oil and 50% mineral spirits by volume.

.3 Apply treatment when air temperature above 10 degrees C.

.4 Apply first coat at 135 mL/m^2.

.5 Apply second coat at 90 mL/m^2 when first coat has dried.

3.10 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 03 30 00 - Cast-in-Place Concrete.

.3 Section 09 91 13 - Exterior Painting.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM).

.1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A90/A90M, Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

.3 ASTM A121, Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.

.4 A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-138.1, Fabric for Chain Link Fence.

.2 CAN/CGSB-138.2, Steel Framework for Chain Link Fence.

.3 CAN/CGSB-138.3, Installation of Chain Link Fence.

.4 CAN/CGSB-138.4,Gates for Chain Link Fence.

.5 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

.3 Canadian Standards Association (CSA).

.1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

.2 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CAN/CSA-A3000, Cementitious Materials Compendium. Includes:

.1 CAN/CSA-A23.5, Supplementary Cementing Materials.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit manufacturer’s data sheets including:

.1 Fence fabric gauge and finish.

.2 Post and rail dimension and finish.

Part 2 Products

2.1 MATERIALS

.1 Concrete mixes and materials: in accordance with Section 03 30 00- Cast-in-Place Concrete.

.1 Nominal coarse aggregate size: 20 mm.

.2 Compressive strength: 20 MPa minimum at 28 days.

.2 Chain-link fence fabric: to CAN/CGSB-138.1.

.1 Type 1, Class A, medium style.

.2 Height of fabric: as indicated.

.3 Posts, braces and rails: to CAN/CGSB-138.2, galvanized steel pipe. Dimensions as indicated.

.4 Bottom tension wire: to CAN/CGSB-138.1, Table 2 single strand, galvanized steel wire, 5 mm diameter.

.5 Tie wire fasteners: to CAN/CGSB-138.1, Table 2 (steel wire), single strand, galvanized steel wire confirming to requirements of fence fabric, 5 mm diameter.

.6 Tension bar: to A653/A653M, 5 x 20 mm minimum galvanized steel.

.7 Tension bar brands: 3 x 20 mm minimum galvanized steel or 5 x 20 mm minimum aluminum.

.8 Gates: to CAN/CGSB-138.4.

.9 Gate frames: to ASTM A53/A53M, galvanized steel pipe, standard weight 45 mm outside diameter pipe for outside frame, 35mm outside diameter pipe for interior bracing.

.1 Fabricate gates as indicated with electrically welded joints, and hot-dip galvanized after welding.

.2 Fasten fence fabric to gate with twisted selvage at top.

.3 Furnish gates with galvanized malleable iron hinges, latch and latch catch with provision for padlock which can be attached and operated from either side of installed gate.

.4 Furnish double gates with chain hook to hold gates open and centre rest with drop bolt for closed position.

.10 Fittings and hardware: to CAN/CGSB-138.2, cast aluminum alloy, galvanized steel or malleable or ductile cast iron.

.1 Tension bar bands: 3 x 20 mm minimum galvanized steel or 5 x 20 mm minimum aluminum.

.2 Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail.

.3 Overhang tops to provide waterproof fit, to hold top rails and an outward inward projection to hold barbed wire overhang.

.4 Turnbuckles to be drop forged.

.11 Organic zinc rich coating: to CAN/CGSB-1.181.

.12 Grounding rod: 16 mm diameter copper well rod, 3 m long.

2.2 FINISHES

.1 Galvanizing:

.1 For chain link fabric: to CAN/CGSB-138.1, Grade2.
.2 For pipe: 550 g/m^2 minimum to ASTM A90.
.3 For barbed wire: to ASTM A121, Class 2.
.4 For other fittings: to CAN/CSA-G164.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for fence and gate installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied .

3.2 ERECTION OF FENCE

.1 Erect fence along lines as indicated and as directed by Owner's Representative and in accordance with CAN/CGSB-138.3.

.2 Excavate post holes 1200 mm depth x 300 mm diameter by methods approved by Owner's Representative.

.3 Space line posts 3 m apart, measured parallel to ground surface.

.4 Space straining posts at equal intervals not exceeding 150 m if distance between end or corner posts on straight continuous lengths of fence over reasonably smooth grade is greater than 150 m.

.5 Install additional straining posts at sharp changes in grade and where directed by Owner's Representative.

.6 Install corner post where change in alignment exceeds 10˚.

.7 Install end posts at end of fence and at buildings. Install gate posts on both sides of gate openings.

.8 Place concrete in post holes then embed posts into concrete to minimum 900 mm depth.

.1 Extend concrete 50 mm above ground level and slope to drain away from posts.
.2 Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.

.9 Do not install fence fabric until concrete has cured minimum of 5 days.

.10 Install brace between end and gate posts and nearest line post, placed in centre of panel and parallel to ground surface.

.1 Install braces on both sides of corner and straining posts in similar manner.

.11 Install overhang tops and caps.

.12 Install top rail between posts and fasten securely to posts and secure waterproof caps and overhang tops.

.13 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.

.14 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300 mm intervals.

.1 Knuckled selvedge at bottom.

.2 Twisted selvedge at top.

.15 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 450 mm intervals.

.1 Give tie wires minimum two twists.

.16 Install barbed wire strands and clip securely to lugs of each projection.

.17 Install grounding rods as indicated.

3.3 INSTALLATION OF GATES

.1 Install gates in locations as indicated.

.2 Level ground between gate posts and set gate bottom approximately 40 mm above ground surface.

.3 Determine position of centre gate rest for double gate. Cast gate rest in concrete as directed. Dome concrete above ground level to shed water.

.4 Install gate stops where indicated.

3.4 TOUCH UP

.1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of organic zinc-rich paint to damaged areas in accordance with Section 09 91 13 – Exterior Painting. Pre-treat damaged surfaces according to manufacturers' instructions for zinc-rich paint.

3.5 CLEANING

.1 Clean and trim areas disturbed by operations. Dispose of surplus material as directed by Owner’s Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 19 - Waste Management and Disposal

.3 Section 01 78 00 - Closeout Submittals

.4 Section 03 30 00 - Cast-in-Place Concrete

.5 Section 07 52 00 - Modified Bituminous Membrane Roofing.

.6 Section 31 23 33.01 - Excavating, Trenching and Backfilling

.7 Section 33 34 00 – Sanitary Utility Sewerage Force Mains

.8 Section 33 05 13 - Manholes and Catch Basin Structures.

.9

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Water Works Association (AWWA)

.1 ANSI/AWWA C500-09, Metal-Seated Gate Valves for Water Supply Service (Includes Addendum C500a-95).

.2 ANSI/AWWA C504-10, Rubber-Seated Butterfly Valves.

.3 ANSI/AWWA C508-09, Swing-Check Valves for Waterworks Service, 2 inch (50 mm) through 24 inch (600 mm) NPS.

.2 ASTM International

.1 ASTM C 478M-11, Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric).

.3 CSA International

.1 CAN/CSA-A257 Series-09, Standards for Concrete Pipe.

.2 CSA B70-06, Cast Iron Soil Pipe, Fittings and Means of Joining.

1.3 SCHEDULING

.1 Notify Departmental Representative 14 calendar days in advance of interruptions to sanitary service.

.2 Schedule work to minimize interruptions to existing services.

.1 If interruptions are required provide alternative facilities for the employees of the south side of the dock and west of the project site.

.1 Alternate facilities shall be fitted with separate male and female washroom facilities each comprising of:

.1 Exterior Siding: Metal siding & metal fascia

.2 Interior Walls: FRP (fibre reinforced plastic) paneling (white)

.3 Windows: 30" x 18" XO horizontal slider with insect screen

.4 Exterior Doors: Solid-core door with passage set, deadbolt, check chain and steel lockbox

.5 Floor: Sheet vinyl flooring (commercial grade)

.6 Ceiling: Vinyl-clad gyproc (white)

.7 Roof: EPDM (rubber) roofing

.8 Heating: Electric forced-air heaters (240V)

.9 Lighting: Fluorescent lights, 2-bulb, surface-mounted; Exterior lights

.10 Electrical: 120/240 volt single phase, mast/weatherhead & electrical panel

.11 Men's: 3 toilets, 2 urinals, 3 sinks and enclosed electric hot water tank (shared)

.12 Women's: 2 toilets, 1 sinks

.13 Aluminum Stairs with 4' x 4' Landing and Handrails

.14 Waste & Water Holding Tank

.2 Alternate facilities to be connected to EGD power systems under the direction of the Departmental Representative.

.3 Waste water holding tanks to be pumped out routinely so as not to interrupt the use of the facilities.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for packaged sewage lift and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings for civil, structural, hydraulic, mechanical and electrical elements.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for sewage lift station for incorporation into manual.

.3 Include information as follows:

.1 Record drawings, wiring diagrams, electrical schematics of equipment as installed.

.2 Interconnections with numbers and wire sizes.

.3 Certified pump characteristic curves.

.4 Detailed operation and maintenance instructions.

.5 Parts list comprising complete schedule clearly identified to facilitate re-ordering.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect packaged sewer lift from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESCRIPTION

.1 Reinforced concrete enclosure.

.1 Pumping system: factory assembled and disassembled for shipment with mating components clearly identified.

.2 Principal items of equipment to include 2 identical submersible sewage pumping units, internal piping and valves, liquid level controls, lifting chains, guide bars, debris vents complete with screens, cover, electrical wiring, control panel with circuit breakers and motor starters.

.2 Equipment and installation including as follows:

.1 Temporary sheet piling.

.2 Excavation for sewage lift station.

.3 Placement of mud slab.

.4 Connection of power to control panel as indicated.

.5 Connections to force mains.

.6 Supply and installation of packaged sewage lift station in accordance with manufacturer's recommendations.

.3 Wet well sewage lift station:

.1 Fully automatic, consisting of duplex submersible pumps mounted on rail system. Ensure control is by series of liquid level bulbs.

.2 Ensure pumps alternate as lead pump on each cycle.

.3 Incorporate time delay relays in control circuits to allow continuation of pump for pre-set time after normal pump shut down signal is received.

.4 Operate both pumps when lag pump "on" water level is reached in wet well.

.1 Ensure lag pump shuts off when water level drops to pump "off" water level.

.5 Locate control system in control station mounted as shown on drawings.

2.2 WET WELL STRUCTURE

.1 Structure : leak free, precast or cast-in-place reinforced concrete with access opening, ladder and designed for following forces:

.1 Dead load of station and components, dynamic and kinetic forces of rotating equipment.

.2 Dead load from soil over structure, superimposed live load equivalent to H-20 loading.

.3 Hydrostatic uplift forces.

.4 Horizontal earth loading and full hydrostatic pressure assuming water at ground elevation.

.2 Waterproof exterior surfaces below grade in accordance with Section 07 52 00 - Modified Bituminous Membrane Roofing.

.3 Materials:

.1 Precast concrete to [ASTM C478M] [CAN/CSA-A257]

.1 1800mm inside diameter

.2 Cast-in-place concrete in accordance with Section 03 30 00 - Cast-in-Place Concrete.

2.3 PUMPS

.1 2 vertical, single stage, bottom suction, solids handling wastewater pump, non-clog, heavy duty, totally submersible centrifugal pumps, direct connected to motor by solid stainless steel shaft and fitted with thrust bearings.

.2 Characteristics:

.1 Intrinsically Safe – Explosion Proof

.2 Capacity: 3.79 L/s minimum at 6.10m minimum head.

.3 Total dynamic head: 6.90 m.

.4 Maximum static suction lift: 5.5 m.

.5 Maximum speed: 1800 rpm.

.6 2 hp.

.3 Volute casing: cast iron, minimum grade Class 30, close coupled.

.4 Volute wear ring: brass

.5 Impeller: ductile iron Class 65 to ASTMA536, enclosed 2 vane, in static and dynamic balance. All fasteners to be 300 Series, stainless steel.

.6 Capable of passing 75 mm solid sphere.

2.4 PUMP LIFTING SYSTEM

.1 Ensure pumps are complete with sliding guide and brackets, chains and quick leak-proof disconnect to discharge piping, all allowing for withdrawal of pumps.

.2 Include galvanized lifting chain or stainless steel cable for each pump accessible from roof access hatches.

.3 Use galvanized steel pipe as quick rails for pump.

2.5 SUBMERSIBLE MOTORS

.1 Motors:

.1 1 phase.

.2 Capable of operating pump at any point on selected impeller curve without exceeding motor nominal rating.

.3 Fully overload protected.

.4 Assembly capable of operating continuously in air without overheating.

.5 Complete with NEMA approved winding temperature sensor.

.2 Motor speed: maximum 1800 rpm.

.3 Motor enclosure and seal housing: corrosion resistant, completely watertight, cast iron.

.4 Bearing: anti-friction type, greasable, with lubrication lines and fittings, 50,000 hours minimum, B-10 life.

.5 Terminal box: watertight, with waterproof cable entry glands mounted at motor.

.6 Shaft seals: double mechanical seals with tungsten/carbide faces.

.7 Motor leads and power cords to be sealed and locked in place using strain bushings. All cables to be waterproof.

2.6 PUMP CONTROL SYSTEM

.1 Liquid level switches: shock-proof mercury switches enclosed in leak-proof polypropylene body.

.2 Include independently adjustable control levels as follows:

.1 Pumps Off

.2 Lead pump start level.

.3 Lag pump start level.

.4 High water alarm.

.3 Ensure lead pump and lag pump controls include alternator relay to provide automatic pump alteration for each pumping cycle when pump sequence selection switch is on automatic.

2.7 PIPING AND VALVES

.1 Schedule 80 pvc pipe.

.2 Butterfly valves: to ANSI/AWWA C504.

.3 Gate valves: Schedule 80 PVC.

.4 Check valves: Schedule 80

2.8 ELECTRICAL CONTROL PANEL AND WIRING

.1 Use only CSA approved components.

.2 Electrical equipment in station in accordance with requirements for Hazardous Locations, Class 1, Group D, Division 2.

.3 Panel enclosure to NEMA 4Xweather proof of fabricated steel suitably braced, double door equipped with locking device, suitable for pole mounting.

.4 Ensure panel is complete with required components including:

- .1 main circuit breaker with thermal magnetic trip and suitable current rating for station load.
- .2 1 phase ground detector, neon lamp type with resistors and fuse cut-outs.
- .3 motor circuit interruptor with toggle handle for each pump motor with adjustable instantaneous trip.
- .4 magnetic full voltage starter with 120 volts coils and 3 overload relays for each pump.
- .5 time delay-relay, 2 - 50 second range, 10 amp minimum resistive contacts to prevent concurrent starting of pumps after power restoration.
- .6 Dry contacts, normally open, on high water alarm relay for remote indication.
- .7 SCADA controls and communication connections

.5 Mount following switches and instrumentation on door of panel:

- .1 Pump mode selector switches for hands-off-automatic operation of each pump.
- .2 Pump sequence selector switch to permit override of automatic pump alternation and selection of either pump to run as lead pump.
- .3 high level audible alarm complete with alarm relay and red light on panel door.

.6 Terminals in circuit of start float switch of lag pump.

.7 Ground connection lug.

.8 Labels: all components on and inside panel to indicate operating routine.

- .1 Labels: anodized aluminum with 5 mm minimum letters.

.9 Schematic wiring diagram: mounted inside panel door, varnish protected.

.10 Conductors: copper.

.11 Control wiring: number 14 AWG minimum, stranded type TEW.

.12 Power wire: number 12 AWG minimum, type RW 90.

.13 Wire:

- .1 Numbered with printed permanent indelible identifying plastic tapes to correspond to schematic diagram.
- .2 Terminated for external control connections by tubular screw type terminal blocks with barrier and labels.
- .3 Equipped with grommet and shields for mechanical protection.

.4 Adequately supported and installed in accordance with written approval of Departmental Representative.

2.9 ACCESS HATCH

.1 Double Door, ductile iron frame and hatch cover, airport extra heavy duty (proof tested to 90,718.47kg), top flange frame design.

.2 Size: 1222.4 mm x 825.5mm clear opening.

.3 Hardware: Type 316 stainless steel (bolts, nuts and Nylock nuts)

.4 Lifting Mechanism: Stainless steel mechanical spring strut and self-engaging safety bar,

.5 Finishes: Slip resistant surface

.6 Safety Grate: Rated 300 PSF. Material shall be 6061-T6 aluminum for bars and angles.

2.10 PACKAGE SYSTEM

.1 Precast concrete enclosure complete with components specified.

2.11 SOURCE QUALITY CONTROL

.1 Perform operational tests on pumps at factory to check for excessive vibration, for leaks in piping or seals and for correct operation of automatic control system and auxiliary equipment. Pump suction and discharge lines to be coupled to reservoir and pumps to recirculate water for minimum of 1 hour our under simulated service conditions.

.2 Provide certification that pumps and controls have been factory tested and deficiencies rectified prior to delivery to site.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sewage lift installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative & Consultant.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative

3.2 EXCAVATION BACKFILLING AND COMPACTION

.1 Excavate, backfill and compact in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.3 CONCRETE

.1 Do concrete work in accordance with Section 33 05 13 - Manholes and Catch Basin Structures.

3.4 EQUIPMENT INSTALLATION

.1 Install equipment, piping and controls in accordance with manufacturers' recommendations.

3.5 WATERPROOFING

.1 Waterproof in accordance with Section 07 52 00 - Modified Bituminous Membrane Roofing.

3.6 FIELD QUALITY CONTROL

.1 After completion of installation, demonstrate functional operation of systems, including sequence of operation, to approval of Departmental Representative.

.2 Test in presence of Departmental Representative & Consultant and representative from equipment supplier.

.3 Provide labour and ancillary equipment necessary to fulfill tests.

.4 Test to demonstrate that:

.1 Pumps and equipment run free from heating, or vibration.

.2 Operation meets requirements of these specifications.

.3 Pumps and pumping are free and clear of debris and obstructions.

.5 Replace equipment found defective.

.1 Repeat test until equipment is accepted by Departmental Representative.

3.7 DEMONSTRATION

.1 Operating Personnel Training

.1 Provide onsite training by qualified personnel for designated operating personnel prior to final commissioning.

.1 Schedule and deliver training in accordance with training plan approved in writing by Departmental Representative

.2 Include training for 3 designated personnel on routine maintenance procedures, minor repairs, replacement of parts, including disassembly of major components.

.3 Include safety precaution procedures for systems.

3.8 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 01 35 33 Health and Safety Requirements

.3 Section 01 45 00 - Quality Control

.4 Section 01 61 00 - Common Product Requirements

.5 Section 01 74 11 - Cleaning

.6 Section 01 74 19 - Waste Management and Disposal

.7 Section 03 20 00 - Concrete Reinforcing

.8 Section 31 23 33.01 - Excavating Trenching and Backfilling.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM A48/A48M- 00 , Standard Specification for Gray Iron Castings.

.2 ASTM C117- 04 , Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.

.3 ASTM C136- 05 , Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.4 ASTM C139- 05 , Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.

.5 ASTM C478M- 06 , Standard Specification for Precast Reinforced Concrete Manhole Sections Metric .

.6 ASTM D698- 00a , Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3(600 kN-m/m^3)).

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1- 88 , Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2- M88 , Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA-A23.1- 04 /A23.2- 04 , Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CAN/CSA-A3000- 03(R2005) , Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.1 CSA-A3001- 03 , Cementitious Materials for Use in Concrete.

.2 CSA-A3002- 03 , Masonry and Mortar Cement.

.3 CAN/CSA-A165 Series- 04 , CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).

.4 CAN/CSA-G30.18- M92(R2002) , Billet Steel Bars for Concrete Reinforcement.

.5 CAN/CSA-G164- M92(R2003) , Hot Dip Galvanizing of Irregularly Shaped Articles.

.4 N/A

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 N/A

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 33 Health and Safety Requirements.

.3 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Submit manufacturer's test data and certification at least 2 weeks prior to beginning Work. Include manufacturer's drawings, information and shop drawings where pertinent.

.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with contractor's representative and Departmental Representative to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 N/A

2.2 MATERIALS

.1 Cast-in-place concrete:

.1 In accordance with Section 03 30 00 - Cast-in-Place Concrete.

.2 Cement: to CAN/CSA-A3001, Type GU.

.3 Concrete mix design to produce 21 MPa minimum compressive strength at 28 days and containing 25mm maximum size coarse aggregate, with water/cement ratio to CAN/CSA-A23.1,

.1 Air entrainment to CAN/CSA-A23.1, class C-3 exposure.

.4 Supplementary cementing materials: with minimum 20% Type F fly ash replacement, by mass of total cementitious materials to CAN/CSA A3001.

.5 Concrete reinforcement: in accordance with Section 03 20 00 - Concrete Reinforcing.

.2 Precast manhole units: to ASTM C478M, circular or oval.

.1 Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation.

.2 Monolithic bases to be approved by Departmental Representative.

.3 Precast catch basin sections: to ASTM C139 and ASTM C478M.

.4 Joints: made watertight using rubber rings, bituminous compound, epoxy resin cement.

.5 Mortar:

.1 Masonry Cement: to CAN/CSA-A3002.

.6 Ladder rungs: to CAN/CSA-G30.18, No.25M billet steel deformed bars, hot dipped galvanized to CAN/CSA-G164.

.1 Rungs to be safety pattern (drop step type).

.7 Adjusting rings: to ASTM C478M.

.8 Concrete Brick: to CAN3-A165 Series.

.9 Drop manhole pipe: same as sewer pipe.

.10 Galvanized iron sheet: approximately 2 mm thick.

.11 Steel gratings, I-beams and fasteners: as indicated.

.12 Frames, gratings, covers to dimensions as indicated and following requirements:

.1 Metal gratings and covers to bear evenly on frames.

.1 Frame with grating or cover to constitute one unit.

.2 Assemble and mark unit components before shipment.

.2 Gray iron castings: to ASTM A48/A48M, strength class 30B.

.3 Castings: coated with two applications of asphalt varnish.

.4 Manhole frames and covers: cover cast with perforations and complete with two 25 mm square lifting holes.

.5 Catch basin frames and covers: ASTM A48 and to withstand H20 loading.

.6 Size: 762mm clear diameter.

.13 Granular bedding and backfill: in accordance with Section 31 23 33.01 Excavating Trenching and Backfilling.

.14 Unshrinkable fill: in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 EXCAVATION AND BACKFILL

.1 Excavate and backfill in accordance with Section 31 23 33.01 - Excavating Trenching and Backfillingand as indicated.

.2 Obtain approval of Departmental Representative before installing manholes or catch basins.

3.3 CONCRETE WORK

.1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.2 Place concrete reinforcement in accordance with Section 03 20 00 - Concrete Reinforcing.

.3 Position metal inserts in accordance with dimensions and details as indicated.

3.4 INSTALLATION

.1 Construct units in accordance with details indicated, plumb and true to alignment and grade.

.2 Complete units as pipe laying progresses.

.1 Maximum of threeunits behind point of pipe laying will be allowed.

.3 Dewater excavation to approval of Departmental Representative and remove soft and foreign material before placing concrete base.

.4 Cast bottom slabs directly on undisturbed ground.

.5 Set precast concrete base on 150 mm minimum of granular bedding compacted to 100% maximum density to ASTM D698.

.6 Precast units:

.1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base.

.2 Make each successive joint watertight with rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination of these materials.

.3 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.

.4 Plug lifting holes with concrete plugs set in cement mortar or mastic compound.

.7 For sewers:

.1 Place stub outlets and bulkheads at elevations and in positions indicated.

.2 Bench to provide smooth U-shaped channel.

.1 Side height of channel to be 0.75 times full diameter of sewer.

.2 Slope adjacent floor at 1 in 20.

.3 Curve channels smoothly.

.4 Slope invert to establish sewer grade.

.8 Compact granular backfill to 95% maximum density to ASTM D698.

.9 Place unshrinkable backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.10 Installing units in existing systems:

.1 Where new unit is installed in existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required and install new unit as specified.

.2 Make joints watertight between new unit and existing pipe.

.3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready for operation, complete installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or other necessary work.

.11 Set frame and cover to required elevation on no more than three courses of brick.

.1 Make brick joints and join brick to frame with cement mortar.

.2 Parge and make smooth and watertight.

.12 Place frame and cover on top section to elevation as indicated.

.1 If adjustment required use concrete ring.

.13 Clean units of debris and foreign materials.

.1 Remove fins and sharp projections.

.2 Prevent debris from entering system.

.14 N/A

3.5 ADJUSTING TOPS OF EXISTING UNITS

.1 Remove existing gratings, frames and store for re-use at locations designated by Departmental Representative.

.2 Sectional units:

.1 Raise or lower straight walled sectional units by adding or removing precast sections as required.

.2 Raise or lower tapered units by removing cone section, adding, removing, or substituting riser sections to obtain required elevation, then replace cone section.

.1 When amount of raise is less than 600 mm use standard manhole brick, moduloc or grade rings.

.3 Monolithic units:

.1 Raise monolithic units by roughening existing top to ensure proper bond and extend to required elevation with mortared brick course for 150 mm or less alteration.

.2 Lower monolithic units with straight wall by removing concrete to elevation indicated for rebuilding.

.3 When monolithic units with tapered upper section are lowered more than 150 mm, remove concrete for entire depth of taper plus as much straight wall as necessary, then rebuild upper section to required elevation with cast-in-place concrete.

.4 Install additional manhole ladder rungs in adjusted portion of units as required.

.5 Re-use existing gratings, frames.

.6 Re-set gratings and frames to required elevation on not more than 3 courses of brick.

.1 Make brick joints and join brick to frame with cement mortar, parge and trowel smooth.

.2 Re-set gratings and frames to required elevation on full bed of cement mortar, parge and trowel smooth.

3.6 SEALING OVER EXISTING UNITS

.1 Cut galvanized iron sheet to extend 50 mm beyond opening of existing manhole or catch basin grating.

.1 Center iron sheet over existing grating and spot or stitch weld to grating.

.2 Fill with cast-in-place concrete.

3.7 FIELD QUALITY CONTROL

.1 N/A

3.8 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 03 30 00 - Cast-in-Place Concrete

.3 Section 31 23 33 01 - Excavating Trenching and Backfilling

1.2 REFERENCES

.1 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA B300- 10 , Standard for Hypochlorites.

.2 ANSI/AWWA B301- 10 , Standard for Liquid Chlorine.

.3 ANSI/AWWA B303- 10 , Standard for Sodium Chlorite.

.4 ANSI/AWWA C111/A21.11- 07 , American National Standard for Rubber-Gasket Joints for Ductile-Iron and Fittings.

.5 ANSI/AWWA C110/A21.10- 08 , American National Standard for Ductile-Iron and Gray Iron Fittings for Water.

.6 ANSI/AWWA C153/A21.53- 11 , Standard for Ductile-Iron Compact Fittings.

.7 ANSI/AWWA C207- 07 , Standard for Steel Pipe Flanges for Waterworks Service, 4 Inch through 144 Inch (100 mm through 3,600 mm).

.8 ANSI/AWWA C500- 09 , Standard for Metal-Seated Gate Valves for Water Supply Service.

.9 ANSI/AWWA C504- 10 , Standard for Rubber-Seated Butterfly Valves.

.10 ANSI/AWWA C651- 05 , Standard for Disinfecting Water Mains.

.11 ANSI/AWWA C800- 05 , Standard for Underground Service Line Valves and Fittings.

.12 ANSI/AWWA C900- 07 , Standard for Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Transmission and Distribution.ASTM International

.2 CSA International

.1 CAN/CSA-B137 Series- 09 , Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).

.1 CAN/CSA-B137.3- 09 , Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions .

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect water distribution piping from nicks, scratches, and blemishes .

.3 Replace defective or damaged materials with new.

1.4 SCHEDULING OF WORK

.1 Schedule Work to minimize interruptions to existing services.

.2 Submit schedule of expected interruptions for approval and adhere to interruption schedule as approved by Departmental Representative.

.3 Notify Departmental Representative a minimum of 5 working days in advance of interruption in service.

.4 Notify fire department of planned or accidental interruption of water supply to hydrants.

.5 Provide and post "Out of Service" sign on hydrant not in use.

.6 Advise local police department of anticipated interference with movement of traffic.

Part 2 Products

2.1 PIPE, JOINTS AND FITTINGS

.1 Polyvinyl chloride pressure pipe: to ANSI/AWWA C900, pressure class 150, DR 18, 1 MPa gasket bell end.

.1 CAN/CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket [coupling.

.2 Cast iron fittings: to ANSI/AWWA C110/A21.10.

2.2 VALVES AND VALVE BOXES

.1 Valves to open clockwise.

.2 Gate valves: to ANSI/AWWA C500 , standard iron body, with non-rising stems, suitable for 1 Pa.

.3 Air and vacuum release valves: heavy duty combination air release valves employing direct acting kinetic principle.

.1 Fabricate valves of cast iron body and cover, with bronze trim, stainless steel floats with shock-proof synthetic seat suitable for 2 MPa working pressure.

.2 Valves to expel air at high rate during filling, at low rate during operation, and to admit air while line is being drained.

.3 Valve complete with surge check unit.

.4 Ends to be flanged to ANSI/AWWA C110/A21.10 .

.4 Cast iron valve boxes: three piece sliding type adjustable over minimum of 450 mm.

.1 Base to be large round type with minimum diameter of 300 mm.

.2 Top of box to be marked "WATER"/"EAU".

2.3 SERVICE CONNECTIONS

.1 Copper tubing: to ASTM B88M type K, annealed.

.2 Copper tubing joints: compression type suitable for 1 MPa working pressure.

.3 Service connections less than 100 mm: corporation stop, tapped to main using AWWA threads, complete with stainless service saddle. Service saddle to consist of circumferential band type complete with side bars and fingers, keeper bar, stud bolts, nuts, washers and gaskets.

2.4 PIPE DISINFECTION

.1 Sodium to ANSI/AWWA B300 ANSI/AWWA B301, ANSI/AWWA B303 to disinfect water mains.

.2 Disinfect water mains in accordance with ANSI/AWWA C651.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for distribution piping installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative. .

3.2 PREPARATION

.1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.

.1 Inspect materials for defects.

.2 Remove defective materials.

3.3 TRENCHING

.1 Do trenching work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling .

.2 .

3.4 PIPE INSTALLATION

.1 Join pipes in accordance with and manufacturer's recommendations.

.2 Bevel or taper ends of PVC pipe to match fittings.

.3 Handle pipe by methods recommended by pipe manufacturer . Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.Lay pipes on prepared bed, true to line and grade.

.1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.

.2 Take up and replace defective pipe.

.3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.

.4 Face socket ends of pipe in direction of laying. For mains on grade of 2 % or greater, face socket ends up-grade.

.5 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.

.6 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.

.1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.7 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.

.8 Align pipes before jointing.

.9 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

.10 Avoid displacing gasket or contaminating with dirt or other foreign material.

.1 Remove disturbed or contaminated gaskets.

.2 Clean, lubricate and replace before jointing is attempted again.

.11 Complete each joint before laying next length of pipe. Minimize deflection after joint has been made.

.12 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.

.13 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes.

.14 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.

.15 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.

.16 Do not lay pipe on frozen bedding.

.17 Do hydrostatic and leakage test and have results approved by Departmental Representative.

.18 Backfill remainder of trench.

3.5 VALVE INSTALLATION

.1 Install valves to manufacturer's recommendations at locations as indicated.

.2 Support valves located in valve boxes or valve chambers by means of concrete located between valve and solid ground.

.3 Install underground post-type indicator valves as indicated.

3.6 SERVICE CONNECTIONS

.1 Do not install service connections until satisfactory completion of hydrostatic and leakage tests of water main.

.2 Construct service connections at right angles to water main unless otherwise directed.

.3 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps, strap type with "O" ring seal cemented in place .

.4 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.

.5 Install single and multiple tap service connections on top half of main, between 45 degrees and 90 degrees measured from apex of pipe.

.6 Tap main at 2:00 o'clock or 10:00 o'clock position only; not closer to joint nor closer to adjacent service connections than recommended by manufacturer, or 1 m minimum, whichever is greater.

.7 Leave corporation stop valves fully open.

.8 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.

.9 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.

.10 Install curb stop with corporation box on services NPS 2 or less in diameter.

.1 Equip larger services with gate valve and cast iron box.

.2 Set box plumb over stop and adjust top flush with final grade elevation.

.3 Leave curb stop valves fully closed.

3.7 THRUST BLOCKS AND RESTRAINED JOINTS

.1 For thrust blocks: do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete .

.2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated..

.3 Keep joints and couplings free of concrete.

.4 Do not backfill over concrete within 24 hours after placing.

.5 For restrained joints: only use restrained joints approved by Departmental Representative.

3.8 PIPE ISULATION

.1 Insulate pipe in location as shown on design drawings

.2 Material:

.1 Rigid polyurethane foam, factory applied
.2 Thickness: 50.8 mm
.3 Density 35 to 48 kg/m3
.4 Closed cell content: 90%, minimum
.5 Thermal conductivity: 0.020 to 0.025 W/m degrees Celsius.
.6 Temperature range: -20C to 40C

.3 Jacketing to be 1.27mm thick polyethylene

3.9 LEAKAGE TESTING

.1 Do tests in accordance with ANSI/AWWA C600 .

.2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.

.3 Notify Departmental 3 working days in advance of proposed tests.

.1 Perform tests in presence of Departmental Representative.

.4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete.

.5 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.

.6 Open valves.

.7 Expel air from main by slowly filling main with potable water.

.1 Install corporation stops at high points in main where no air-vacuum release valves are installed.
.2 Remove stops after satisfactory completion of test and seal holes with plugs.

.8 Apply leakage test pressure of 1380 kPa minimum after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of 2 hours.

.9 Do not exceed allowable leakage of 1.25 L/mm of pipe/ 1000m length/ 24 hours, including lateral connections.

.10 Locate and repair defects if leakage is greater than amount specified.

.11 Repeat test until leakage is within specified allowance for full length of water main.

3.10 BACKFILL

.1 Place backfill material, above pipe surround, in uniform layers not exceeding 300 mm compacted thickness up to grades as indicated.

.2 Do not place backfill in frozen condition.

.3 Under paving and walks, compact backfill to at least [[95 % corrected maximum dry density 95% maximum density to ASTM D698 .

.1 In other areas, compact to at least [90% corrected maximum dry density [[90 % maximum density to ASTM D698 .

3.11 FLUSHING AND DISINFECTING

.1 Flushing and disinfecting operations:.

.1 Notify Departmental Representative 4 days in advance of proposed date when disinfecting operations will begin.

.2 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear.

.3 Flushing flows as follows:

Pipe Size NPS	Flow (L/s) Minimum
6 and below	38
8	75
10	115
12	150

.4 Provide connections and pumps for flushing as required.

.5 Open and close valves, hydrants and service connections to ensure thorough flushing.

.6 When flushing has been completed introduce strong solution of chlorine as approved by into water main and ensure that it is distributed throughout entire system .

.7 Disinfect water mains to the requirements of local authority.

.8 Rate of chlorine application to be proportional to rate of water entering pipe.

.9 Chlorine application to be close to point of filling water main and to occur at same time.

.10 Operate valves, hydrants and appurtenances while main contains chlorine solution.

.11 Flush line to remove chlorine solution after 24 hours.

.12 Measure chlorine residuals at extreme end of pipe-line being tested.

.13 Perform bacteriological tests on water main, after chlorine solution has been flushed out.

.1 Take samples daily for minimum of 2 days.

.2 Should contamination remain or recur during this period, repeat disinfecting procedure.

.3 Specialist contractor to submit certified copy of test results.

.14 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.

.15 After adequate chlorine residual [not less than 50 ppm has been obtained leave system charged with chlorine solution for 24 hours.

.1 After 24 hours, take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 31 05 16 - Aggregate Materials

1.2 REFERENCES

.1 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA C104/A21.4-08 , Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

.2 ANSI/AWWA C111/A21.11- 06 , Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.3 ANSI/AWWA C151/A21.51- 09 , Standard for Ductile-Iron Pipe, Centrifugally Cast.

.4 ANSI/AWWA C207- 07 , Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 Inch Through 144 Inch (100 mm Through 3,600 mm).

.5 ANSI/AWWA C600- 10 , Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.

.6 ANSI/AWWA C900- 07 , Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 Inch Through-12 Inch (100 mm-300 mm), for Water Transmission and Distribution.

.2 ASTM International

.1 ASTM C136- 06 , Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.2 ASTM C117- 04 , Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.3 ASTM D698- 07e1 , Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort ((12,400 ft-lbf/ft;) (600kN-m/m;)).

.4 ASTM D2241- 09 , Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

.5 ASTM D2310- 06 , Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

.6 ASTM D2992- 06 , Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fitting.

.7 ASTM D2996- 01(07)e1 , Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber- Reinforced Thermosetting Resin Pipe).

.8 ASTM D3034- 08 , Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Scheduling:

.1 Schedule Work to minimize interruptions to existing services.

.2 Submit schedule of expected interruptions and adhere to schedule approved by Departmental Representative.

.3 Notify Departmental Representative a minimum of 24 hours in advance of interruption in service.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Certification to be marked on pipe.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations.

.2 Store and protect pipes from damage.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Polyvinyl chloride (PVC) pipe: to CSA B137

.1 Schedule 80 PVC.

.2 Pressure Class: 210 PSI.

.3 Gasket bell end.

.4 Pipe joints: bell and spigot with rubber gaskets, solvent welded joints, or mechanical joints to ANSI/AWWA C111/A21.11, with transition gaskets to pipe manufacturers specifications.

2.2 PIPE BEDDING AND SURROUND MATERIALS

.1 Granular material to Section 31 05 16 - Aggregate Materials and following requirements:

2.3 BACKFILL MATERIAL

.1 As indicated.

.2 Type 3, in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling].

.3 Unshrinkable fill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling].

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for pipe installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representativeof unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 TRENCHING

.1 Do trenching Work, in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.2 Place granular bedding in unfrozen condition.

.3 Place granular bedding material in uniform layers not exceeding 300 mm compacted thickness.

.4 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.

.5 Shape transverse depressions as required to suit joints.

.6 Compact each layer full width of bed to at least 95% maximum density to ASTM D698.

.7 Fill excavation below design elevation of bottom of specified bedding with compacted bedding material.

3.3 INSTALLATION

.1 Lay pipes in accordance with manufacturer's recommendations.

.2 Join pipes in accordance with manufacturer's recommendations.

.3 Avoid damage to machined ends of pipes in handling and moving pipe.

.4 Maintain grade and alignment of pipes.

.5 Align pipes carefully before jointing.

.6 Joint deflection permitted within limits in accordance with pipe manufacturer's written recommendations.

.7 Support pipe firmly over entire length, except for clearance necessary at couplings.

.1 Do not use blocks to support pipe.

.8 Keep pipe and pipe joints free from foreign material.

.9 Avoid bumping gasket and knocking it out of position, or contaminating with dirt or other foreign material. Remove disturbed gaskets clean, lubricate and replace before jointing is attempted.

.10 Support pipes using hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

.11 Apply sufficient pressure in making joint to ensure that joint is complete to manufacturer's recommendations.

.12 Apply restraint to pipe to ensure that joints when completed are held in place, by tamping fill material under and alongside pipe, or otherwise as approved by Departmental Representative.

.13 When stoppage of Work occurs, block pipe as directed by Departmental Representative to prevent creep during downtime.

3.4 PIPE ISULATION

.1 Insulate pipe in location as shown on design drawings

.2 Material:

.1 Rigid polyurethane foam, factory applied
.2 Thickness: 50.8 mm
.3 Density 35 to 48 kg/m3
.4 Closed cell content: 90%, minimum
.5 Thermal conductivity: 0.020 to 0.025 W/m degrees Celsius.
.6 Temperature range: -20C to 40C

.3 Jacketing to be 1.27mm thick polyethylene

3.5 THRUST BLOCKS

.1 Restrain bends, tees and fittings using concrete thrust blocks as indicated.

.2 Keep pipe couplings free of concrete.

.3 Bearing area of thrust blocks to be as indicated.

3.6 PIPE SURROUND

.1 Place surround material in unfrozen condition.

.2 Compact each layer from pipe invert to mid height of pipe to at least 95% maximum density to ASTM D698.

.3 Compact each layer from mid height of pipe to underside of backfill to at least 95% maximum density to ASTM D698.

.4 When field test results are acceptable to Departmental Representative place surround material at pipe joints.

3.7 BACKFILL

.1 Place backfill material in unfrozen condition.

.2 Place backfill material, above pipe surround in uniform layers not exceeding 300 mm compacted thickness up to grades as indicated.

.3 Compact backfill to at least 95 % maximum density to ASTM D698.

.4 Place unshrinkable fill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.8 FIELD TESTING OF FORCE MAIN

.1 Testing of force main to be carried out in presence of Departmental Representative

.2 Strut and brace caps, bends and tees, to prevent movement when test pressure is applied.

.3 Expel air from force main, by slowly filling main with water.

.1 Drill and tap high points and install suitable cocks to vent air and to be shut when pressure is applied.

.2 Remove cocks after satisfactory completion of test and seal holes with tight fitting plugs.

.4 Apply hydrostatic test pressure of 60 kPa based on elevation of lowest point in line and corrected to elevation of test gauge for hydrostatic test and 60 kPa for leakage test.

.5 Apply pressure for 1 hour for pressure test and 2 hours for leakage test.

.6 Examine exposed pipe, joints and fittings while system is under pressure.

.7 Remove defective joints, pipe and fittings and replace with new sound material.

.8 Define leakage as amount of water supplied from water storage tankin order to maintain test pressure for 2 hours.

.9 Do not exceed allowable leakage as defined in ANSI/AWWA C600.

.10 Locate and repair defects if leakage is greater than amount specified.

.11 Repeat test until leakage is within specified allowance for full length of force main.

.12 Complete backfill.

.13 Repeat test after completing backfill. Locate and repair defects and backfill. Repeat tests, repairs and backfills as needed until leakage is less than amount specified.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 01 74 11 – Cleaning.

.3 Section 01 74 19 - Waste Management and Disposal

.4 Section 03 30 00 - Cast-in-Place Concrete

.5 Section 32 11 23 - Aggregate Base Courses

.6 Section 31 23 33.01 - Excavating, Trenching and Backfilling

1.2 REFERENCES

.1 ASTM International

.1 ASTM C12- 09 , Standard Practice for Installing Vitrified Clay Pipe Lines.

.2 ASTM C14M- 07 , Standard Specification for Concrete Sewer, Storm Drain and Culvert Pipe (Metric).

.3 ASTM C76M- 10a , Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).

.4 ASTM C117- 04 , Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.5 ASTM C136- 06 , Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

.6 ASTM C425- 04(2009) , Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.

.7 ASTM C428- 97(06) , Standard Specification for Asbestos-Cement Nonpressure Sewer Pipe.

.8 ASTM C443M- 10 , Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).

.9 ASTM C506M- 10b , Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe.

.10 ASTM C507M- 10b , Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe (Metric).

.11 ASTM C663- 98(2008) , Standard Specification for Asbestos-Cement Storm Drain Pipe.

.12 ASTM C700- 11 , Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.

.13 ASTM D698- 07e1 , Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft;(600 kN-m/m;)).

.14 ASTM D1056- 07 , Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.

.15 ASTM D1869- 95(2010) , Standard Specification for Rubber Rings for Asbestos-Cement Pipe.

.16 ASTM D2680- 01(2009) , Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.ASTM D3034- 08 , Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

.17 ASTM F405- 05 , Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings.

.18 ASTM F667- 06 , Standard Specification for Large Diameter Corrugated Polyethylene Tubing and Fittings.

.19 ASTM F794- 03(2009) , Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1- M89 , Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2- M88 , Sieves, Testing, Woven Wire, Metric.

.3 CAN/CGSB-34.9- 94 , Asbestos-Cement Sewer Pipe.

.3 CSA International

.1 CAN/CSA-A3000- 08 , Cementitious Materials Compendium.

.2 CSA A257 Series- M92(R2009) , Standards for Concrete Pipe.

.3 CAN/CSA-B1800- 06 , Thermoplastic Non-pressure Pipe Compendium - B1800 Series.

.4 CSA G401- 07 , Corrugated Steel Pipe Products.

.4 U.S. Environmental Protection Agency (EPA) / Office of Water

.1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 SCHEDULING

.1 Schedule Work to minimize interruptions to existing services and to maintain existing flow during construction.

.2 Submit schedule of expected interruptions for approval and adhere to approved schedule.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for pipes, and backfill and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Shop drawings to indicate proposed method for installing carrier pipe for under crossings.

.2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada.

.4 Certification to be marked on pipe.

.5 Test and Evaluation Reports: submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations.

.2 Store and protect pipes from damage.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 CONCRETE PIPE

.1 Reinforced circular concrete pipe and fittings: to CSA A257, ASTM C76M 600 mm diameter, strength classification as indicated, designed for flexible rubber gasket joints to ASTM C443M, CSA A257.

2.2 PLASTIC PIPE

.1 Type PSM Poly Vinyl Chloride (PVC): to ASTM D3034 CAN/CSA-B1800.

.1 Standard Dimensional Ratio (SDR): 28.

.2 Separate gasket and integral bell system.

.3 Nominal lengths: 4 m.

2.3 PIPE BEDDING AND SURROUND MATERIAL

.1 Granular material in accordance with Section 32 11 23 - Aggregate Base Courses.

.2 Concrete mixes and materials for bedding, cradles, encasement, supports: in accordance with Section 03 30 00 - Cast-in-Place Concrete.

2.4 BACKFILL MATERIAL

.1 As indicated on design drawings and in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling..

.2 Type 3 in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.3 Unshrinkable fill: in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.5 JOINT MORTAR

.1 Portland cement: to CAN/CSA-A3000, normal type 10.

.2 Mortar: one part Portland cement to two parts clean sharp sand mixed with minimum amount of water to obtain optimum consistency for use intended. Do not use additives.

Part 3 Execution

3.1 PREPARATION

.1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.

3.2 TRENCHING

.1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.2 Protect trench from contents of sewer.

.3 Trench alignment and depth to approval of Departmental prior to placing bedding material and pipe.

3.3 CONCRETE BEDDING AND ENCASEMENT

.1 Do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete. Place concrete to details as indicated.

.2 Position pipe on concrete blocks to facilitate placing of concrete.

.1 When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.

.3 Backfill over concrete after 24 hours from placing.

3.4 GRANULAR BEDDING

.1 Place bedding in unfrozen condition.

.2 Place granular bedding material in uniform layer s not exceeding 300 mm compacted thickness to depth as indicated.

.3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.

.1 Do not use blocks when bedding pipes.

.4 Shape transverse depressions as required to suit joints.

.5 Compact each layer full width of bed to at least 95% maximum density to ASTM D698.

.6 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with compacted bedding material.

3.5 INSTALLATION

.1 Lay and join pipes to: ASTM C12.

.2 Lay and join pipe in accordance with manufacturer's recommendations and to approval of Departmental Representative.

.3 Handle pipe using methods approved by Departmental Representative

.1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.

.4 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points.

.1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.

.5 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.

.6 Joint deflection permitted within limits recommended by pipe manufacturer.

.7 Water to flow through pipes during construction only as permitted by Departmental Representative.

.8 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.9 Install plastic pipe and fittings in accordance with CAN/CSA-B1800.

.10 Joints:

.1 Concrete, clay and asbestos cement pipe:

.1 Install gaskets as recommended by manufacturer.

.2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

.3 Align pipes before joining.

.4 Maintain pipe joints free from mud, silt, gravel and other foreign material.

.5 Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.

.6 Complete each joint before laying next length of pipe.

.7 Minimize joint deflection after joint has been made to avoid joint damage.

.8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.

.9 Mortared joints:

.1 Pipe exterior: for bell and spigot pipe, use mortar to seal outside of joints. Press and bed mortar into place.

.1 Allow mortar to set minimum of 1 hour before backfilling.

.11 When any stoppage of Work occurs, restrain pipes as directed by Departmental Representative to prevent "creep" during down time.

.12 Plug lifting holes with Departmental Representative approved prefabricated plugs, set in shrinkage compensating grout.

.13 Cut pipes as required for special inserts, fittings or closure pieces, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.

.14 Make watertight connections to manholes and catch basins.

.1 Use shrinkage compensating grout when suitable gaskets are not available.

.15 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes.

.1 Joint to be structurally sound and watertight.

.16 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

3.6 PIPE SURROUND

.1 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.

.1 Leave joints and fittings exposed until field testing is completed.

.2 Hand place surround material in uniform layers not exceeding 300mm compacted thickness as indicated.

.1 Do not dump material within 3 m of pipe.

.3 Place layers uniformly and simultaneously on each side of pipe.

.4 Compact each layer from pipe invert to mid height of pipe to at least 95 % maximum density to ASTM D698.

.5 Compact each layer from mid height of pipe to underside of backfill to at least 95 % maximum density to ASTM D698.

.6 When field test results are acceptable to Departmental Representative place surround material at pipe joints.

3.7 BACKFILL

.1 Place backfill material in unfrozen condition.

.2 Place backfill material, above pipe surround, in uniform layers not exceeding 300mm compacted thickness up to grades as indicated.

.3 Under paving and walks, compact backfill to at least 95 % maximum density to ASTM D698. In other areas, compact backfill to at least 95 % maximum density to ASTM D698.

.4 Place unshrinkable backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.8 FIELD TESTS AND INSPECTIONS

.1 Repair or replace pipe, pipe joint or bedding found defective.

.2 Remove foreign material from sewers and related appurtenances by flushing with water.

.3 Television and photographic inspections:

.1 Carry out inspection of installed sewers by television camera, photographic camera or by other related means.

.2 Provide means of access to permit Departmental Representative to do inspections.

.3 Payment for inspection services in accordance with Price and Payment Procedures in PART 1.

3.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 Materials and installation for subsoil drainage piping.

1.2 Related Sections

.1	Section 01 91 13	General Commissioning (Cx) Requirements
.2	Section 01 91 31	Commissioning (Cx) Plan
.3	Section 01 91 33	Commissioning Forms
.4	Section 01 91 41	Commissioning Training
.5	Section 01 91 51	Building Management Manual (BMM)
.6	Section 31 23 33.01	Excavation, Trenching and Backfill

1.3 References

.1 Canadian Standards Association (CSA International)

.1 CSA B1800, Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).

.2 CSA B182.1-02, Plastic Drain and Sewer Pipe and Pipe Fittings.

.3 CSA B182.2-02, PVC Sewer Pipe and Fittings (PSM Type).

.4 CSA B182.11-02, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.

1.4 Definitions

.1 Pipe section is defined as length of pipe between successive manholes and/or between manhole and any other structure which is part of sewer system.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with the manufacturer's recommendations.

1.6 Waste Management and Disposal

.1 Remove from site and dispose of packaging materials at appropriate disposal facilities.

.2 Place materials defined as hazardous or toxic in designated containers.

.3 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations, and Division 2 specifications.

.4 Dispose of unused asbestos cement pipe in accordance with regulations governing the disposal of hazardous materials and Division 2 specifications.

PART 2 PRODUCTS

2.1 Subsoil Drain Piping

.1 Perforated rigid drainage pipe: Polyvinyl Chloride (PVC) to CSA-B182.2.

.2 Standard Dimensional Ratio (SDR): 35.

.3 Pipe stiffness: 320 kPa at 5% deflection, ASTM D2412.

.4 Fitting: solid hub by hub.

.5 Size: 150mm [6”] unless otherwise noted.

2.2 Cleanout

.1 Extended ferrule, Dura-Coated cast iron body with gas and water tight ABS countersunk plug.

PART 3 EXECUTION

3.1 Preparation

.1 Clean and dry pipes and fittings before installation.

.2 Obtain Departmental Representative's approval of pipes and fittings prior to installation.

3.2 Excavation

.1 Do excavation work in accordance with Section 31 23 33.01.

3.3 Pipe Bedding and Cover

.1 Subsoil drain shall be laid to on 150 mm drain gravel and covered with 250mm of drain gravel measured from the top of pipe, unless otherwise shown or specified. Do not place material in frozen conditions.

.2 Shape bed true to grade to provide continuous uniform bearing surface for pipe. Do not use blocks when bedding pipe.

.3 Shape transverse depressions in bedding as required to suit joints.

.4 Fill excavation below design elevation to bottom of specified bedding in accordance with Section 31 23 33 with backfill material.

3.4 Installation of Pipe Subsoil Drain Piping

.1 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.

.2 Handle pipe using methods approved by the Departmental Representative. Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.

.3 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.

.1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.

.2 Correct pipe which is not in true alignment and grade or pipe which shows differential settlement after installation great than 10 mm in 3 meters.

.3 Subsoil drain shall be laid continuous and even falls of not less than 0.5% unless otherwise noted.

.4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.

.5 Do not exceed maximum joint deflection recommended by pipe manufacturer.

.6 Do not allow water to flow through pipe during construction, except as may be permitted by the Departmental Representative.

.7 Install plastic pipe and fittings in accordance with CSA B182.11.

.8 Make watertight connections to manholes and catch basin. Use shrinkage compensating grout when suitable gaskets are not available. Stabilize pipe at openings made in rock pit manhole with shrinkage compensating grout.

.9 All changes in direction shall be made with solid hub by hub fittings. Vertical drops shall be solid with a minimum of 100mm [4"] gravel curtain around pipe. Branches will be taken off with Y's and catch basin connections shall be made with one length of cast iron pipe.

.10 Provide cleanouts at changes in direction, extended to terminate flush with grade.

.11 Where noted on drawing, provide geotextile materials.

3.5 Installation of French Drains

.1 Install French drains as indicated.

.2 Backfill remainder of trench to Section 32 23 33.01 – Excavating Trenching and Backfill.

.1 Install clay seal at top of French drain.

.3 Provide perforated rigid subsoil drain piping with cleanout to 600mm x 600mm x 600mm French Drain and connect to subsoil drain piping adjacent. Confirm exact location of French Drain on site. Slope away grade around French Drain.

END OF SECTION

ESQUIMALT GRAVING DOCK

ESU SSSR

ESQUIMALT, BRITISH COLUMBIA

APPENDIX A

PRE-CONSTRUCTION HAZARDOUS BUILDING MATERIAL AND SURVEY REPORT

Hazardous Building Material Assessment

Esquimalt Graving Dock – PWGSC Buildings

Prepared for:

Public Service Commission of Canada | Commission de la fonction publique du Canada

Environmental Services

Prepared by

North West Environmental Group Ltd.

210-2950 Douglas Street
Victoria, British Columbia
NWEG Project: 15458

EXECUTIVE SUMMARY

Introduction

North West Environmental Group Ltd. was retained by Public Works and Government Services Canada (PWGSC) Environmental Services to conduct a Hazardous Materials Assessment on the Public Works and Government Services Canada owned buildings located within the Esquimalt Graving Dock (EGD), Esquimalt BC.

The surveys were conducted on PWGSC owned buildings at the Esquimalt Graving Dock on various dates between October 24th - December 9th 2011.

Previous Hazardous Building Materials Assessment reports and documentation were reviewed and additional non-destructive floor-by-floor, room-by-room assessments of all building areas were conducted in order to identify hazardous materials and their condition.
Identification of all sampling locations were made on detailed floor plans, and a summary of remedial recommendations made by priority.

FINDINGS AND RECOMMENDATIONS

Asbestos

Asbestos-containing materials were found in various locations within the building fabric and mechanical systems of the PWGSC buildings.

Asbestos was identified in the following materials:

- Floor tiles (exposed and concealed)
- Sheet flooring (exposed and concealed)
- Floor mastic (concealed)
- Transite board
- Caulking (various)
- Cementitious Parging

Table 1: Asbestos Containing Materials Summary-Current Survey

Asbestos containing materials were identified to be in the following materials/locations:			
Sample ID	**Building**	**Material**	**Recommendation**
15458-58	Building 61 PWGSC Land Leased to Seaspan (Butler Buildings) – SJ39 Stores	Exterior Caulking – 7% Chrysotile Asbestos Content	Routine Surveillance: Institute routine surveillance of the ACM.
15458-59	Building 61 PWGSC Land Leased to Seaspan (Butler Buildings) – SJ40 Offices	Sheet Flooring (Brown & Beige) – 20% Chrysotile Asbestos Content	Proactive Removal or Routine Surveillance: Institute routine surveillance of the ACM.

Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material

Asbestos containing materials were identified to be in the following materials/locations:			
15458-68	Building 31 PWGSC Owned Pump House	Concrete Cementitious Parging Compound – <1% Chrysotile Asbestos Content	Routine Surveillance: Institute routine surveillance of the ACM.
15458-73	Building 58 PWGSC Owned South Side Sub Station – Electrical Generator Room	Caulking (Tan) - South Door Frame – 2% Chrysotile Asbestos Content	Routine Surveillance: Institute routine surveillance of the ACM.
15458-83	Building 7 DND Property PWGSC Washroom (Back Lot) – Storage/Furnace Room	Floor Tile (White 12"x12") – 3% Chrysotile Asbestos Content	Routine Surveillance: Institute routine surveillance of the ACM.
15458-87	Building 7 DND Property PWGSC Washroom (Back Lot) – Women's Washroom	Sheet Flooring (Yellow/Brown – Bottom Layer) – 15% Chrysotile Asbestos Content	Repair and/or Proactive Removal
15458-89	Building 7 DND Property PWGSC Washroom (Back Lot) – Men's Washroom	Mastic – (2nd Layer under White Sheet Flooring) – <1% Chrysotile Asbestos Content	Routine Surveillance: Institute routine surveillance of the ACM.
15458-95	Tunnels	Transite Piping (Sewage Line) – 40% Chrysotile & 8% Crocidolite Asbestos Content	Routine Surveillance: Institute routine surveillance of the ACM.
15458-100	Building 9 PWGSC Old Guard House	Floor Tile (Beige 12"x12" – Bottom Layer) – 12% Chrysotile Asbestos Content	Routine Surveillance: Institute routine surveillance of the ACM.

In addition to the materials identified in Table 1, the following ACM were identified during the review of previous documents and reports.

Table 2: Asbestos Containing Materials Summary-Previous Surveys

Asbestos containing materials were identified to be in the following materials/locations:			
Sample ID	**Building**	**Material**	**Recommendation**
1865-10	Back Gate Guardhouse Siding and soffit	Exterior Cladding- 55% Chrysotile Asbestos Content	Routine Surveillance: Institute routine surveillance of the

Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material

Lead

Table 3: Paint Chip Sampling Results

Sample	Description	Lead (%)
15458- 17	Pumphouse-Penstock Room (South Wall) Desc: Paint-Lt. Green	6.5
15458- 20	Pumphouse-Main Penstock Building Desc: Paint-Yellow/Lt.Blue int.Conc.Walls	<0.010
15458-23	Pumphouse-Main Penstock Building Desc: Paint- Grey-Exterior	0.093
15458-27	Site: Pumphouse - Welding Shop - South Wall, Yellow	1.9
15458-29	Site: Pumphouse - Welding Shop - South Wall, Lt. Green	0.27

Paint

Analysis of paint samples indicated that lead is present in concentrations ranging from 6.5% to a low of <0.010%. Samples were found to have lead concentrations in excess of the threshold specified in the federal *Surface Coatings Material Regulation SCMR* of 90 mg/kg for new paint acceptable for use in residential applications.

Overall, paint coatings were found to be in fair to good condition. Where damaged and deteriorating, paint should be removed following procedures designed to protect the workers from heavy metal exposure and to avoid the spread of contamination. Lead content of painted materials should not increase their disposal costs however; concentrated paint chips would need to be disposed as hazardous waste. Routine removal of lead paint is not recommended, rather it should be managed in place and removed on an "as needed" basis.

Polychlorinated Biphenyls (PCB) in Electrical Equipment

Fluorescent light fixtures were observed and appeared to be of a vintage often found to contain ballasts which Environment Canada (EC) has developed a guideline called - *Identification of Lamp Ballasts Containing PCBs –Environment Canada 1991.*

Manufacturers of ballasts and capacitors use distinct catalogue and date codes to identify their product, its date of manufacture, and, for some capacitors, its dielectric fluid. Fluorescent lamp ballasts are usually mounted between the fluorescent tubes on the light fixture and are shielded with a metal protective device which reduces heat radiation. Due to the fact the covers are easily broken and the risk of electrical shock when accessing the ballast, it is standard practice to make the observation that there is a potential for PCBs to be present and have the ballasts inspected prior to disposal.

The hazardous building material materials assessment report from NWEG in 2000 mentioned that many of these ballasts have already been removed.

Inspect all light ballasts for the presence of PCB prior to disposal. PCB containing ballasts must be disposed as hazardous waste.

Mould

No mould or significant moisture issues were observed during the survey.

Hantavirus-Animal Droppings

Materials suspected of containing Hantavirus were not observed during the survey.

Workers accessing areas where rodent or other animal droppings are present must be informed of the potential risk of Hantavirus exposure and employ suitable precautions for personal protection and control of the spread of contamination.

Ozone Depleting Substances

Several pieces of equipment containing ozone depleting substances (ODS) were observed during this investigation. PWGSC maintains an active halocarbon inventory.

Crystalline Silica

Testing for crystalline silica in dust was not completed/conducted as part of this survey however it is known to be a component of concrete dust. All concrete, plaster and stucco is suspected of containing silica in crystalline and non-crystalline forms. Many of the removal techniques (grinding, cutting, chipping etc) for these materials can generate high levels of crystalline silica in the air.

Use wetting techniques and/or HEPA equipped extraction systems attached to drills and other power equipment where possible in order to decrease dust levels.

As per the clients request, non-invasive investigative techniques were used. Even with the most invasive survey techniques, however, it should be noted that the possibility remains for other concealed materials to be found during a renovation or demolition.

Warning: in the event any additional suspect materials are encountered during demolition or renovation activities, work on those materials must stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material. If this any materials suspected of containing asbestos or another hazardous material are disturbed during the work, all work shall stop until the area is contained, the hazard evaluated by a qualified professional and the hazardous materials, if indeed present, is safely managed by a qualified contractor.

TABLE OF CONTENTS

LIST OF ACRONYMS

ACM ..... asbestos-containing materials
ALARA ..... As Low As Reasonably Achievable
AMP ..... Asbestos Management Program
CFCs ..... chlorofluorocarbons
EC ..... Environment Canada
EGD ..... Esquimalt Graving Dock
EMA ..... Environmental Management Act
HCFCs ..... hydrochlorofluorocarbons
HFCs ..... hydrofluorocarbons
HPA ..... Hazardous Products Act
HWR ..... Hazardous Waste Regulation
NWEG ..... North West Environmental Group
ODS ..... ozone-depleting substances
PCBs ..... Polychlorinated biphenyls (PCBs
PWGSC ..... Public Works and Government Services Canada
SCMR ..... Surface Coating Materials Regulation
SOW ..... Statement of Work
WMO ..... United Nations World Meteorological Organization

1.0 INTRODUCTION

North West Environmental Group Ltd. was retained by Public Works and Government Services Canada (PWGSC) Environmental Services to conduct a Hazardous Materials Assessment Survey on the Public Works and Government Services Canada owned buildings located at the Esquimalt Graving Dock, Esquimalt BC. The facility is referred to as the "subject site" or "site" throughout this document. The site location is shown on Drawing 1.

The surveys were conducted between October 24th and December 9th 2011 by Julie Scott-Moncrieff, Jason Smit and Kris White, Industrial Hygienists from North West Environmental Group.

Note: this document is detailed review of hazardous materials found within the building fabric of the site; however, it cannot be considered an absolute listing of all hazardous materials present within the structure. Occupant supplies and processes were not generally considered except where they may have contaminated the building fabric and some materials may have been concealed within enclosed areas of the building structure and not visible to the inspectors at the time of the survey. In the event that materials suspected of containing asbestos, heavy metals or other hazardous components are uncovered or impacted during operations, maintenance, renovation, construction or demolition activities, all work must stop until such time as the materials can be evaluated by a qualified person and appropriate precautions are employed to protect workers and building occupants.

2.0 SCOPE OF WORK

The scope of work for this hazardous materials assessment survey was based on the *Scope of Work* (SOW) outlined by PWGSC-Environmental Services (date) and included the following tasks:

- Previous Hazardous Building Materials Assessment reports and documentation were reviewed, incorporating the pertinent and confirmed information into the current assessment. These included:
  - Hazardous Materials Report: Esquimalt Graving Dock: Rob Christie, NWEG (March 2000)
  - First Aid Washroom Hazardous Materials Survey (1999)
- Non-destructive floor-by-floor, room-by-room assessment of all building areas, identifying the location, accessibility to personnel, type of material (e.g. vinyl floor tiles, wall paint, thermostat) and condition of all asbestos-containing materials (including vermiculite insulation), lead materials, mercury containing equipment, ozone depleting substances and PCBs.

  The following buildings were assessed:
  - Building: 31 PWGSC Owned Pump House
  - Building: 26 PWGSC Penstock Structure
  - Building: 32 PWGSC Owned Middle Dock Stairwell
  - Building: 29 PWGSC Owned Welding Shop
  - Building: 19 PWGSC Administration Trailers
  - Building: PWGSC Security Trailer (H&S)
  - Building: 18 PWGSC Owned Operations Building
  - Building: 61 PWGSC Land Leased To Seaspan (Butler Buildings)
  - Building: 16 PWGSC Owned Electrical Shop Building
  - Building: 58 PWGSC Owned South Side Sub Station
  - Building: 24 PWGSC Owned Main Sub Station
  - Building: 30 PWGSC Owned Garage
  - Building: 41 PWGSC Owned Winch Building
  - Building: 7 PWGSC Washroom Trailer
  - Building: 68 PWGSC Washroom Trailer
  - Building: 9 PWGSC Old Guard House
  - Service Tunnels
  - Caissons 1 & 2

- Sampling and subsequent analysis to ascertain the amount of hazardous materials within the buildings using a laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP), as per PWGSC Departmental Directive 057.
- Identification of all sampling locations on detailed floor plans, distinguishing between those that are confirmed to be hazardous and those that are not.
- A summary of remedial recommendations sorted by priority. Preparation of a separate summary of costs for repair, encapsulation or removal of the asbestos containing materials and other hazardous materials, presented as remedial options and report detailing the results, conclusions and recommendations as well as an abatement cost estimate, if necessary.

3.0 SITE DESCRIPTION

3.1 Site Location

The Esquimalt Graving Dock (EGD) is located in Esquimalt, BC, near the city of Victoria, on the southern tip of Vancouver Island. The site is located as shown on in Appendix A. EGD is owned by PWGSC and private shipyard companies lease space at the EGD for ship maintenance and buildings operations. This survey assessed buildings on site owned by PWGSC (excluded tenant owned buildings)

See Appendix A for map of Site Location and Plan.

4.0 REGULATORY FRAMEWORK, GUIDELINES AND CODES

4.1 Federal Occupational Health and Safety

In Federal jurisdictions, asbestos-containing materials (ACM) are regulated under the *Canada Labour Code, Part II.* Specifically, *Part X, Hazardous Substances,* provides the direction for the control of exposure to potentially toxic substances in the workplace. Under this regulation, employers are required to:

- Maintain a record of all hazardous materials;
- Undertake a hazard investigation by competent persons;
- Ensure materials are properly stored and handled;
- Post warning signs;
- Inform and educate employees regarding hazards; and
- Control exposure through substitution, engineering or protective equipment.

4.2 BC Occupational Health and Safety Regulation

Most of the employees working in the PWGSC buildings are Federal employees and are subject to the federal OHSA. However the majority of contractors and some site tenants Workplace health and safety is regulated in British Columbia by WorkSafeBC under the *Workers' Compensation Act* (effective April 15, 1998), as amended by *Workers' Compensation (Occupational Health and Safety) Amendment Act* (effective October 1, 1999). The Act defines the general duties and obligations of the employer, employees and others at the work site.

Under this regulation, employers are required to:

- Maintain a record of all hazardous materials;
- Undertake a hazard investigation by competent persons;
- Ensure materials are properly stored and handled;
- Post warning signs;
- Inform and educate employees regarding hazards; and
- Control exposure through substitution, engineering or protective equipment

WorkSafeBC Regulations apply to the handling of materials containing designated substances and the prevention of possible worker exposures. Permissible exposure limits to these designated substances, which include asbestos, lead, mercury and arsenic, are established by the American Conference of Governmental Industrial Hygienists (ACGIH) and adopted by WorkSafeBC.

4.3 Environmental Management Act

The *Environmental Management Act* (EMA), brought into force in July 2004, is the principle environmental statute in British Columbia. The EMA prohibits the introduction of waste into the environment in such a manner or quantity as to cause pollution, except in accordance with a regulation, permit, approval or code of practice issued under the Act. The Hazardous Waste Regulation (HWR) addresses the proper handling, transport and disposal of hazardous wastes, under provisions of the EMA. While the Provincial Regulations do not apply directly to the sites operated by the Federal Government, they do apply when the materials are removed from the site for disposal.

4.4 BC Occupational Health and Safety Regulation

WorkSafeBC Regulations apply to the handling of materials containing designated substances and the prevention of possible worker exposures. These designated substances, which include lead, mercury and arsenic, are established by the American Conference of Governmental Industrial Hygienists (ACGIH) and adopted by WorkSafeBC.

Where worker exposure to a designated substance may exceed 50% of the threshold limit value for a substance, WorkSafeBC requires that the employer establish an exposure control plan. All routes of entry must be considered when establishing the extent of worker exposure. Exposure limits are summarized in Table 4.4.1.

Table 4.4.1: ACGIH / WorkSafeBC Exposure Limits

Substance [CAS No.]	*Time Weighted Average (TWA)*
Asbestos - All forms [1332-21-4]	0.1 f/cc (F)
Lead - elemental and inorganic compounds, as Pb [7439-92-1]	0.05 mg/m3
Silica, Crystalline - alpha quartz [14808-60-7; 1317-95-9] and Cristobalite, Respirable [14464-46-1] Revised 2006	0.025 mg/m3

4.5 Hazardous Products Act, Surface Coating Materials Regulation

The *Hazardous Products Act (HPA), Surface Coating Materials Regulation (SOR/2005-109) (SCMR)* permits the advertising, sale and labeling of surface coatings (including paint) that meet the following criteria set out below. Quantities of lead and mercury are specifically limited. Other heavy metals are not addressed in this regulation.

There has been confusion in the past regarding the limits for lead and mercury in paint and how that relates to worker safety and disposal. An explanation of the SCMR limits for paint and mercury are included in this report to help alleviate this confusion. Although a given paint sample may have concentrations of lead and mercury lower than the limits specified within the SCMR, worker exposure may still occur if sufficient quantities of lead and/or mercury are inhaled, ingested or absorbed through the skin. The risk to workers posed by heavy metal containing coatings is proportional to the work undertaken. Heavy metal laden coatings that are not disturbed pose little risk to non-pre-school aged building occupants.

Lead

Paints containing lead may be advertised, sold or imported into Canada when under standardized testing conducted on a dried sample of the coating indicates that lead concentrations do not exceed 600 mg/kg.

In 2005 the *Federal Surface Coating Materials Regulation* was amended to reduce this threshold from 5,000 mg/kg to 600 mg/kg. As paints under this concentration of lead are acceptable for use in residential settings today, such coatings do not pose a significant hazardous material issue unless rendered airborne within a worker's breathing zone by fine dust generating processes.

Paints that exceed this concentration threshold are prohibited to be advertised, sold or imported into Canada unless they meet certain conditions of use and labeling. Permitted uses include:

- as an anti-corrosive or an anti-weathering coating applied on the interior or exterior surface of any building or equipment that is used for an agricultural or industrial purpose;
- as an anti-corrosive or an anti-weathering coating applied on any structure, other than a building, that is used for an agricultural, industrial or public purpose;
- as a touch-up coating for metal surfaces;
- on traffic signs;
- for graphic art on billboards or similar displays;
- for identification marks in industrial buildings; or
- as material for the purposes of arts, crafts or hobbies, other than material for use by children.

Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) are regulated under both Federal (*Canadian Environmental Protection Act*) and Provincial (*BC Hazardous Waste Regulation*) legislation and must be treated as PCB waste and be stored and disposed of accordingly.

Each fluorescent light fixture removed during facility renovation or demolition should have the ballast checked to determine if it contains PCBs. Ballasts containing PCBs must be removed, sorted and transported to a licensed facility. Although rare, paints have been known to contain PCBs.

Ozone-depleting Substances (CFCs/ODS)

Chlorofluorocarbons (CFCs) are ozone-depleting substances (ODS) and a type of halocarbon. ODS are regulated by the *Canadian Environmental Protection Act* under the *Ozone-Depleting Substances Regulations 1998 SOR/99-7* and the *Federal Halocarbon Regulations (FHR) SOR/99-225.* Compounds that contain only chlorine, fluorine and carbon are called CFCs. These materials are used in refrigeration systems and in fire suppression systems. The other main refrigerants are

hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs) and blends of fluorocarbons (designated by "R").

In BC these substances are regulated under the BC Ozone Depleting Substances and Other Halocarbons Regulation.

While the regulations allow the continued use of halocarbon refrigerants, they strictly prohibit any person from releasing any halocarbons into the environment.

In the case of demolition, ODS will require proper recovery and disposal. The BC Ozone-Depleting Substances Regulations would also apply to any CFC/ODS abatement procedures. These regulations require that all ODS be collected, stored and recycled, or collected and disposed of accordingly.

Crystalline Silica

Crystalline silica is a substance which is considered hazardous by inhalation and can result in serious and sometimes fatal lung disease. The ACGIH and WorkSafeBC, under the Occupational Health and Safety Regulation and the Canada Labour Code specify an exposure limit of 0.025 mg/m^3.

Paint

Paints often contain heavy metals as pigments and/or preservatives. Common heavy metal additives to paints are lead, mercury, and arsenic. Under specific circumstances, persons may be exposed to these metals by ingestion, skin absorption and/or inhalation.

Other than during the application process, the primary mechanism of exposure for workers would be the inhalation of dusts through activities such as sanding, scraping, drilling, crushing, heating, burning or other processes likely to damage the coatings themselves. Paints containing heavy metals pose little risk to workers when in good condition and when undisturbed.

Although limits are currently imposed in the quantities of lead permitted in paints intended for specific uses, lead content below these limits may still pose a health hazard if rendered airborne and inhaled, ingested or absorbed through the skin. The same applies to mercury. The Hazardous Products Act, Surface Coating Materials Regulation (SOR/2005-109) (SCMR) permits the advertising, sale and labeling of surface coatings (including paint) that meet the following criteria set out below. Quantities of lead and mercury are specifically limited. Other heavy metals are not addressed in this regulation.

In 1976, the amount of lead that could be added to interior paints was limited by law, but exterior paints could still contain higher amounts of lead, provided they carried a warning label. Under the Surface Coating Materials Regulations, which came into effect in 2005, the lead limit was further reduced (from Health Canada). The 600 mg/kg maximum total lead standard is the same as that proposed for paints and other liquid coating materials used for furniture, household products, children's products, and exterior and interior surfaces of any building frequented by children, under the recent

amendment to the Hazardous Products Act Liquid Coating Materials Regulations. It is also the same standard prescribed by the U.S. Consumer Product Safety Commission Regulation 16 CFR Part 1303, for paint and other liquid coatings for residential use, toys and furniture (97). This limit was determined by a risk assessment which calculated that 600 mg/kg of lead in paint was the threshold level, at or below which there would be no significant lead exposure if a child consumed a one square inch paint chip each day.

When lead is present in paint, there is a potential for airborne exposure of lead to workers. Airborne exposure can occur if the material is disturbed (especially if the lead containing materials are hand sanded); hand demolished and/or any other disturbances are made to the coating. An exposure control plan is necessary if workers are, or may be, exposed to lead in excess of 50 % of the exposure limit established by the Workers' Compensation Board (WorkSafeBC) for an 8 hours total weighted average exposure, or if exposure through any route of entry could cause elevated levels of lead in the blood. Lead precautions during demolition or renovation may be required, including the use of personal protective equipment for workers and/or dust suppression methods.

5.0 METHODOLOGY

The methodology of the survey is summarized in the following sections. Prior to all site work, a *Site Specific Health and Safety Plan* was developed and forwarded to PWGSC Environmental Services.

Asbestos

The asbestos survey methodology and sampling procedure are outlined in the following sections.

Survey Methodology

The survey was designed to determine the type and extent of asbestos containing material (ACM) presence within the subject site. The survey was non-destructive and therefore did not include areas that were inaccessible at the time of the survey. Where practicable, sample volumes were minimized to avoid unnecessary damage to building systems. Specific building material components were examined within the building and include, where applicable:

- Structural – all visible structural components including walls, roofs and supporting members
- Mechanical systems - insulation, domestic hot and cold water, and caulks.
- Architectural – systems including: texture coats, sheet flooring, vinyl floor tile, ceiling tile, wall board, drywall joint compound, asbestos sheet products.

Where materials were observed that were suspected of containing asbestos, representative samples were collected. One hundred and one (101) samples of materials suspected of containing asbestos were collected and submitted with a chain of custody to the contract laboratory.

A complete listing of all materials suspected of containing asbestos that were sampled, including the results of analysis is found in Section 6 of this report.

Sampling Procedures

Bulk Samples

Sampling procedures for various building materials vary somewhat depending on the exact conditions at each site. In all cases standardized protocols are used for collecting samples for asbestos analysis. All accessible suspect materials that were visually unique were sampled. Visually similar materials were only sampled once unless known to be heterogeneous such as drywall joint compound.

Sampled materials were cut down to the base substrate to ensure that a representative sample was collected.

Paint

Painted surfaces were scraped down to the base substrate to ensure that all layers of paint were included. Paint samples were tested using the following analytical method:

- Lead: EMSL (SW 846 3050B*/7000B) Lead in Paint Chips by Flame Atomic Absorption Spectrophotometer

A total of five paint chips were submitted to EMSL Analytical for analysis. The sample locations are shown on the floor plans

Polychlorinated Biphenyls (PCB)

The Site was surveyed for the presence of PCBs in electrical equipment. The primary source of PCBs was identified in fluorescent light ballasts which were evaluated according to the guideline developed by Environment Canada (EC) - *Identification of Lamp Ballasts Containing PCBs –Environment Canada 1991.*

Manufacturers of ballasts and capacitors use distinct catalogue and date codes to identify their product, its date of manufacture, and, for some capacitors, its dielectric fluid. Fluorescent lamp ballasts are usually mounted between the fluorescent tubes on the light fixture and are shielded with a metal protective device which reduces heat radiation. In order to determine if fluorescent light ballasts contain PCB's the metal protective cover is removed while the power is off to the fixture. With the ballast exposed the date code is visible and can be referenced in the EC guideline.

For ballasts not stamped "no PCB", in most cases, fluorescent light ballasts need to be removed from the fixture before the date of manufacture can be determined. The date of manufacture is critical in establishing whether PCB may be present in the ballast capacitor.

Ozone Depleting Substances (ODS) and Other Halocarbons

The subject building was inspected for the presence of devices that are known or suspected of containing to contain ODS or other halocarbons. Devices suspected of containing these materials were documented so that any hazardous materials can be removed prior to demolition or disposal of the equipment. These devices typically include refrigeration and air conditioning equipment.

Crystalline Silica

Testing for crystalline silica in dust was not completed/conducted as part of this survey however it is known to be a component of concrete dust. All concrete, plaster and stucco is suspected of containing silica in crystalline and non-crystalline forms. Many of the removal techniques (grinding, cutting, chipping etc) for these materials can generate high levels of crystalline silica in the air.

Mould

Within the BC Occupational Health and Safety Regulations, there are no established permissible exposure levels for mould spores in air. This means that there are no published concentrations above which worker exposure is deemed to be hazardous

and under which workers would not need respiratory protection. WorkSafeBC does, however, provide guidance on protocols for protecting workers from the hazards of airborne mould and bacteria within the section(s) of the Regulation guidelines addressing Indoor Air Quality.

Various other guidelines are provided for addressing mould in Canada including:

- The Institute of Inspection, Cleaning and Restoration and Certification (IICRC) standard S500 governing both water damage restoration and entitled: Standard for Professional Water Damage Restoration – S500. This document is approved by the American National Standards Institute (ANSI)
- Health Canada: Fungal contamination in public buildings: A guide to recognition and management, 1995
- Health Canada. Fungal Contamination in Public Buildings: Health Effects and Investigation Methods, 2004

These guidelines also state that any non-porous (metal, glass and hard plastics) and semi-porous (wood and concrete) materials that are structurally sound and visibly mouldy can be cleaned and re-used. However, porous materials such as ceiling tiles, wallpaper, insulation, drywall, and sometimes carpets with more than a small area of contamination should be removed and discarded.

6.0 FINDINGS AND RISK ASSESSMENT

The findings of the survey are discussed in the following sections. Photographs of sample locations are provided in Section 7.0. The asbestos risk assessment and indicative cost estimates are provided in this section. The analytical reports are provided in Appendix A.

6.1 Asbestos in Bulk Building Material Samples

A total of one hundred and one (101) samples of suspected asbestos containing materials were collected and submitted for analysis to the contract laboratory. The analytical results are provided both as an Excel Spreadsheet provided to the PWGSC-Environmental Services and attached as a pdf report in Appendix A.

Asbestos-containing materials were found in various locations within the building fabric and mechanical systems of the PWGSC buildings.

Asbestos was identified in the following materials:

- Floor tiles (exposed and concealed)
- Sheet flooring (exposed and concealed)
- Floor mastic (concealed)
- Transite board
- Caulking (various)
- Cementitious Parging

The roof structures, in most buildings, were not tested for the presence of asbestos so as not to disrupt the building envelope. Sampling will need to be undertaken prior to the commencement of any work and may require the presence of a qualified roofer to make good any damage to the roof membrane.

Recommendations are based on Public Works and Government Services Canada Departmental Policy 057 – Asbestos Management (DP 057).

Asbestos Containing Materials must be managed under the PWGSC Asbestos Management Plan (AMP). The AMP should conform to PWGSC Departmental Policy 057. The purpose of the AMP is to assist the organization in managing ACM in a systematic fashion to ensure identified ACM are managed in a safe manner which complies with the Canada Labour Code and WorkSafeBC guidelines.

ACM in good condition may be managed in place in accordance with the implementation of the Asbestos Management Plan (AMP). Institute routine surveillance of the ACM. Trained workers or contractors must use appropriate asbestos precautions (Type 1, Type 2 or Type 3) during disturbance of the remaining ACM.

Inspect all identified asbestos containing materials annually to identify any damage and ensure proper labeling is present.

Any damaged ACM found during future inspections, as well as ACM that could be impacted by any demolition or renovation activity, should be removed following procedures outlined in the AMP.

Throughout any abatement activities, appropriate air monitoring and inspection should be conducted by qualified personnel to ensure all contamination is contained and ACM are disposed of appropriately. It is recommended that a proper scope of work and asbestos removal specifications be written to ensure the complete and proper removal of all ACM.

Table 1: Asbestos Containing Materials Summary-Current Survey

Asbestos containing materials were identified to be in the following materials/locations:						
Sample ID	**Building**	**Material**	Access-ibility	Friability (F or N)	Condition (G/F/P)	Action Code
15458-58	Building 61 PWGSC Land Leased to Seaspan (Butler Buildings) – SJ39 Stores	Exterior Caulking – 7% Chrysotile Asbestos Content	A	N	G	ACTION 7
15458-59	Building 61 PWGSC Land Leased to Seaspan (Butler Buildings) – SJ40 Offices	Sheet Flooring (Brown & Beige) – 20% Chrysotile Asbestos Content	A	F	G	ACTION 5/7
15458-68	Building 31 PWGSC Owned Pump House	Concrete Cementitious Parging Compound – <1% Chrysotile Asbestos Content	A	N	F	ACTION 7
15458-73	Building 58 PWGSC Owned South Side Sub Station – Electrical Generator Room	Caulking (Tan) - South Door Frame – 2% Chrysotile Asbestos Content	A	N	G	ACTION 7
15458-83	Building 7 DND Property PWGSC Washroom (Back Lot) – Storage/Furnace Room	Floor Tile (White 12"x12") – 3% Chrysotile Asbestos Content	A	N	G	ACTION 7
15458-87	Building 7 DND Property PWGSC Washroom (Back Lot) – Women's Washroom	Sheet Flooring (Yellow/Brown – Bottom Layer) – 15% Chrysotile Asbestos Content	B	F	F	ACTION 6/5
15458-89	Building 7 DND Property PWGSC Washroom (Back Lot) – Men's Washroom	Mastic – (2nd Layer under White Sheet Flooring) – <1% Chrysotile Asbestos Content	C	N	G	ACTION 7
15458-95	Tunnels	Transite Piping (Sewage Line) – 40% Chrysotile & 8% Crocidolite Asbestos Content	B	N	F	ACTION 7

Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material

Asbestos containing materials were identified to be in the following materials/locations:						
15458-100	Building 9 PWGSC Old Guard House	Floor Tile (Beige 12"x12" – Bottom Layer) – 12% Chrysotile Asbestos Content	C	N	F	ACTION 7

In addition to the materials identified in Table 1, the following ACM were identified.

Table 2: Asbestos Containing Materials Summary-Previous Surveys

Asbestos containing materials were identified to be in the following materials/locations:						
Sample ID	**Building**	**Material**	Accessibility	Friability (F or N)	Condition (G/F/P)	Action Code
1865-10	Back Gate Guardhouse Siding and soffit	Exterior Cladding- 55% Chrysotile Asbestos Content	A	N	G	ACTION 7

Evaluation of asbestos containing materials is based on the condition of the material and its accessibility. Following are the guidelines used to evaluate ACMs and the action, if any, required to safely manage them.

Figure 1: Action Matrix from DP 057

	CONDITION			
ACCESS	GOOD	FAIR	POOR	DEBRIS
(A)	ACTION 5/7	ACTION 5/6	ACTION 3	ACTION 1
(B)	ACTION 7	ACTION 6/5	ACTION 3	ACTION 1
(C) exposed	ACTION 7	ACTION 6	ACTION 4	ACTION 2
(C) concealed	ACTION 7	ACTION 7	ACTION 4	ACTION 2
(D)	ACTION 7	ACTION 7	ACTION 7	ACTION 7

The following is excerpted from Public Works and Government Services Canada Departmental Policy 057 – Asbestos Management (DP 057).

Condition

Spray Applied Fireproofing, Insulation and Texture Finishes

In evaluating the condition of ACM spray applied as fireproofing, thermal insulation or texture, decorative or acoustic finishes, the following criteria apply;

GOOD	Surface of material shows no significant signs of damage, deterioration or delamination. Up to one percent visible damage to surface is allowed within range of GOOD. Evaluation of sprayed fireproofing requires the surveyor to be familiar with the irregular surface texture typical of sprayed asbestos products. GOOD condition includes unencapsulated or unpainted fireproofing or texture finishes, where no delamination or damage is observed, and encapsulated fireproofing or texture finishes where the encapsulation has been applied after the damage or fallout occurred.
POOR	Sprayed materials show signs of damage, delamination or deterioration. More than one percent damage to surface of ACM spray.

Mechanical Insulation

In evaluating the condition of mechanical insulation (on boilers, breeching, ductwork, piping, tanks, equipment etc.) the following criteria are used:

GOOD	Insulation is completely covered in jacketing and exhibits no evidence of damage or deterioration. No insulation is exposed. Includes conditions where the jacketing has minor surface damage (i.e., scuffs or stains), but the jacketing is not penetrated.
FAIR	Minor penetration damage to jacketed insulation (cuts, tears, nicks, deterioration or delamination) or undamaged insulation that has never been jacketed. Insulation is exposed but not showing surface disintegration. The extent of missing insulation ranges should be minor to none.
POOR	Original insulation jacket is missing, damaged, deteriorated or delaminated. Insulation is exposed and significant areas have been dislodged. Damage cannot be readily repaired.

Non-Friable and Potentially Friable Materials

Non-friable materials generally have little potential to release airborne fibres, even when damaged by mechanical breakage. However, some non-friable materials, i.e., exterior asbestos Concrete products, may have deteriorated so that the binder no longer effectively contains the asbestos fibres. In such cases of significantly deteriorated non-friable material, the material will be treated as a friable product.

Accessibility

The accessibility of building materials known or suspected of being ACM is rated according to the following criteria:

Access (A)	Areas of the building within reach (from floor level) of all building users. Includes areas such as gymnasiums, workshops, and storage areas where activities of the building users may results in disturbance of ACM not normally within reach from floor level.
Access (B)	Frequently entered maintenance areas within reach of maintenance staff, without need for a ladder. Includes: frequently entered pipe chases, tunnels and service areas or areas within reach from a fixed ladder or catwalk, i.e., tops of equipment, mezzanines.
Access (C) Exposed	Areas of the building above 8'0" where use of a ladder is required to reach the ACM. Only refers to ACM materials that are exposed to view, from the floor or ladder, without removing or opening other building components such as ceiling tiles, or service access doors or hatches. Does not include infrequently accessed service areas of the building.
Access (C) Concealed	Areas of the building which require removal of a building component including lay-in ceilings and access panels into solid ceiling systems. Includes rarely entered crawl spaces, attic spaces etc. Observations are limited to the extent visible from the access points.
Access (D)	Areas of the building behind inaccessible solid ceiling systems, walls, or mechanical equipment, etc., where demolition or the ceiling, wall or equipment etc., is required to reach the ACM. Evaluation of condition and extent of ACM is limited or impossible, depending on the surveyor's ability to visually examine the materials in Access D.

Figure 2: Action Key

Action 1	**Immediate Clean Up of Debris That is Likely to be Disturbed** Restrict access that is likely to cause a disturbance of the ACM DEBRIS and clean up ACM DEBRIS immediately. Utilize correct asbestos procedures. This action is required for compliance with regulatory requirements.
Action 2	**Entry Into Areas with ACM Debris** At locations where ACM DEBRIS can be isolated in lieu of removal or clean up, use appropriate means to limit entry to the area. Restrict access to the area to persons utilizing Type 2 asbestos-work precautions. The precautions will be required until the ACM DEBRIS has been cleaned up, and the source of the DEBRIS has been stabilized or removed.
Action 3	**ACM Removal Required for Compliance** Remove ACM for compliance with regulatory requirements. Utilize asbestos procedures appropriate to the scope of the removal work.
Action 4	**Access into Areas Where ACM is Present and Likely to be Disturbed by Access** Use asbestos precautions when entry or access into an area likely to disturb the ACM. ACTION 4 must be used until the ACM is removed (Use ACTION 1 or 2 if DEBRIS is present).
Action 5	**Proactive ACM Removal** Remove ACM in lieu of repair, or at locations where the presence of asbestos in GOOD condition is not desirable.
Action 6	**ACM Repair** Repair ACM found in FAIR condition, and not likely to be damaged again or disturbed by normal use of the area or room. Upon completion of the repair work, treat ACM as material in GOOD condition and implement ACTION 7. If ACM is likely to be damaged or disturbed during normal use of the area or room, implement ACTION 5.
Action 7	**Routine Surveillance** Institute routine surveillance of the ACM. Trained workers or contractors must use appropriate asbestos precaution during disturbance of the remaining ACM.

Note: any additional suspect materials encountered during renovation or demolitions activities must be left undisturbed until testing determines the presence or absence of asbestos or other hazardous material. In the event they are damaged or otherwise impacted, all work shall stop until appropriate control can be put in place to protect workers and the public.

6.2 Lead

Lead Paint

Lead was found in all but one sample of paint collected both on the interior and exterior of the buildings. The results vary from a high of 6.5% to a low of <0.010%. The sample from the Pumphouse (15458-20) was found to have a lead concentration below that of the detection limit (DL). Unfortunately the DL is higher than the SCMR limit for lead paint.

With this one exception, all samples were confirmed to exceed the concentration of lead permissible in new paint (0.009% - SCMR) threshold to be sold without notifying the consumer of its lead content.

Table 3: Paint Chip Sampling Results

Sample	Description	Lead (%)
15458- 17	Pumphouse-Penstock Room (South Wall) Desc: Paint-Lt. Green	6.5
15458- 20	Pumphouse-Main Penstock Building Desc: Paint-Yellow/Lt.Blue int.Conc.Walls	<0.010
15458-23	Pumphouse-Main Penstock Building Desc: Paint- Grey-Exterior	0.093
15458-27	Site: Pumphouse - Welding Shop - South Wall, Yellow	1.9
15458-29	Site: Pumphouse - Welding Shop - South Wall, Lt. Green	0.27

Overall, paint coatings were found to be in poor to good condition. Where damaged and deteriorating, paint should be removed following procedures designed to protect the workers from heavy metal exposure and to avoid the spread of contamination. Lead content of painted materials should not increase their disposal costs however; concentrated paint chips would need to be disposed as hazardous waste. Routine removal of lead paint is not recommended, rather it should be managed in place and removed on an "as needed" basis.

Elemental Lead

Lead within the copper water pipes/fittings was not tested for lead content however lead content in solder, especially from buildings of this vintage, is known to reach levels up to 98% lead.

If lead materials are found they are typically recognized as having significant salvage value, disposal therefore should not be a major concern. Workers should exercise caution if heat is to be used to melt any lead found as means of facilitating its extraction. Molten lead can produce significant quantities of inhalable lead fume which can pose a severe health hazard. The BC Occupational Health and Safety Regulation requires that worker exposure to airborne lead be kept below 0.05 mg/m^3.

Polychlorinated Biphenyls (PCB) in Electrical Equipment

Fluorescent light fixtures were observed and appeared to be of a vintage often found to contain ballasts which Environment Canada (EC) has developed a guideline called - *Identification of Lamp Ballasts Containing PCBs –Environment Canada 1991*.

Manufacturers of ballasts and capacitors use distinct catalogue and date codes to identify their product, its date of manufacture, and, for some capacitors, its dielectric fluid. Fluorescent lamp ballasts are usually mounted between the fluorescent tubes on the light fixture and are shielded with a metal protective device which reduces heat radiation. Due to the fact the covers are easily broken and the risk of electrical shock

when accessing the ballast, it is standard practice to make the observation that there is a potential for PCBs to be present and have the ballasts inspected prior to disposal.

The Hazardous materials report from NWEG in 2000 mentioned that many of these ballasts have already been removed.

Inspect all light ballasts for the presence of PCB prior to disposal. PCB containing ballasts must be disposed of as hazardous waste.

6.3 Mould

No mould or significant moisture issues were observed during the survey.

6.4 Hantavirus-Animal Droppings

Materials suspected of containing Hantavirus were not observed during the survey.

Workers accessing areas where rodent or other animal droppings are present must be informed of the potential risk of Hantavirus exposure and employ suitable precautions for personal protection and control of the spread of contamination.

6.5 Ozone Depleting Substances

Several pieces of equipment containing ozone depleting substances (ODS) were observed during this investigation. PWGSC maintains an active halocarbon inventory.

6.6 Crystalline Silica

Testing for crystalline silica in dust was not completed/conducted as part of this survey however it is known to be a component of concrete dust. All concrete, plaster and stucco is suspected of containing silica in crystalline and non-crystalline forms. Many of the removal techniques (grinding, cutting, chipping etc) for these materials can generate high levels of crystalline silica in the air.

Use wetting techniques and/or HEPA equipped extraction systems attached to drills and other power equipment where possible in order to decrease dust levels.

As per the clients request, non-invasive investigative techniques were used. Even with the most invasive survey techniques, however, it should be noted that the possibility remains for other concealed materials to be found during a renovation or demolition.

Warning: in the event any additional suspect materials are encountered during demolition or renovation activities, work on those materials must stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material. If this any materials suspected of containing asbestos or another hazardous material are disturbed during the work, all work shall stop until the area is contained, the hazard evaluated by a qualified professional and the hazardous materials, if indeed present, is safely managed by a qualified contractor.

Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material

7.0 ABATEMENT COST ESTIMATE

1) Sheet flooring as identified in the hot water tank storage room of building 7 (PWGSC Washroom) should be repaired using Type 2 (moderate risk procedures) within the hot water tank storage room and adjacent woman's washroom.

   Cost for the repair of approximately 5 m^2 of flooring:
   (including labor, materials, air sampling and inspection) is estimated at
   $ 1,200.00

2) Sheet flooring as identified in building 61(Butler Building SJ40 Offices) may be managed in place or be proactively removed using Type 3 (high risk procedures).

   Cost for the removal of this flooring (approximately 10 m^2):
   (including labor, materials, air sampling and inspection) is estimated at
   $ 20,000.00

8.0 BULK SAMPLES

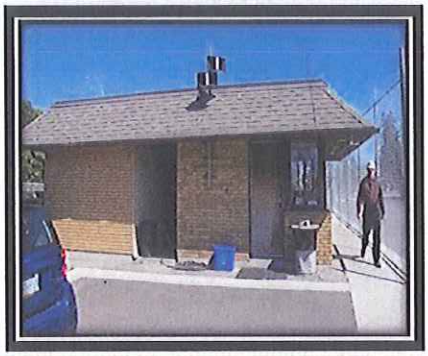
The following photoplate is a summary of the room by room assessment including samples collected.

Building: 38 PWGSC Owned Guard House – Old Front Gate

Area: Old Front Gate

Details:

Ceiling: Drywall and plywood panels
Walls: Drywall and plywood panels
Flooring: Concrete and sheet flooring
Roof: Asphalt shingles
Construction Date:



Area: Office and Bathroom

Hazardous Materials Observed:

- Lead: [potential] Lead containing paint on walls and trim
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: Fridge present
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None observed

Samples:

15458-10: Roof Shingles No Asbestos Detected
15458-11: Sheet Flooring- No Asbestos Detected
15458-12: Drywall Joint Compound - No Asbestos Detected
15458-13 : Washroom - Drywall Joint Compound - No Asbestos Detected

Asbestos siding was not observed. Building envelope was brick and mortar.

Building: 38 PWGSC Owned Guard House – Old Front Gate

Area: New Guard House

Details:

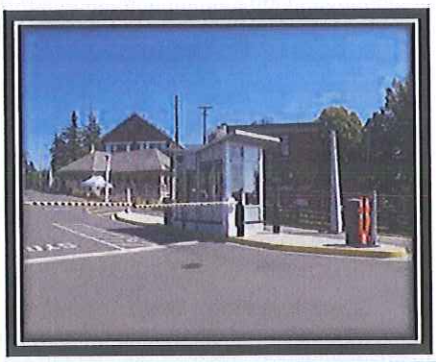
- Constructed in 2000
- Ceiling: Drywall
- Walls: Glass and painted steel
- Flooring: Concrete
- Roof: Roof Membrane

Hazardous Materials Observed:

- Lead: [potential Lead containing paint on walls and trim
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent ballasts present
- Mould: None Observed

Samples:

15458-8: Drywall Joint Compound - No Asbestos Detected
15458-9 : Caulking – Exterior - No Asbestos Detected



Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material

Building: 67 PWGSC Washroom Trailer (A Lot)

Room: PWGSC Washroom Trailer

Details:

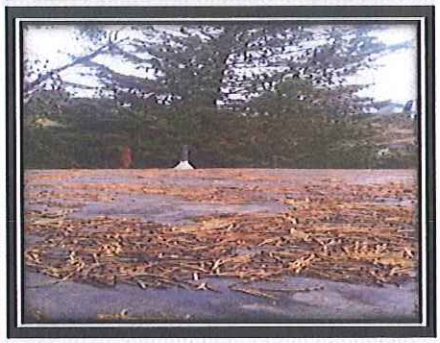
- Constructed in November 2000
- Ceiling: Wood Fiber Ceiling Tiles
- Walls: Wall Panels
- Flooring: Sheet Flooring

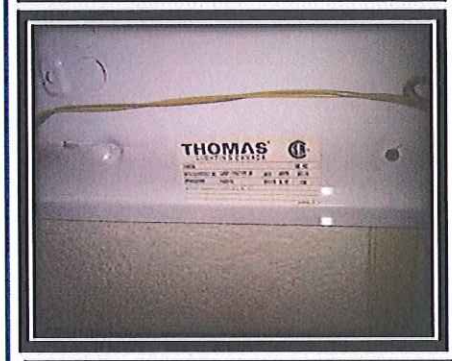
Hazardous Materials Observed:

- Lead: [potential] Lead containing paint on walls and trim
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-01: Sheet Flooring - No Asbestos Detected
15458-02: Roof Membrane Caulking - No Asbestos Detected



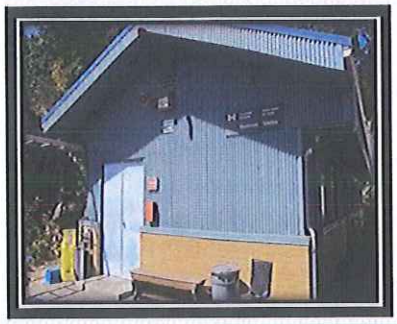


Building: 20 PWGSC Owned Main Washrooms

Room: Womens? ashroom

Details:

- Estimated date of construction: 1997-1999
- Ceiling: Drywall
- Walls: Cinder Block
- Flooring: Concrete/Coating (Epoxy & Sealant)
- Roof: Metal Sheeting



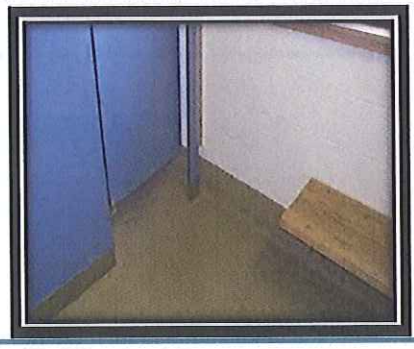
Room: Men's Washroom

Hazardous Materials Observed:

- Lead: [potential] Lead containing paint on walls and trim
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-03: Drywall Joint Compound – Ceiling - No Asbestos Detected
15458-04: Beige Trowel on Flooring (Coating) - No Asbestos Detected



Area: Exterior of Building

Hazardous Materials Observed:

- Lead: [potential] Lead containing paint on walls and trim
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-03: Drywall Joint Compound – Ceiling - No Asbestos Detected
15458-04: Beige Trowel on Flooring (Coating) - No Asbestos Detected

Building: 20 PWGSC Owned Main Washrooms

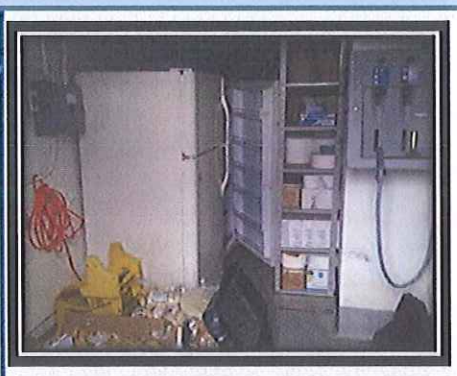
Room: Mechanical Room

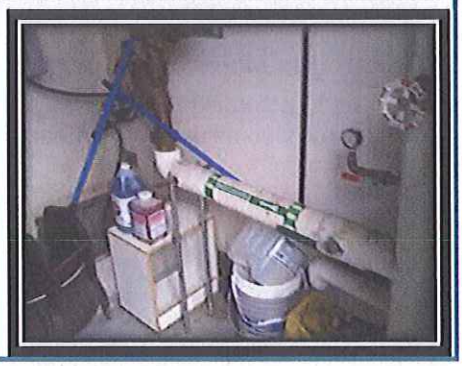
Hazardous Materials Observed:

- Lead: [potential] Lead containing paint on walls and trim
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-03: Drywall Joint Compound – Ceiling - No Asbestos Detected
15458-04: Beige Trowel on Flooring (Coating) - No Asbestos Detected



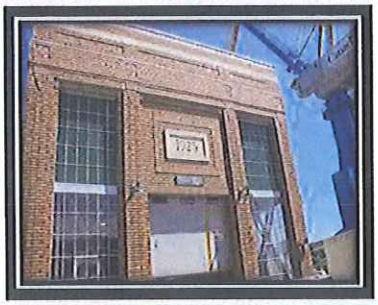


Building: 31 PWGSC Owned Pump House

Area: PWGSC Owned Pump House

Details:

- Constructed in 1925
- Ceiling: Concrete
- Walls: Brick & Mortar
- Flooring: Concrete
- Roof: Roof Membrane



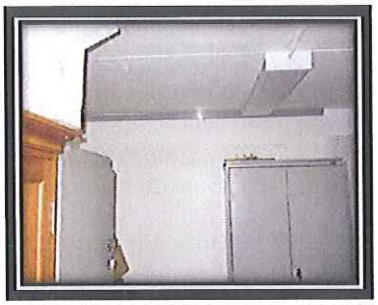
Area: Scada Storage Room

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: Fridge(s) present
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-14: Drywall Joint Compound - No Asbestos Detected



Area: Work Shop

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-15: Caulking – Window - No Asbestos Detected

Area: Hydraulic Room

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-16: Brick Mortar - No Asbestos Detected

Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material

Building: 31 PWGSC Owned Pump House

Area: Main Floor

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-22: Caulking – Interior Window (Perimeter West Wall) - No Asbestos Detected
15458-24: Caulking – Exterior Window (Perimeter West Wall) - No Asbestos Detected
15458-25: Wall Coating – Interior Wall (Perimeter West Wall) - No Asbestos Detected
15458-26: Gasket – Compressor (A-13271) - No Asbestos Detected
15458-31: Brick Mortar – East Wall (Top of Stairs) - No Asbestos Detected

Area: Washroom (Main Floor)

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-30: Drywall Joint Compound - No Asbestos Detected

Building: 31 PWGSC Owned Pump House

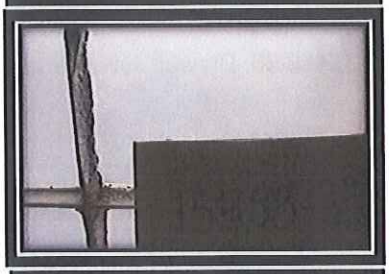
Area: Lunch Room (Second Floor)

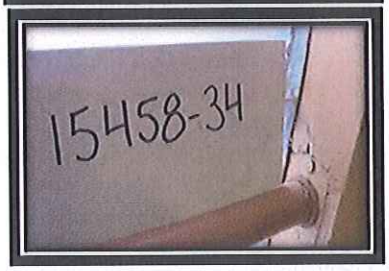
Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: Fridge(s) Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-32: Sheet Flooring (Grey) & Mastic - No Asbestos Detected
15458-33: Caulking/Putty Window - No Asbestos Detected
15458-34: Cementitious Wall Coating - No Asbestos Detected





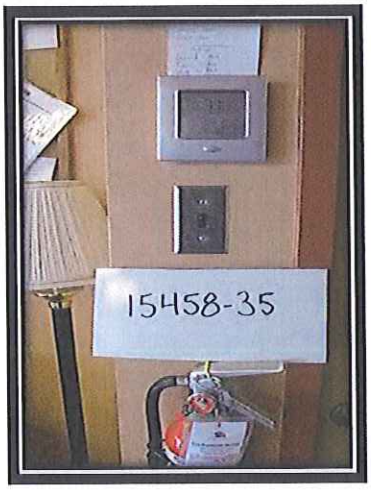
Area: Lunch Room (Second Floor)

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: Fridge(s) Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-35: Drywall Joint Compound (West Wall) - No Asbestos Detected



Building: 31 PWGSC Owned Pump House

Area: Washroom (Second Floor)

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-36: Drywall Join Compound - No Asbestos Detected

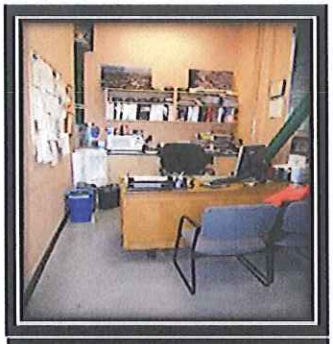
Area: Office (Main Floor)

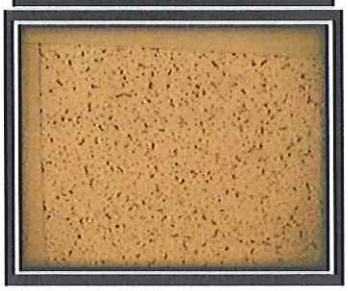
Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: Fridge(s) Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-67: Drywall Joint Compound - No Asbestos Detected
15458-68: Concrete Cementitious - <1% Chrysotile Asbestos Content
15458-69: Acoustic Ceiling Tile - No Asbestos Detected





Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material

Building: 31 PWGSC Owned Pump House

Area: Basement

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

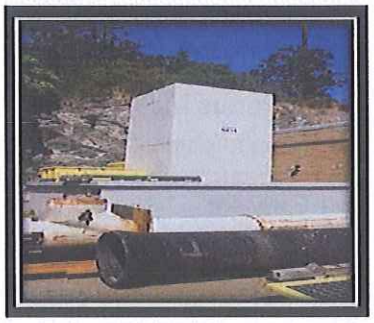
Samples:

15458-70: Gasket - No Asbestos Detected

Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material

Building: 26 PWGSC Penstock Structure

Area: PWGSC Penstock Structure

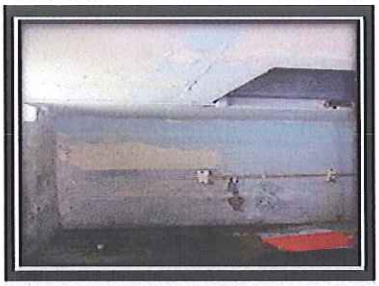


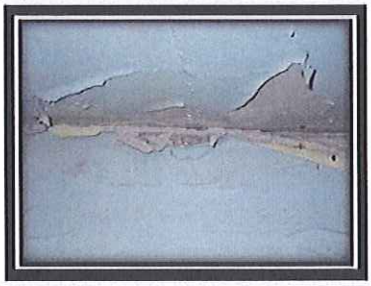
Details:

- Constructed in 1926
- Ceiling: Concrete
- Walls: Cinder Block
- Flooring: Concrete
- Roof: Concrete

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed





Samples:

15458-19: Caulking – Exterior - No Asbestos Detected
15458-20: Lead Paint - <0.010% w.t. – Yellow/Lt. Blue Interior Concrete Walls (West Wall)
15458-21: Mortar – Expansion Joint - No Asbestos Detected
15458-23: Lead Paint 0.093% w.t. – Grey - Exterior Concrete Walls

Building: 32 PWGSC Owned Middle Dock Stairwell

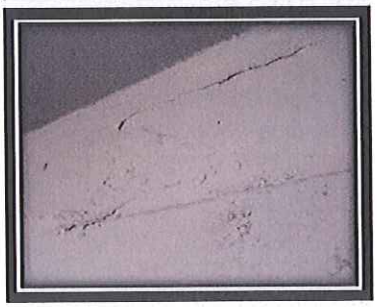
Area: PWGSC Owned Middle Dock Stairwell

Details:

- Constructed in 1926
- Ceiling: Concrete
- Walls: Cinder Block
- Flooring: Concrete
- Roof: Concrete

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed



Samples:

15458-17: Lead Paint 6.5% w.t. – Lt. Green - Interior Concrete Walls (South Wall)
15458-18: Wall Coating (South Wall) - No Asbestos Detected

Building: 29 PWGSC Owned Welding Shop

Area: PWGSC Owned Welding Shop

Details:

- Constructed in 1940
- Ceiling: Concrete
- Walls: Cinder Block
- Flooring: Concrete
- Roof: Concrete

Hazardous Materials Observed:

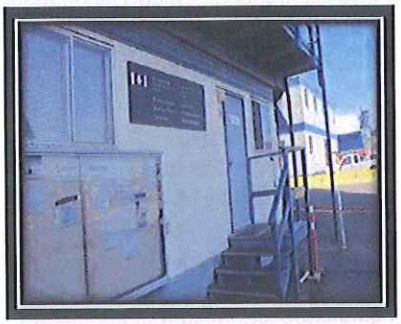
- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-27: Lead Paint 1.9% w.t. – Yellow - South Interior Wall
15458-28: Cementitious Wall Coating (North Interior Wall) - No Asbestos Detected
15458-29: Lead Paint 0.27% w.t. – Lt. Green - South Interior Wall
Exhaust duct with black expansion gasket observed within Welding Shop and suspected of containing asbestos (not sampled).

Building: 19 PWGSC Administration Trailers

Area: PWGSC Administration Trailers

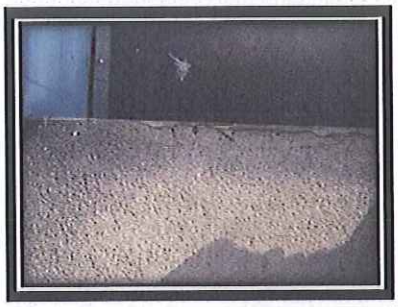


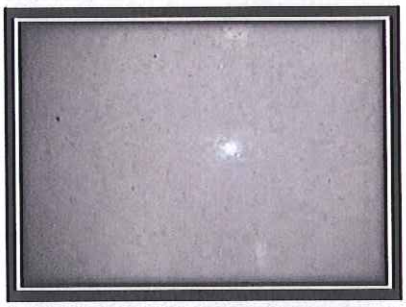
Details:

- Constructed in 1998
- Ceiling: Panel
- Walls: Drywall
- Flooring: Sheet Flooring
- Roof: Roof Membrane

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: Fridge(s) Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed





Samples:

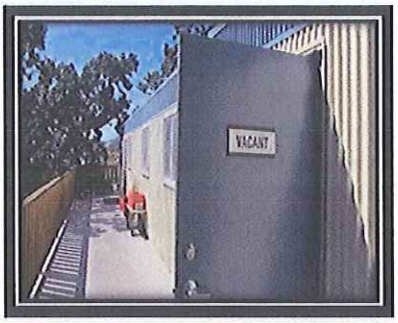
15458-38: Shingle/Grip Mat - No Asbestos Detected
15458-39: Sheet Flooring (Cream) & Mastic - No Asbestos Detected
15458-40: Door Caulking - No Asbestos Detected
15458-41: Window Caulking - No Asbestos Detected

Building: PWGSC Security Trailer (H&S)

Area: PWGSC Security Trailer (H&S)

Details:

- Constructed in 2009
- Ceiling: Panel
- Walls: Wood Panel
- Flooring: Floor Tile
- Roof: Roof Membrane



Area: Orientation Training Room

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: Fridge(s) Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-37 Floor Tile – Grey 12"x12" & Mastic - No Asbestos Detected

Building: 18 PWGSC Owned Operations Building

Area: PWGSC Owned Operations Building

Details:

- Constructed in 2001
- Ceiling: Acoustic Ceiling Tile
- Walls: Drywall
- Flooring: Sheet Flooring
- Roof: Metal Sheeting

Area: Men's & Women's Bathroom (2nd Floor)

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: Fridge(s) Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-42 Sheet Flooring (Green) & Mastic - No Asbestos Detected
15458-43 Drywall Joint Compound - No Asbestos Detected

Area: Kitchenette & Hallway (2nd Floor)

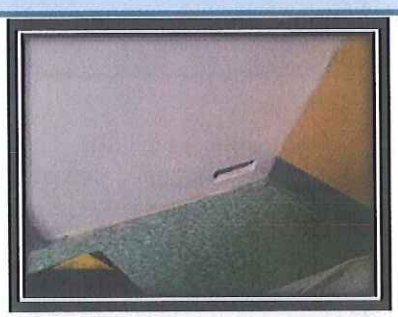
Hazardous Materials Observed:

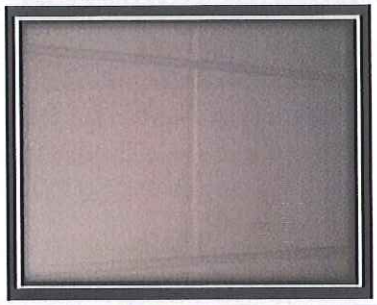
- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: Fridge(s) Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Building: 18 PWGSC Owned Operations Building

Samples:

15458-44: Drywall Joint Compound - No Asbestos Detected
15458-45: Acoustic Ceiling Tile - No Asbestos Detected





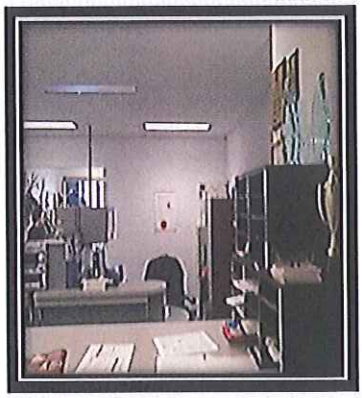
Area: Reception/Office Area

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-46: Drywall Joint Compound



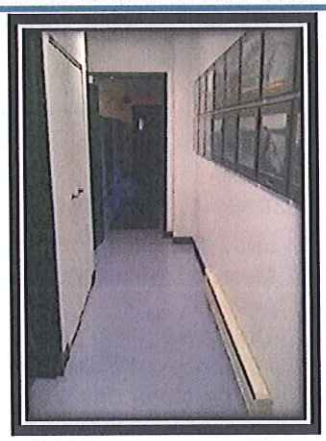
Area: Hallway by Boardroom

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-47: Sheet Flooring (Lt. Blue) - No Asbestos Detected



Building: 18 PWGSC Owned Operations Building

Area: Boardroom

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: Fridge observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-48: Sheet Flooring (Blue) & Mastic - No Asbestos Detected
15458-49: Drywall Joint Compound - No Asbestos Detected

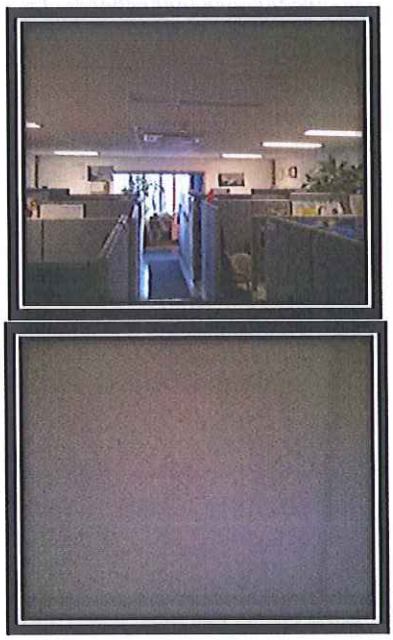
Area: Open Office Area

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-50: Drywall Joint Compound - No Asbestos Detected
15458-51: Acoustic Ceiling Tile - No Asbestos Detected



Building: 18 PWGSC Owned Operations Building

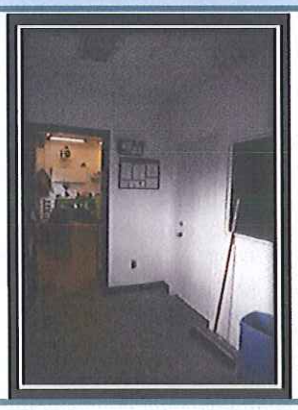
Area: Entrance Hallway (Main Floor)

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-52: Drywall Joint Compound - No Asbestos Detected



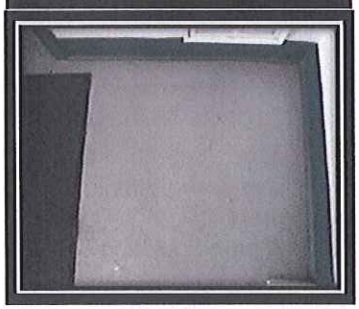
Area: Stairwell (Main Floor)

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-53: Drywall Joint Compound - No Asbestos Detected
15458-54: Sheet Flooring (Lt. Green) - No Asbestos Detected



Area: Lunchroom (Main Floor)

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: Fridge Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-55: Drywall Joint Compound - No Asbestos Detected

Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material

Building: 61 PWGSC Land Leased to Seaspan (Butler Buildings)

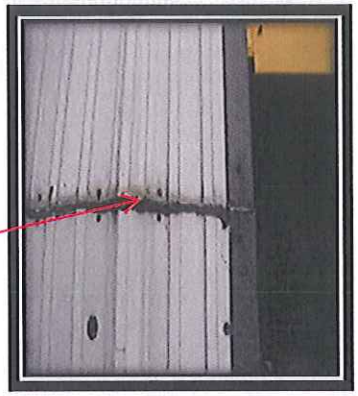
Area: SJ39 Stores

Details:

- Construction Date Unknown
- Ceiling: Metal Sheeting
- Walls: Wood Panel/Metal Sheeting
- Flooring: Concrete
- Roof: Metal Sheeting

Hazardous Materials Observed:

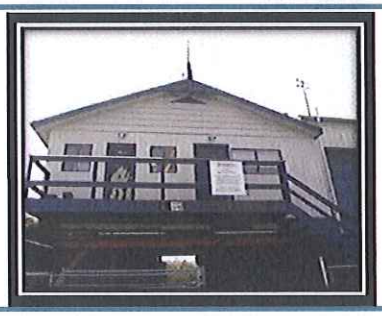
- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed



Samples:

15458-58: Caulking (Exterior) - Chrysotile 7%

Area: SJ40 Offices



Details:

- Construction Date Unknown
- Ceiling: Wood Panel
- Walls: Wood Panel
- Flooring: Sheet Flooring
- Roof: Shingle Roof

Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material

Building: 61 PWGSC Land Leased to Seaspan (Butler Buildings)

Hazardous Materials Observed:

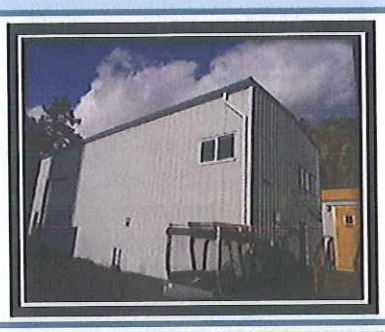
- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-59: Sheet Flooring (Brown & Beige) - Chrysotile 20% Asbestos Content
15458-60: Floor Tile – White 12"x12" - No Asbestos Content
15458-61: Coating (Balcony Steps) - No Asbestos Content

Building: 16 PWGSC Owned Electrical Shop Building

Area: Shop Building NS29



Details:

- Constructed in 2004
- Ceiling: Metal Sheeting
- Walls: Metal Sheeting/Drywall
- Flooring: Concrete/Sheet Flooring
- Roof: Metal Sheeting

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: Fridge observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-62: Sheet Flooring (Beige) - No Asbestos Content
15458-63: Sheet Flooring (Blue) - No Asbestos Content
15458-64: Drywall Joint Compound - No Asbestos Content
15458-65: Drywall Joint Compound - No Asbestos Content
15458-66: Drywall Joint Compound - No Asbestos Content

Building: 58 PWGSC Owned South Side Sub Station

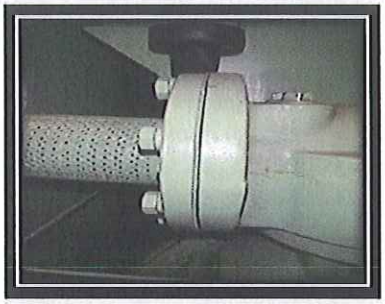
Area: Building SJ23

Details:

- Constructed in 1926
- Ceiling: Concrete
- Walls: Concrete/Brick
- Flooring: Concrete
- Roof: Concrete

Hazardous Materials Observed:

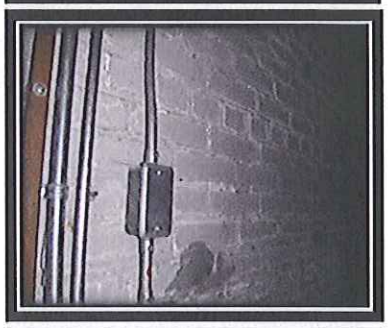
- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

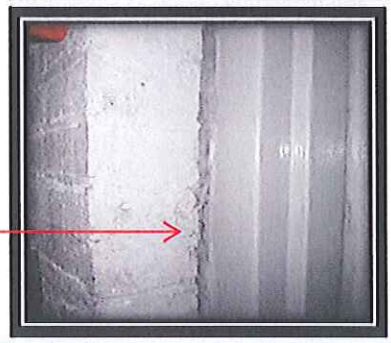


Samples:

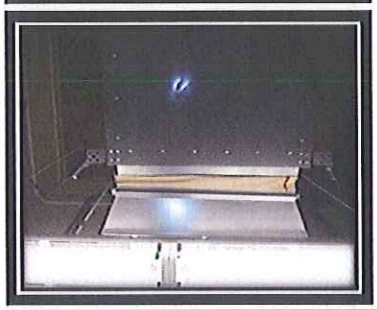
15458-71: Gasket - No Asbestos Content
15458-72: Brick Mortar - No Asbestos Content
15458-73: Caulking - Chrysotile 2% Asbestos Content
15458-74: Firestopping (Cementitious) - No Asbestos Content
15458-75: Firestopping (Black Putty) - No Asbestos Content

Note: Expansion Gaskets observed in ducting are suspect of asbestos-containing. Not sampled.





Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material



Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material

Building: 24 PWGSC Owned Main Sub Station

Area: Main Sub Station

Details:

- Constructed in 1926
- Ceiling: Concrete
- Walls: Brick
- Flooring: Concrete
- Roof: Concrete

Area: Main Sub Station (Main Floor)

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

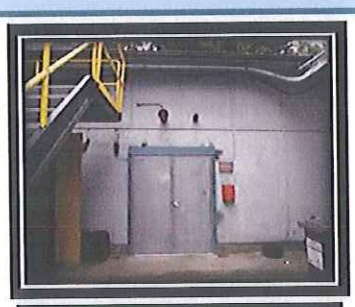
15458-76: Brick Mortar - No Asbestos Content
15458-77: Caulking (Window Frame) - No Asbestos Content
15458-78: Firestopping (Black Putty) - No Asbestos Content

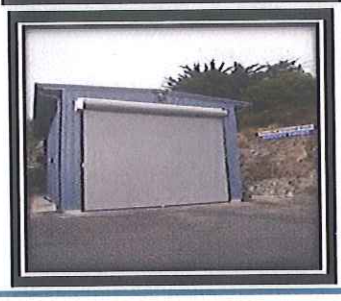
Building: 30 PWGSC Owned Garage

Area: Garage NS4 (Exterior)

Details:

- Constructed in 1985
- Ceiling: Concrete/Metal Sheeting
- Walls: Concrete/Wood Panel/Metal Sheeting
- Flooring: Concrete
- Roof: Metal Sheeting/Roof Membrane





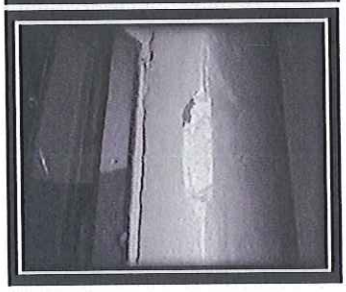
Area: Garage NS4 (Rear Building)

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-79: Putty (Window Frame) - No Asbestos Content
15458-80: Roof Tar - No Asbestos Content
15458-81: Cementitious Wall Coating - No Asbestos Content



Building: 30 PWGSC Owned Garage

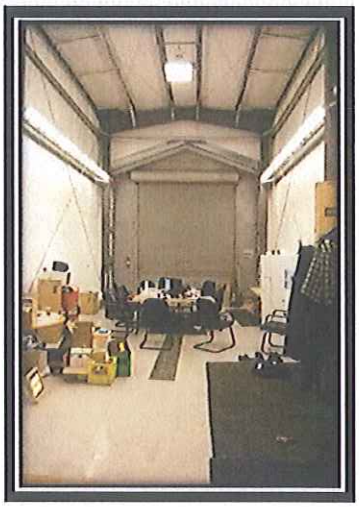
Area: Garage NS4 (Front Building)

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: Fridge observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

No Samples Collected.

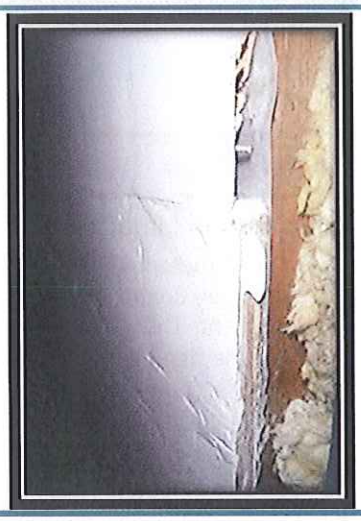


Building: 41 PWGSC Owned Winch Building

Area: Winch Building SJ22

Details:

- Constructed in 1940
- Ceiling: Metal Sheeting
- Walls: Metal Sheeting/Wood Paneling
- Flooring: Concrete
- Roof: Metal Sheeting



Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: None Observed
- Ozone depleting substances: Fridge observed
- PCB's: None Observed
- Mould: None Observed

Samples:

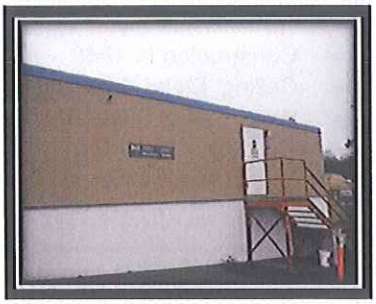
15458-82: Drywall Joint Compound - No Asbestos Content

Building: 7 PWGSC Washroom

Area: DND Property PWGSC Washroom

Details:

- Constructed in 2002
- Ceiling: Panel/Acoustic Ceiling Tile (Fibreglass)
- Walls: Drywall/Wood Paneling
- Flooring: Wood Panel Substrate
- Roof: Roof Membrane



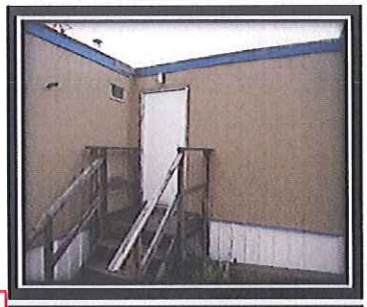
Area: Rear Storage Room

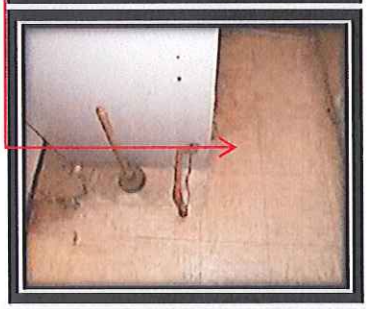
Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present, Thermostat
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-83: Floor Tile (12"x12" White) & Mastic - Storage/Furnace Room – Chrysotile 3% Asbestos Content
15458-84: Sheet Flooring (Peach) & Mastic - Storage/Locker Area - No Asbestos Content





Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material

Building: 7 PWGSC Washroom Trailer

Area: Women's Washroom

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present, Thermostat
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-85: Sheet Flooring (Layer 1) – Lt. Pink - No Asbestos Content
15458-86: Drywall Joint Compound - No Asbestos Content
15458-87: Sheet Flooring (Layer 2) – Yellow/Brown - Chrysotile 15% Asbestos Content

Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material

Building: 7 PWGSC Washroom Trailer

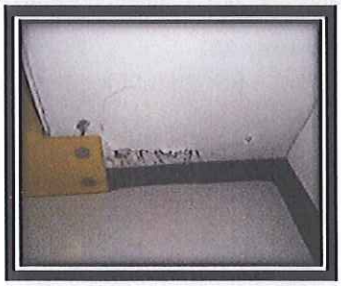
Area: Men's Washroom

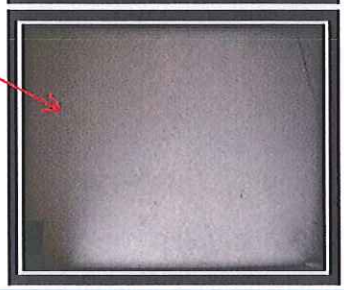
Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present, Thermostat
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-88: Drywall Joint Compound - No Asbestos Content
15458-89: Sheet Flooring (White) - No Asbestos Content
15458-89: Mastic - Chrysotile <1% Asbestos Content





Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material

Building: 68 PWGSC Washroom Trailer

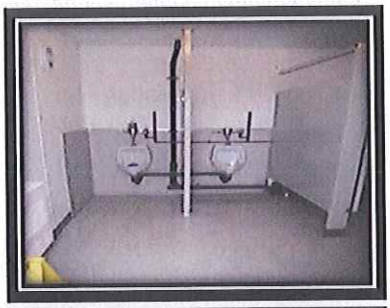
Area: Washroom Trailer Electrical Shop

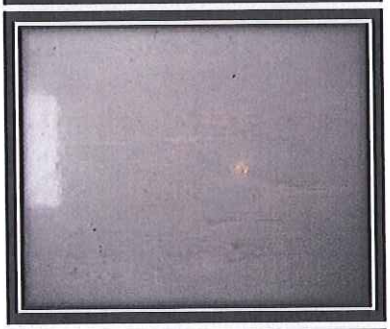
Details:

- Constructed in 1997
- Ceiling: Paneling
- Walls: Paneling
- Flooring: Wood Substrate
- Roof: Roof Membrane

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: None Observed
- Ozone depleting substances: None Observed
- PCB's: None Observed
- Mould: None Observed





Samples:

15458-90: Caulking (Grey) - No Asbestos Content
15458-91: Sheet Flooring (Lt. Grey) - No Asbestos Content
15458-92: Caulking (Exterior) – Light Fixture - No Asbestos Content

Building: 9 PWGSC Old Guard House

Area: Old Guard House NS35

Details:

- Construction Date 2000
- Ceiling: Paneling
- Walls: Paneling
- Flooring: Wood Substrate
- Roof: Roof Membrane

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-100: Floor Tile – Beige 12"x12" - 12% Chrysotile Asbestos Content (under Sheet Flooring)
15458-100: Mastic - No Asbestos Content
15458-101: Sheet Flooring – Lt. Brown Mosaic - No Asbestos Content

Note: Asbestos-Containing Siding (Exterior) and soffits are asbestos containing transite

EGD Service Tunnels

Area: Tunnels

Details:

- Constructed in 1926
- Ceiling: Concrete
- Walls: Concrete
- Flooring: Concrete

Hazardous Materials Observed:
Lead: [potential] Lead based paint on walls and equipment
Mercury containing equipment: Fluorescent light fixtures present
Ozone depleting substances: None Observed
PCB's: [potential] Fluorescent light ballasts present
Mould: None Observed

Samples:
15458-95: Transite Pipe (Sewage Line) - 40% Chrysotile, 8% Crocidolite Asbestos Content
15458-96: Gasket (Sewage Line Valve) - No Asbestos Content
15458-97: Firestopping - No Asbestos Content
15458-98: Canvass (Salt Water Line) - No Asbestos Content

Caissons 1 & 2

Area: Caissons

Details:

- Constructed in 1978
- Ceiling: Metal
- Walls: Metal
- Flooring: Metal

Hazardous Materials Observed:

- Lead: [potential] Lead based paint on walls and equipment
- Mercury containing equipment: Fluorescent light fixtures present
- Ozone depleting substances: None Observed
- PCB's: [potential] Fluorescent light ballasts present
- Mould: None Observed

Samples:

15458-99: Wall Insulation (Porthole) - No Asbestos Content

9.0 Limitation of Survey

This document details the methodology, findings and conclusions of this survey and assessment conducted on the subject site in October – December 2011.

Analytical results included in the report reflect the sampled materials at the specific sample locations. Visually similar materials were referenced to specific analyzed samples.

The survey of the building did not include destructive sampling which would permit an intrusive investigation of inaccessible wall and ceiling cavities. Limited access into interior and perimeter walls, voids, crawlspaces, and mechanical shafts was obtained for the investigation of insulation materials. It is possible that hazardous materials are present in these areas but were not identified. If materials suspected of containing asbestos or other hazardous materials are encountered during future renovations or demolition, they should be treated as hazardous proven otherwise. Locations and building materials that have not been surveyed should be considered potentially hazardous materials-containing until such time as they can be evaluated by a qualified person. Until such time as the material can be appropriately evaluated, all work that could impact the suspect materials shall cease in the affected areas until such time as appropriate precautions can be implemented to protect workers and others at the subject site.

Roofing materials may contain asbestos, however, due to the potential for damage to the building and its contents, full depth roofing core samples were not obtained from the roofing systems. Roofing materials should be sampled and analyzed for asbestos prior to disturbance in the event that roof repairs or replacement is required.

All vermiculite insulation should be considered as asbestos containing until such time as a comprehensive destructive testing sampling program is carried out within the building or structure. Asbestos containing vermiculite should be considered present within all concrete block walls, voids, and spaces including attics, walls, ceiling and floor voids.

Some materials cannot be reasonably surveyed without causing significant damage to the building structure or envelope systems. These materials should be assessed for risk specific to any planned renovations or demolition activities. Materials suspected of containing asbestos may be located in concealed locations on this site include:

- Materials inside double wall metal chimney sections,
- Concealed roofing, caulk and felts,
- Internal parts of appliances and white goods,
- Vermiculite in walls that do not have existing penetrations,
- Buried cement pipes, and
- Gaskets in pipe flanges and valves.

Other materials were not sampled for fear of causing damage to building systems including vibration dampeners and electrical wiring.

An asbestos risk assessment must be completed prior to any removal and/or alteration work in or on a building. Removal and/or alteration work requires control measures to be implemented in accordance with WorkSafeBC. Regulations. Protective personal equipment is required during any work or major alteration that may disturb synthetic or asbestos insulation and/or dust that may be present.

Yours very truly,

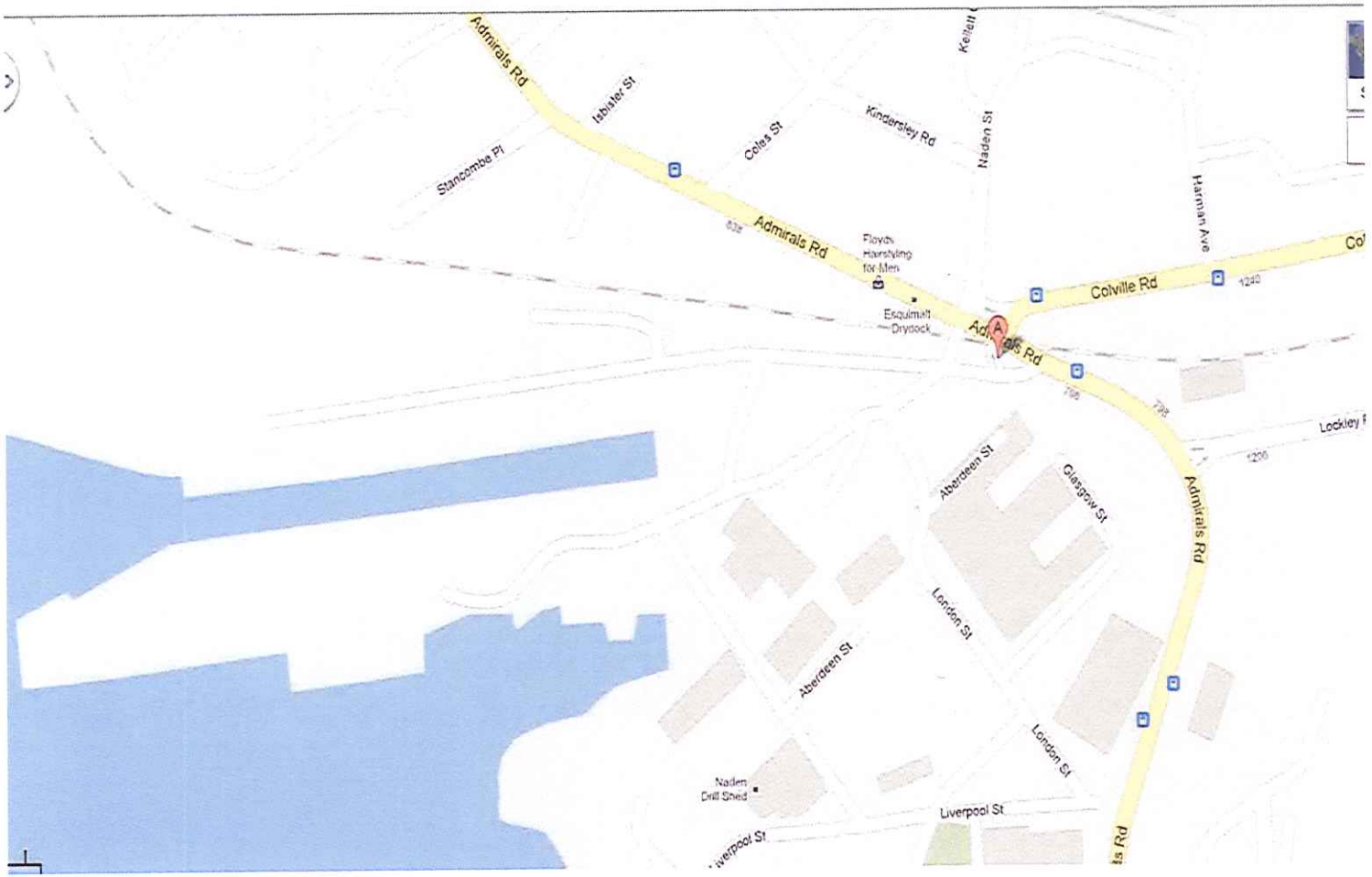
North West Environmental Group Ltd.

Julie Scott-Moncrieff, B.Sc.,
Senior Occupational Hygienist

APPENDICES

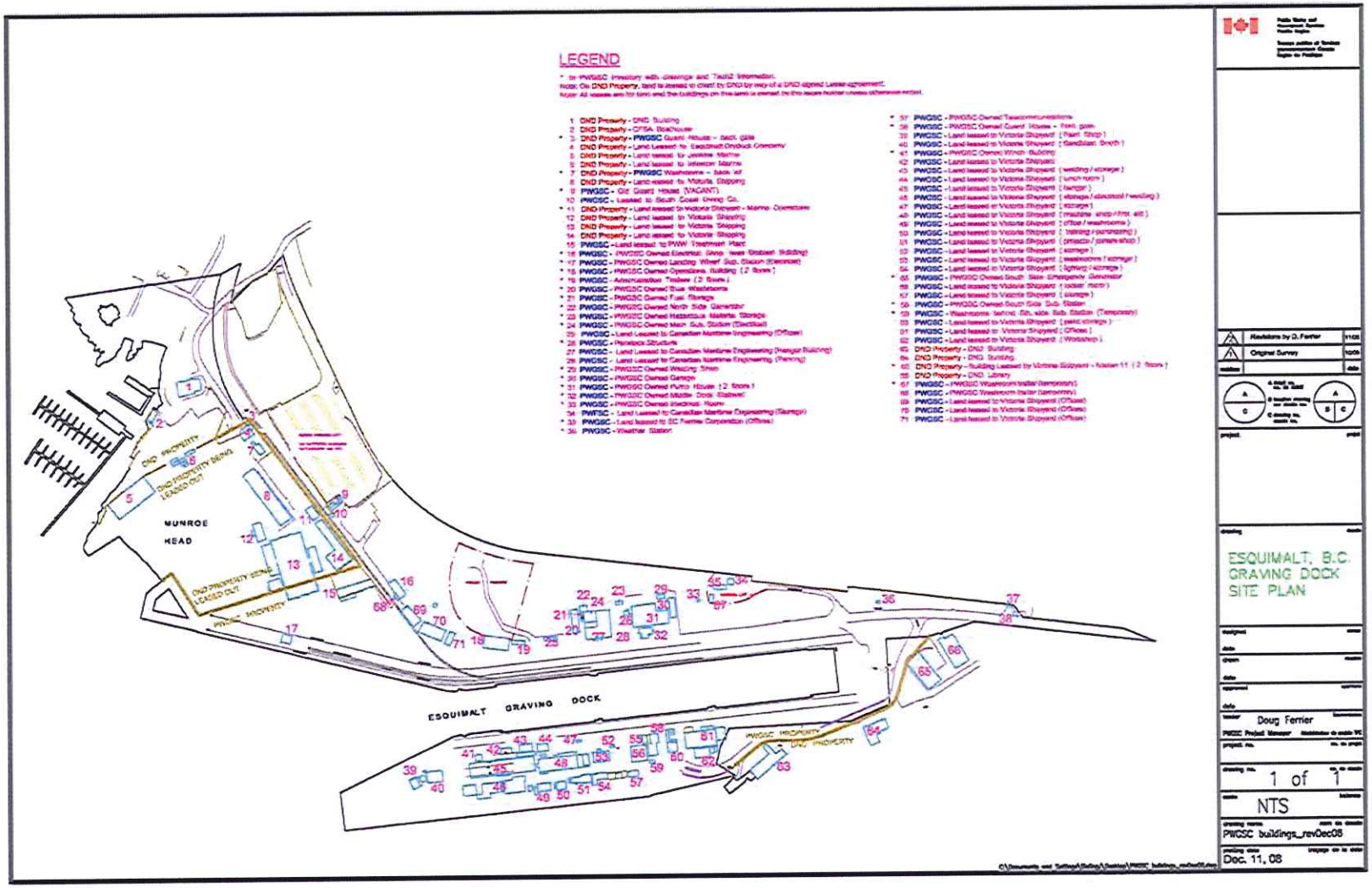
APPENDIX A – SITE LOCATION AND SITE PLAN

Drawing 1: Site Location (Google maps)



North West Environmental Group Ltd.

Drawing 2: Site Plan



Warning: in the event any additional suspect materials are encountered during renovation/repair activities, work on those materials should stop immediately and remain undisturbed until testing confirms the presence or absence of asbestos or other hazardous material

ESQUIMALT GRAVING DOCK

ESU SSSR

ESQUIMALT, BRITISH COLUMBIA

APPENDIX B

ESQUIMALT GRAVING DOCK SOUTH SIDE SUBSTATIONS GEOTECHNICAL ASSESSMENT

ESQUIMALT GRAVING DOCK

ESU SSSR

ESQUIMALT, BRITISH COLUMBIA

APPENDIX C

SAMPLE CONTRACTOR'S HEALTH

& SAFETY PLAN

HEALTH AND SAFETY REQUIREMENTS APPENDIX C

July 2012

CHECKLIST OF HEALTH & SAFETY PLAN REQUIREMENTS

- Prepare and comply with a site-specific project Health and Safety Plan (see sample below) based on hazard assessment, including, but not limited to, the following:

- Reference to Contractor's health & safety policy.

- Indication Health & Safety has been fully considered in the bid.

- General safety rules for the project.

- Commitment to comply with all applicable regulations and applicable policies and procedures of PWGSC and Pacific Forestry Centre.

- Confirmation that PWGSC will be informed of any sub-contractors before they enter the site and that PWGSC has the right to remove any sub it deems unsatisfactory.

- Commitment to completion of a Job Hazard Analysis and ensuring workers are made aware of the hazards and comply with specific requirements.

- Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations.

- Commitment to the documentation of job-specific safe work procedures and ensuring workers are trained in those procedures before starting work.

- Define regular communication channels to ensure information is transferred between the Construction team and the Departmental Representative/ operations and record keeping procedures.

- Commitment to provision of plans by Qualified Persons when required by regulation (e.g. fall arrest program, etc.), ensuring workers are trained in the plan, have approved equipment and follow the agreed plan.

- Commitment to ensuring no worker (including sub-trades) enters the job site without proper training. Ensuring Workers are made aware of their right to refuse work they consider too hazardous. Acknowledgement that the PWGSC orientation is not to be considered complete training.

- Commitment to using only "Qualified Persons" on the project and provision of proof of qualification as required.

- Definition of roles & responsibilities for project safety/organization for project specifically the Construction Superintendent, OH&S Representative and Worker

- Safety Representative. Identify any alternates and the qualifications of all individuals.

- A commitment to holding Occupational Health and Safety Meetings at a frequency agreed with the Departmental Representative and provision of minutes within 2 days of the meeting.

- Define Inspection Policy & Procedures. A commitment to holding formal site inspections at a frequency agreed with the Departmental Representative and provision of a report within 2 days of the inspection. The Worker Safety Representative will participate whenever possible.

- A commitment to conform to all environmental requirements and safe work procedures for hazardous materials. This includes provision of MSD Sheets and training of workers in correct use, handling, disposal and personal protective measures to be used.

- Definition of how First Aid will be provided and how medical emergencies will be treated.

- Incident reporting and investigation policy and procedures. Commitment to reporting all incidents, accidents, near-miss and WORKSAFEBC inspections/ orders to the Departmental Representative immediately followed by copies of relevant reports etc. within 2 days.

- Occupational Health and Safety Committee/Representative procedures.

- Occupational Health & Safety communications and record keeping procedures.

- List hazardous materials to be brought on site as required by work.

- Indicate engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.

- Identify personal protective equipment (PPE) to be used by workers.

- Identify personnel and alternates responsible for site safety and health.

- Identify personnel training requirements and training plan, including site orientation for new workers.

ESQUIMALT GRAVING DOCK

ESU SSSR

ESQUIMALT, BRITISH COLUMBIA

APPENDIX D

PRELIMINARY JOB HAZARD CHECKLIST

Preliminary JOB HAZARD ANALYSIS CHECK LIST August 2011

APPENDIX D

Project Title: **Master.** **Project No.**

Inspection Date:

Inspection/Job Hazard Analysis Conducted By:

Note:

1. This form is also intended for use as a checklist when making daily inspections of the worksite. Therefore some questions will not apply to the initial inspection/ job hazard analysis.

2. This form is intended as a guide only and does not necessarily cover every situation regulated by WORKSAFEBC or other jurisdictions. It is imperative that the Contractor be familiar with safety requirements and add anything that is relevant but not listed below. New items should be noted to the attention of the Project Manager for inclusion in future revisions. Contractors must finalize the JHA to reflect the methods/equipment etc. they will use to do the work.

3. Project Managers must review all items as part of creating preliminary JHA. Do not simply reuse this form from a previous project. Delete or add to "Hazard/action required" items as appropriate for your project and enter checkmarks or NA (not applicable) or TBD (to be determined with Contractor) under "Existing" column as appropriate.

4. CODES:

- **"*" indicates covered in Basic Site Orientation for Contractors presentation by PWGSC.**
- **"S" indicates item covered in startup meeting with Contractor and up to Contractor to carry out appropriate action. Not covered in EGD orientation session.**
- **"O" indicates item covered in EGD project specific orientation session. This does not relieve the contractor of responsibility for training workers with regards to this item.**

5. Column "WORKSAFEBC Ref." May also contain Canadian Occupational Safety & Health (COSH) regulation references.

Add brief description of work to be done:

Significant Risks include but are not limited to:

Project Title: **Master.** **Project No.**

	Cond. No.	Condition	Existing √	CODE	WORKSAFEBC Ref. #	Hazard/ Action Required
GENERAL	1.1	Notice of Project (NOP) given to WORKSAFEBC? Check regulations for conditions requiring notice: - Over $100,000. - All or part of works are required to be designed by P.Eng. - Asbestos removal - Disturb Lead coatings - Significant Risk of Occupational Disease - New construction, major alteration, structural repair or demolition of : - Bldg over 2 stories (or 20ft.) - Bridge - Earth/water retaining structure over 10' - Silo/chimney over 20' - Work in compressed air environment - Work in a caisson - Work in a tunnel (see 22.2) - Work on underground working (22.6) - Trenches 4' deep and 100' long or other type of excavation over 4' a worker must enter. - Diving Operations check 24.9 - Aircraft involved? check 29.8	√	S	20.2 24.9 22.6 29.8	Contractor to provide NOP to WORKSAFEBC and provide copy to Project Manager before pre-startup safety orientation meeting. Note that WORKSAFEBC NOP Form 52E49 is used for general construction work and when asbestos or lead is involved. Use WORKSAFEBC Form 52E48 for NOP when diving, underground workings or aircraft are involved. NOP should go to WORKSAFEBC 4-5 days before starting work if possible and MUST be submitted no less than 24 hrs before commencing work. The white copy is for the site and the canary and pink copies go to the WORKSAFEBC. Photocopies should be posted on the safety notice board, placed on the project file, contract file and sent to the Regional Safety Coordinator. Note also the requirement to provide written notice to WORKSAFEBC before commencing (under Part 19) if workers, equipment, machinery or materials could come in contact with energized high voltage conductors or other exposed electrical equipment. Note application to underground workings in WORKSAFEBC section 22.2
	1.2	Multiple Contractor Coordination. - 2 or more employers? - Overlapping work areas - Appoint qualified safety coordinator - Post construction procedures and JHA	√	S	Review WORK SAFEBC 20.3	Contractor to appoint Worker Safety Representative and Construction Superintendent. Coordination with EGD personnel and others on site will be through Project Manager. Post Final JHA and procedures.
	1.3	Building and other permits obtained?	√	S		Building permit required for new construction.
	1.4	Notice of Project Posted?	√	S		Contractor will post on safety notice board.

Project Title: Master. **Project No.**

	1.5	Post emergency response plan and site plan? Workers trained in emergency response? Conduct risk assessment for: Work at high-angles Special needs individuals Others as required by 4.13 or identified in other sections below	√	*	4.13-4.18 20.3	Site plan and emergency response to be posted on safety notice board. Contractor to ensure all workers trained in emergency response for fire, earthquake, medical, bomb threats and hazardous materials accidents before starting work. Note the special rescue requirements for high-angle work and the need for written agreements to provide service.
	1.6	Regular Safety Meeting Minutes Posted?	√	*	3.2	Weekly safety meeting to be held. Contractor to provide minutes to Project Manager for posting.
	1.7	WORKSAFEBC Orders, Inspections or "Notice to Workers" Posted? Notification of compliance posted?	√	S	Div. 10 183	Contractor to provide any WORKSAFEBC inspections and/or orders to Project Manager and post any inspections and compliance reports.
	1.8	Regular Inspections carried out with Safety Rep and Posted? Conduct special inspection if required due to malfunction or accident.	√	S	3.5 3.7 3.8	Provide inspection reports to P.M. and post.
	1.9	Contractor's workers safety representative identified for each employer? Alternatively, a Joint Committee set up if required by WORKSAFEBC Div. 4?	√	S	20.3 Div4 125-140	Worker Safety representative if 9 or more workers.
	1.10	Insufficient lighting?	√	S	4.65	Contractor to ensure lighting levels are sufficient for work to be performed. Provide portable lighting where necessary.
	1.11	Workers informed of the hazards of the job and that they have the right to refuse work they consider too hazardous without discriminatory action?	√	*	Review 3.12	To be covered in orientation session and reinforced by Contractor
	1.12	Workers with physical or mental impairment that could affect work must inform their supervisor.	√	*	4.19	To be covered in orientation session and reinforced by Contractor. Do not work at heights if subject to dizziness or if worker has a fear of heights
	1.13	Workers informed no alcohol, drugs or other substance so as to endanger self or others?	√	*	4.20	To be covered in orientation session and reinforced by Contractor. Inform First Aid attendant of any medications being taken as they may be important in case of accident.
	1.14	Firearms of any kind are prohibited on site.	√	*		To be covered in orientation session and reinforced by Contractor
	1.15	Duties of Employers, Workers, Supervisors and Owners	√	*	Div.3 115-119	Review duties/responsibilities of parties involved. To be covered in orientation session.

Project Title: Master. **Project No.**

	1.16	General Duty: In the absence of a specific requirement, all work must be carried out without undo risk of injury or disease to anyone.	√	*	2.2	To be covered in orientation session and reinforced by Contractor
	1.17	Do not remove or render inoperative any safeguard and ensure safeguards are in place before operating equipment.	√	*	4.11 4.12	To be covered in orientation session and reinforced by Contractor
	1.17a	All workers must be given adequate instruction in the fire prevention and emergency evacuation procedures applicable to their workplace	√	O	4.16	To be covered in orientation session and reinforced by Contractor
	1.18	Do not operate any EGD equipment. Only those trained and authorized by the contractor are to operate contractor's equipment.	√	*	4.10	
	1.19	Ensure equipment inspection & maintenance record (s) are readily available to equipment operators or inspectors.	√	*	4.9	To be covered in orientation session and reinforced by Contractor
	1.20	Workers must not engage in improper activity that could constitute a hazard to themselves or others including horseplay threats or physical force. Improper activity must be investigated.	√	*	4.24-4.31	To be covered in orientation session and reinforced by Contractor. Violence or harassment will not be tolerated. Contractor carry out risk assessment of injury from violence if there is potential for violence. Inform workers and prepare plans to minimize risk as required by 4.30
	1.21	Workers to restrict activity to designated areas of the site.	√	*		Restrictions to be discussed at pre-start-up safety orientation meeting.
	1.22	Workers informed of location of copy of WORKSAFEBC Regulations and Worker's Compensation Act.	√	*		Cover at orientation meeting. Contractor to ensure current copy of Regulations and the Act is available on site.
	1.23	Written work procedures developed? Provided to P.M. and workers?	√	S & O		Contractor to document work procedures and sequence of activities and provide to Project Manager and workers before starting work.
	1.24	Do not work on site outside of agreed working hours.	√	*		EGD must ensure an employee is on site anytime contractors are on site. Therefore notice is required.
	1.25	If work damages a utility it must be reported.	√	O	4.18	Immediately inform the Utility and then the Project Manager
	1.26	Wildlife, rodents may be encountered on the site.	√	O		Be aware of potential for encounters with wildlife on the site. Rodents may leave droppings in crawl spaces that could present a hazard if dust is breathed. Also, raccoons may be aggressive if cornered and deer may protect their young.

FIRST AID & INVESTIGATIONS	**2.1**	**Has the Contractor carried out an assessment and identified the numbers of workers who may require first aid at any time; the types of injuries that might occur; barriers to first aid being provided to an injured worker; and time required to transport an injured worker to medical attention?**	√	*	**3.16 & 3.17**	**Contractor to provide written first aid assessment and written procedures for providing first aid to comply with first aid amendments effective 1 Feb/08**
	2.2	**Workers instructed to report ALL injuries or near misses, hazardous conditions?**	√	*	**3.10**	**To be covered at the pre-startup safety orientation meeting.**
	2.3	**Workers know where first aid is located and how to call for first aid? Communication between first aid attendant and ambulance service defined?**	√	*	**3.17 & 3.18**	**Contractor MUST have own F.A. Before starting work. Identify location & adequacy of Contractor's F.A. equipment. Cover procedures in orientation.**
	2.4	**First Aid qualified person(s) on contractor's crew? ORIGINAL Certificate(s) must be with person(s) on site. Provide photocopy to Project Manager.**	√	**S**	**Part 3**	**Required. Provide certificate(s) to Project Manager before orientation session.**
	2.5	**F.A. equipment on site where required? Must comply with "High" Hazard class 20 min or less travel to hospital.**	√	**S**	**3.16**	**Provide location and type.**
	2.6	**Provide immediate investigation & notice to WORKSAFEBC for: - serious injury/death - major structural failure of bldg., bridge, tower, crane, hoist, excavation, temp. construction support system. - major release of a hazardous substance - incident required to be reported.**	√	**S**	**Div. 10 172**	**To be covered in project startup meeting with Contractor. Do not disturb the accident site except to attend injured persons, prevent further injuries or protect property. Assist investigators every way possible.**
	2.7	**Provide emergency transport to hospital as required by WORKSAFEBC and written procedures for transport**	√	**S**	**3.17**	**Contractor to define procedures for provision of first aid, calling ambulance service etc. as required by regulation. Post them and ensure workers are informed.**
	2.8	**Is the first aid attendant available to render prompt service?**	√	**S**	**3.18**	**Do not assign activities that will interfere with the attendant's ability to receive and respond to call for first aid. Ensure coverage during lunch and other breaks. Provide backup first aid immediately for planned absences. About ½ shift absence is permissible for unplanned absence until replacement attendant is in place.**

	2.9	**Has the general contractor included all subs in determining the numbers or workers and first aid requirements**	√	**S**	**3.20**	**General Contractor's first aid assessment and procedures to include sub-contractors.**
	2.91	**Has the contractor assigned a person to manage first aid service?**	√	**S**	**3.17**	**Assign someone to ensure attendants, supplies, facilities and equipment are always available.**
	2.92	**Does the Contractor have New or Young Workers as defined by WorkSafeBC regulations?**	√	**S**	**3.22-3.25**	**Ensure New or Young workers receive special orientation and training as required by regulations and documentation is provided to the Project Manager. Ensure follow up observation and provide reinforcement training if required or requested by the worker.**
	2.91	**Has the contractor assigned a person to manage first aid service?**	√	**S**	**3.17**	**Assign someone to ensure attendants, supplies, facilities and equipment are always available.**

CHEMICAL/ BIOLOGICAL - WHMIS	**3.1a**	**Hazardous Substances Used? Provide details.**	**TBD**	**O**	**PART 5**	**Contractor to provide Material Safety Data (MSD) Sheets for all hazardous substances to be used including welding materials and gases. Sheets must be provided by the contractor at first meeting with the engineer in order to complete the Job Hazard Analysis and define safe work practices. Ensure effective written procedures are prepared and implemented to prevent exposure by any route that could cause an adverse health effect, and to address emergency and cleanup procedures in the event of a spill or release of the substance. Ensure the supervisor and the workers are trained in and follow the established procedures.**
	3.1b	**Environmental Assessment completed? Check identified hazards and measures to be taken.**	**TBD**	**S**		**Environmental Assessment to be provided to Contractor.**
	3.1c	**EGD Environmental Best Management Practices applicable?**	**TBD**	**O**		**Contractor to follow Best Management Practices provided by Environmental Services.**
	3.2	**Implementation Plan Checklist completed?**	**TBD**	**S**	**5.7**	**Contractor to follow Implementation plan checklist for hazardous substances. See WORKSAFEBC section 5.7**
	3.3	**Material Safety Data Sheets Available?**	**TBD**	**O**	**5.16**	**Contractor to provide MSD Sheets and make available at worksite to all workers.**
	3.5	**Emergency Response Defined?**	**TBD**	**O**		**Contractor to define emergency response as appropriate for hazardous substances.**
	3.6	**Training Checklist Completed?**	**TBD**	**S**	**5.7**	**Contractor to follow education & training checklist for hazardous substances provided by WORKSAFEBC. See 5.7**
	3.7	**Flammable/Combustible Substances?**	**TBD**	**O**	**5.27-5.35**	

Project Title: Master. **Project No.**

	3.8	Substances under pressure?	TBD		5.36-5.47	
	3.9	Controlling Worker Exposure	TBD	O	5.48-5.59	
	3.10	Ventilation controls?	TBD	O	5.60-5.71	
	3.11	Internal Combustion Engines operated in poorly ventilated areas?	TBD		5.72-5.75	
	3.12	Hazardous Wastes & Emissions	TBD	O	5.76-5.81	
	3.13	Personal Hygiene	√	O	5.82-5.84	Wash hands before eating or smoking or at breaks as required by regulation.
	3.14	Emergency Washing Facilities, eyewash required?	TBD	O	5.85-5.96	Contractor to provide emergency washing facilities where required due to hazardous substances.
	3.15	Emergency Procedures defined? Review First Aid, Fire, Spill Control.	TBD	O	5.97-5.102	Contractor to review emergency procedures with workers
	3.16	First Aid and Fire depts. aware of substance and quantities used and locations stored?	TBD	S	4.17	Contractor provide notice if required by regulations.
	3.17	Supervisor & Workers trained? General WHMIS instruction as well as substance specific training?	TBD	S		Contractor to ensure Workers and Supervisors have WHMIS training and training in dealing with specific substances.
	3.18	Substance specific requirements?	TBD	S	PART 6	Review Part 6 and ensure compliance as per MSD sheets. See also sections 25, 28 and 29 below.
	3.19	Evaluate worker understanding of substance specific requirements and emergency/spill procedures during inspections.	TBD	S		Inspection item.
	3.20	Ensure containers for hazardous substances are maintained to ensure secure containment. Keep covered when not in use.	TBD	S	5.20-5.22	Inspection item.
	3.21	Keep only enough for one shift, store balance of quantity in designated separate area. Ensure workplace/supplier labels are on EVERY container.	TBD	S	5.23	To reduce the risk of a major spill, fire etc. minimize quantities on site. Ensure workers can easily tell what is in every container. Inspection item.
	3.22	Store incompatible substances so that they can not mix in event of leakage, breakage etc.	TBD	S	5.24	Serious consequences can result from mixing certain substances. Ensure they cannot mix. Inspection item.
	3.23	Store hazardous substances so they can't fall, be damaged or exposed to extreme temperatures.	TBD	S	5.25	Inspection item.
	3.24	Ensure the designated storage area meets design requirements.	TBD	S	5.26	Inspection item.

	3.25	Protective and spill equipment available?	TBD	O		Contractor to ensure all personal protective equipment and spill response equipment is readily available and workers are trained in spill response plan.
	3.26	Follow proper procedures in disposing of hazardous substances.	TBD	S		Follow MSD Sheet instructions.
	3.27	Other	TBD			
		Note: Refer to WHMIS Implementation Plan checklist when doing inspections for hazardous substances	TBD	S		Create inspection checklist where required.
WORKING ALONE	4.1	Working alone process defined for workers assigned to work alone? Note new guidelines Nov./08 for determining if working alone regs apply. Amongst other things a "person check" system alone is unlikely to meet the "readily available" test.	No working alone	*	4.21-4.23	There will generally be no working alone. Document special procedures and agree with Project Manager if working alone is necessary. Note regulation changes 1 Feb/08
	4.2	Working alone process followed?	√		4.21-4.23	Inspection item.
	4.3	Restricted Access area?	√	O		Contractor to ensure workers follow procedures for restricted access.
CONFINED SPACE	5.0	Confined Space Entry Control required?	NA	S		Considerable danger may exist if personnel enter designated confined spaces without proper ventilation and other controls/procedures being in place. No confined space identified on this project.
	5.1	Confined Space Entry Controlled and/or hazard identified?	√	S	9.3, 9.12	Project Manager to identify confined space and inform Contractor.
	5.2	Hazard Assessment Completed by Qualified Person?	√	S	9.9-9.11	Ensure space has been assessed by a Qualified Person. All known spaces have been assessed at EGD.
	5.3	Entry permits completed, signed and posted per regulations? Keep permit for 1 year.	√	S	9.13- 9.16	Inspection item.
	5.4	Confined Space Entry Program Defined?	√	S	9.5	Follow WORKSAFEBC regulations. Contractor will use own policy and forms. EGD CSE policy and forms to be used for EGD workers. Ensure emergency/rescue plans are coordinated and compatible.
	5.5	Person assigned to administer confined space program?	√	S	9.6	EGD confined space program coordinator is Kim Wilson

Project Title: **Master.** **Project No.**

	5.6	**Confined Space Entry Program followed?**	√	**S**		**EGD workers will Follow the program outlined in the binder in the Pump House. Contactor will follow own program. Inspection item.**
	5.7	**Workers & Supervisors Trained?**	√	**O**		**Ensure workers are trained in written procedures for entry, monitoring air quality and rescue. Only trained workers may participate in the work, rescue, monitoring etc.**
	5.8	**Ventilation adequate?**	√	**O**	**9.31 – 9.33**	**Check ventilation considering work to be done and airborne contaminants etc. Each job must be separately assessed.**
	5.9	**Lockouts Performed when required?**	√	**O**	**9.17-920**	**Lockout may be required as part of the confined space entry procedure. Follow EGD lockout policy.**
	5.10	**Rescue Equipment condition checked.**	√	**S**		**Check equipment maintenance log.**
	5.11	**Standby worker requirements being followed?**	√	**O**	**9.34-9.36**	**Inspection item.**
	5.12	**Rescuer's trained and drills conducted?**	√	**O**	**9.37-9.38**	**Standby Rescuers to have performed drills in this area, otherwise conduct drill before starting work.**
	5.13	**Notify Rescue personnel before workers enter and again when workers complete work unless agreement is for 24 hour service. Ensure rescuers monitor the signalling system.**	√	**O**	**9.39 9.40**	**Follow agreed protocol with rescuers. Generally must have rescuers on standby at entrance with Fire Dept. considered backup.**
	5.14	**No cylinders of compressed gas inside confined space.**	√	**S**	**9.48**	**Inspection item.**
	5.15	**Welding/Cutting torches and hoses must be removed when not in use.**	√	**S**	**9.49**	**Inspection item.**
	5.16	**Ensure electrical tools & equipment meets WORKSAFEBC 9.50**	√	**S**	**9.50**	**Inspection item.**
	5.17	**Use only non-sparking tools if flammable/explosive gases, vapors or liquids are present.**	√	**S**	**9.51**	**Inspection item.**
	5.18	**Provide means of communication – radio for workers inside confined space.**	√	**O**		**Inspection item.**
	5.19	**Ensure rescue equipment is inspected by Qualified Person before each use.**	√	**S**		**Contractor to ensure inspection and document.**
		Note: Follow Confined Space Entry program details as inspection guideline. These must be agreed with Rescuer personnel.	√	**O**		

Project Title: **Master.** **Project No.**

LOCK-OUT & ELECTRICAL	**6.1**	**Has the EGD Lockout policy been reviewed and relevant sections complied with?**	**√**	**S**		**Policy to be reviewed by Contractor with workers as part of training.**
	6.2	**Each worker has own lock, no combination locks? Means of identifying lock owner?**	**√**	**O**	**PART 10**	**Every worker must have own lock and tag identifying worker and company.**
	6.3	**Lockout procedures documented for project?**	**√**	**O**	**PART 10**	**To be documented and agreed with J. Lezetc and permit issued before initiating lockout.**
	6.4	**Workers and Supervisors trained in lockout? Only certified electricians to do electrical work.**	**√**	**O**	**PART 10**	**Contractor to ensure all Workers and Supervisors are trained in the lockout procedure. Contractor to provide proof of certification to Project Manager before start of work.**
	6.5	**All isolation points identified?**	**√**	**S**	**PART 10**	**To be done in conjunction with J. Lezetc and documented in lockout procedure.**
	6.6	**Electrical ground hazard?**	**√**	**S**		**To be done in conjunction with J. Lezetc and documented in lockout procedure.**
	6.7	**Pneumatic Devices hazard?**	**√**	**S**		**Document if this type of hazard exists and controls required.**
	6.8	**Potential Energy hazards? All parts secured against inadvertent movement?**	**√**	**S**		**Document if this type of hazard exists and controls required.**
	6.9	**Kinetic Energy hazards? All parts secured against inadvertent movement?**	**√**	**S**		**Document if this type of hazard exists and controls required.**
	6.10	**Hydraulic Energy hazards?**	**√**	**S**		**Document if this type of hazard exists and controls required.**
	6.11	**Chemical Energy hazards (eg. Flammable, Combustible, corrosive) ?**	**√**	**S**		**Document if this type of hazard exists and controls required.**
	6.12	**Radiation hazards (eg microwave, lasers, Ultraviolet, infrared)**	**√**	**S**		**Document if this type of hazard exists and controls required.**
	6.13	**Thermal Energy hazards (eg, steam, hot water or other substances, refrigeration lines)**	**√**	**S**		**Document if this type of hazard exists and controls required.**
	6.14	**If over 750V follow H.V. guidelines in lockout policy.**	**√**	**O**		**Document if this type of hazard exists and controls required.**
	6.15	**No working NEAR energized H.V. equipment or conductors.**	**Not permitted**	**S**	**Lockout Policy**	**Not permitted.**
	6.16	**No working on <u>energized</u> lighting circuits.**	**Not permitted**	**S**	**Lockout Policy**	**Not permitted.**
	6.17	**Control the use of metal ladders, wire reinforced ladders,, metal scaffolds or work platforms.**	**√**	**S**	**19.10**	**Planned use of ladders, scaffolds etc. to be determined with Contractor and electrical risks assessed.**
	6.18	**No Qualified workers within 1 m. of uninsulated, energized parts.**	**Not permitted**	**S**	**Lockout Policy**	**Not permitted. Keep unqualified personnel at least 3 m. from energized parts.**

	6.19	**If using an insulated aerial device has it been tested as required by WORKSAFEBC Reg. 19.9**	√	**S**	**19.9**	**Check plans to use aerial device & insure compliance.**
	6.20	**Is all portable electrical equipment either double insulated and so marked or effectively grounded? Workers trained to inspect?**	√	**S**	**19.14**	**Contractor to check any portable equipment and ensure workers trained in inspecting electrical equipment for safe operation.**
	6.21	**Is all portable electrical equipment used outdoors or in wet/damp conditions protected by Class A Type ground fault circuit interrupters?**	√	**S**	**19.15**	**Contractor to check any portable equipment and ensure workers trained in inspecting electrical equipment for safe operation.**
	6.22	**Ensure good access to electrical equipment and that no flammable materials are stored or placed close to electrical equipment.**	√	**O**	**19.7**	**Practice good housekeeping. Keep areas clear in front of electrical panels, fire alarms & extinguishers. No flammables inside work areas unless agree by Project Manager.**
	6.23	**Other, specify:**				
	6.24	**Are lockout points easily identifiable (e.g. By number) to prevent lockout errors and identify the equipment it serves?**	√	**S**	**19.13**	**All lockout points are labelled.**
	6.25	**Note that lockout of a panel door preventing access to other live breakers is unacceptable.**	√	**S**		**Generally there should be no other users of panels while the project work is underway. Confirm.**
	6.26	**Note lockout of Control Circuits is not sufficient for total isolation.**	√	**S**		**Reminder item**
	6.27	**Be SURE to understand what will happen if an energy source is activated.**	√	**S**		**Reminder item**
	6.28	**Consider severity of injury, frequency of doing the job and probability of injury in assessing tasks.**	√	**S**		**Reminder item**
	6.29	**Before the conclusion of the job and after energizing, have conspicuous signs been placed near the equipment stating "Danger – Energized Equipment"?**	√	**O**	**19.11** **19.17**	**Place signs when finished.**
	6.30	**Ensure electrical instrumentation is functioning properly and has not been the subject of recall by the manufacturer.**	√			**Note that some Fluke Model 179 Multimeters have exhibited faulty readings and need to be replaced.**

Project Title: **Master.** **Project No.**

FALL PROTECTION	**7.0**	**Fall Protection required?**	√	**S**	**11.2**	**1.Work over 7.5 ft. (CLC requirement) or shorter distance if risk of injury greater than fall to flat surface 2.Use guardrails or similar restraint if practicable. 3.Use other fall restraint if 2 not practicable. 4.If 3 not practicable use fall arrest system 5.If 4 not practicable ensure work procedures acceptable to WORKSAFEBC are used. Note changes to WORKSAFEBC regulations 1 Jan/05**
	7.1	**Fall Protection System defined in writing?**	√	**S&O**	**11.3**	**Contractor to define fall protection plan for any work over 7.5 ft. (CLC requirement) above ground on unguarded surfaces from which fall greater than 7.5m.(25ft) can occur or 11.2(5) applies.**
	7.2	**Workers & Supervisors Trained?**	√	**S&O**	**11.2(6)**	**Contractor to ensure all workers & supervisors trained in fall protection procedures before work starting and provide documentation to Project Manager.**
	7.3	**Workers trained & Fall Protection Procedures followed?**	√		**11.2(6)**	**Inspection item.**
	7.4	**Inspection of fall arresting equipment before each use by a qualified person being done?**	√	**S**	**11.9-**	**Qualified Person to perform inspection before use on each shift. Keep free from foreign substances & conditions that can contribute to deterioration & keep in good working order.**
	7.5	**Fall Protection System used?**	√	**S**	**11.2(7)**	**Ensure workers use system**
	7.6	**Safety Belts used for fall restraint only? Otherwise use body harness.**	√	**S**	**11.4**	**Follow written fall protection plan.**
	7.7	**Ensure equipment meets standards**	√	**S**	**11.5**	**Ensure components are suitable and compatible, sufficient to support the forces and meet and are used in accordance with standards.**
	7.8	**Ensure anchors meet standards**	√	**S**	**11.6**	**Check anchors meet WORKSAFEBC requirements. Changed 17 May/06**
	7.9	**Temporary horizontal lifeline system used?**	√		**11.7**	**Acceptable if 1) manufactured for commercial use and installed and used per written instructions and drawings (available on site) 2)designed, installed & used per written instruction and drawings (available on site) certified by P.Eng. 3) other acceptable to WORKSAFEBC Changed 17 May/06**
	7.10	**Need to remove from service?**	√	**s**	**11.10**	**If fall protection system has arrested fall of a worker remove from service until inspected and recertified safe by manufacturer or P.Eng.**

FIRE RELATED	**8.1**	**Workers aware they generally do not fight fires? First priority is to raise the alarm and get selves and others to safety.**	√	*		**Workers to fight fires only if small (2'x2') and they have been trained in fire extinguisher use and they are confident they can extinguish the fire. To be reinforced at orientation meeting and reinforced by Contractor.**
	8.2	**Fire Extinguishers Available and accessible?**	√	**O**		**Contractor to ensure proper type and number of extinguishers available. Check monthly inspection and tags.**
	8.3	**Electrostatic Discharge**	√	**O**		**Contractor to determine risk of ignition due to discharge and take preventive measures.**
	8.4	**Ignition Sources eliminated or controlled if flammable gas or liquid used or stored?**	√	**O**	**5.27**	**No smoking on this project except in designated areas defined by Project Manager. Define any other ignition sources and controls required.**
	8.5	**Flammable gas concentrations**	√	**S&O**		**Ensure adequate ventilation to comply with WORKSAFEBC regulations. Monitor flammable gas concentrations and use forced ventilation if required.**
	8.6	**Combustible materials**	√	**O**		**Keep area clear of combustibles. Practice good housekeeping. Store oily rags in approved metal containers with tight fitting lids and empty daily.** **Burning of waste is prohibited.**
	8.7	**No smoking in buildings, on cranes, in caissons or tunnels. Define other restrictions. Rules being followed?**	√	**O**	**4.81**	**Contractor to enforce no smoking except in areas designated by the Project Manager.**
	8.11	**Do not use flammable liquids as a manual cleaning solvent.**	√	**S**	**5.32**	**Flammable fumes can collect on clothes and result in the worker being engulfed in flames should ignition occur. Also, these substances are often hazardous to health and can be absorbed through the skin. Contractor to reinforce with workers and monitor for compliance.**
	8.12	**Hot Work Permits issued and posted?**	√	*		**Obtain permit from Project Manager before starting any cutting, welding, brazing, soldering, grinding, heat-treating or other hot work like roof tarring, thawing pipe, hot riveting or using powder-driven fasteners.**
	8.13	**Fire Alarms explained?**	√	*		**To be covered at pre-startup meeting and worker orientation session.**

LADDERS/SCAFFOLDS & TEMP WORK PLATFORMS	**9.0**	**Is work off ladders/scaffolds etc planned? Note new guidelines Nov/08 re suitable ladders, work platforms, and scaffoldings, and to specify that the top plate of interior or exterior walls, the top plate/top walers used in concrete formwork, or other elevated surfaces narrower than 50 cm (20 in) are not considered suitable work platforms or acceptable as elevated walkways.**	**NA**	**S**		**No work off ladders/scaffolds foreseen.**
	9.1a	**Workers trained and authorized to use temporary work platform?**	**√**	**S**	**COSH 3.5**	**Ensure all workers trained before authorizing use.**
	9.1b	**Weather conditions likely to be hazardous to use of temporary structure?**	**√**	**S**	**COSH 3.3**	**No work in rain, snow, hail or electrical/wind storm likely to be hazardous to worker safety**
	9.2	**Has Qualified Person inspected temporary structure before use each shift?**	**√**	**S**	**COSH 3.6**	**If defect found, do not use until remedied.**
	9.3	**Could temporary structure be contacted by person or vehicle?**	**√**	**S**	**COSH 3.7**	**Install hi-viz barricade around base or post a person.**
	9.4	**Ladder type and condition? Meet specifications per WORKSAFEBC?**	**√**	**S**	**PART 13**	**Contractor to ensure all ladders are in good condition and meet WORKSAFEBC requirements for the application. Ensure portable ladders are marked with grade of material and use for which ladder constructed.**
	9.5	**Ladder Inclination, Footing and Support and use according to WORKSAFEBC regulations**	**√**	**S**	**PART 13 COSH 3.11**	**Check for minimum ¼ maximum 1/3 inclination, solid footing and support. Projects at least 1m(3ft.) above upper landing to which it supplies access. Check extension overlap. Tie off if possible for stability during use.**
	9.6	**Contractor to ensure work off ladders meets regulations. If work cannot be done safely from a ladder provide work platform.**	**√**	**O**	**13.6**	**Follow safe ladder work practices**
	9.7	**Heavy/bulky objects or others that may make ascent or descent unsafe not to be carried up ladders**	**√**	**O**	**13.6**	**Use an assist to raise & lower tools.**
	9.8	**Scaffold or other work platforms to be designed and approved by a P.Eng.?**	**√**	**S**	**Check WORKS AFEBC PART 13 13.11**	**Contractor to provide P.Eng. certified scaffolding plan where required by regulation 13.11. Follow instructions including fall protection during erection/ dismantling and use of the system. Signed copy to be available on site.**

	9.9	**Employer must ensure scaffold is in a safe condition regardless of who erected it. Ensure scaffold manufacturer's technical data & instructions for erection available on site.**	√	**O**	**13.13, 13.15 COSH 3.10**	**Ensure manufacturer's documentation is on site or follow P.Eng. instructions. Contractor ensure compatibility if different manufacturers of components used. Ensure qualified Person supervises erection, use and dismantling and scaffold capable of holding 4 times load likely to be imposed. (COSH)**
	9.10	**Guardrails and toe boards installed at every open edge of platform?**	√	**S**	**4.55-4.60 COSH 3.8**	**Ensure guardrails and toeboards installed**
	9.11	**Tools/equipment/materials arranged to prevent being accidentally knocked off platform?**	√	**S**	**COSH 3.4**	**Ensure safe arrangement on platform**
	9.12	**Check Scaffold Stability, Bracing, Access and all connections secure.**	√	**S**	**13.17 13.18**	**Ensure scaffold is stable, plumb and level and WORKSAFEBC requirements are met. If height 3 times min. base dimension or other circumstance requiring stability- bldg ties/guys required. Inspection item.**
	9.13	**Plank type & condition inspection. Planks secured?**	√	**S**	**13.14 13.16**	**Contractor Inspect planks regularly and secure to scaffold frame. Dimensions and guardrails meet requirements?**
	9.14	**Scaffold grounded if near high voltage or hazardous level of voltage likely to be induced in scaffold?**	√	**S**	**13.19**	**Ensure grounding. Inspection item**
	9.15	**Safe access provided to work platform?**	√	**S**	**13.7 COSH 3.9**	**Provide safe access. Temporary stairs have uniform steps, slope not exceeding 1.2 in 1; hand-rail between 90 and 110cm above stair level. Ensure temporary ramps securely fastened; safe footing, braced if necessary; slope l in 3 except in stairwells check COSH Inspection item**
	9.16	**Work platform strength sufficient for load and secured against separation form supporting equipment, structure or surface?**	√	**S**	**13.8**	**Ensure scaffold can support 4 times load likely to be imposed on it (COSH 3.10)**
	9.17	**Work platform subjected to sudden drop, contact with electrical conductors or showing signs of mechanical damage/wear?**	√	**S**	**13.12**	**Remove from service until certified safe by manufacturer or P.Eng.**
	9.18	**Ensure movable work platforms are clearly marked with rated capacity**	√	**S**	**13.20**	**Also check for marking on components (e.g. rigging capacity, counterweight, etc.) as required by regulations**
	9.19	**For elevating work platforms ensure operation manual, maintenance instructions, replacement parts information are reasonably available to workers.**	√	**S**	**13.21**	**If information is not available, equipment must not be used until obtained or written instructions provided by P.Eng.**

	9.20	**Employer must keep records regarding inspection, maintenance, repair or modification for each elevating work platform, swing stage, and permanent powered platform**	**√**	**S**	**13.22**	**If inspection and maintenance records other than pre-shift inspections not available, do not use until certified safe by manufacturer or P.Eng.**
	9.21	**Vehicle-mounted and self-propelled boom-supported elevating work platforms tested?**	**√**	**S**	**13.23**	**Inspect and certified by manufacturer or P.Eng. every 12 months. In 10th year after manufacture & every 5 years thereafter include structural inspection to verify integrity and stability.** **Dielectric test insulated units at least annually- certified by testing agency.**
	9.22	**If a movable work platform is not designed to be moved while a worker is on it, ensure it is secured before being accessed by the worker.** **Move platforms designed to be moved while occupied only as specified by the manufacturer.**	**√**	**S**	**13.24**	**Exceptions:** **If the height of the work platform of a rolling scaffold is:** **(a) not more than 1 1/2 times the least base dimension of the scaffold, the scaffold may be moved by the effort of the person occupying the platform or a person on the floor or other supporting surface,** **(b) more than 1 1/2 times the least base dimension of the scaffold, the scaffold must be moved only by the effort of a person on the floor.** **(c) more than 2 times the least base dimension of the scaffold, the scaffold must not be moved while the person is occupying the platform**
	9.23	**Elevating work platform meets requirements for warning devices and controls?**			**13.25** **13.26**	**Ensure intermittent horn or flashing light and warning system for deviation from level are provided as required by regulation. Ensure controls including STOP are clearly marked. Clearly mark overriding lowering control to be used in emergency.**
	9.24	**Guardrails installed? Ensure temporary guardrails meet specs.**	**√**	**S**	**4.58**	**Contractor to ensure guardrails are installed and meet regulations. Inspection item.**
	9.25	**Forklift mounted work platform not to be used except as defined by WorkSafeBC regulation.**	**√**	**S**	**13.30**	**Check revised regulations 1 Feb/08. Inform Project Manager before using a forklift mounted platform.**
	9.26	**Work platforms suspended from a crane or hoist must be certified and loaded weight including rigging not over 50% of crane/hoist rated capacity at the working radius or configuration.**	**√**	**S**	**13.27-**	**Boom must be powered or fixed. No platform suspended from articulating boom crane unless approved by manufacturer. Secondary hoisting line must not be used when workers are on platform suspended from a crane.**

	9.28	**Hoisting and lowering work platforms done according to safe practices?**			**13.29**	**Operate as slowly as practicable. Lower under power if device powered. May not be controlled only by brakes. Ensure lower travel limit device is used where required. Carry out a trial lift before platform is occupied.**
	9.29	**Portable powered platform capable of raising/lowering by 2 or more separately controlled hoists?**			**13.31**	**Ensure controls located so one person can operate all hoists simultaneously.**
	9.30	**Ensure fall protection meeting WORKSAFEBC requirements is in place for suspended or elevating work platforms**	**√**	**S**	**13.33**	**Include in fall protection plan. Each person on a work platform attached to a crane boom must use a personal fall arrest system secured to an anchor on the boom or on the platform that is designated by the manufacturer, or a professional engineer.**
	9.31	**WORKSAFEBC approval obtained for high risk situations?**	**√**	**S**	**13.32**	**A swing stage, boatswain's chair and portable powered platform must not be used without prior permission of the Board if (a) one work platform will be used above or below any portion of another work platform, (b) a deck or planking will be used to span a gap between two independent work platforms, (c) the work platform will exceed 10 m (32 ft) in length, or (d) the suspension height will exceed 91 m (300 ft).**
PROTECTIVE EQUIPMENT	**10.1**	**Hard Hats Worn at all times. Chinstraps available for high wind/ bending over?**	**√**	*****	**8.11-8.13**	**Contractor to monitor and enforce hardhat and chinstrap usage.**
	10.2	**High Visibility Clothes, correct type for the job.**	**√**	**O**	**8.24-8.25**	**Wear high viz vests when required. Traffic Control Persons will have special requirements.**
	10.3	**Approved Buoyancy Equipment (note change in acceptable standards G8.27-2)**	**NA**	**O**	**8.26-8.30**	**Required if working within 5 feet of water.**
	10.4	**Safety Footwear**	**√**	*****	**8.22-8.33**	**Approved steel-toed footwear in good repair, required at all times meeting WORKSAFEBC requirements for the work to be performed.**
	10.5	**Approved Safety Eyewear/ Face Shields. Note new guidelines re acceptable standards Nov/08**	**√**	**O**	**8.14-8.18**	**Eye protection required when energizing and de-energizing breakers. Also when doing any other work where flying objects may be encountered. Also may be required when using hazardous substances (TBD).**
	10.6	**Wear Hearing Protection when required by WORKSAFEBC regulations.**	**√**	**O**	**7.1-7.9**	**Hearing protection required when in high noise situations exceeding WORKSAFEBC noise exposure limits. Implement and provide evidence of noise control and hearing conservation program where required by regulation. Post warning signs in high noise areas.**

	10.7	**Respiratory Protection & Fit**	**√**	**O**	**8.32-8.37**	**Wear approved respiratory protection considering the respirator protection factor and maximum use concentration, MSD Sheets, exposure to oxygen deficient atmosphere when selecting respirators for workers that may be exposed to dusts or hazardous fumes/mists above exposure limits.**
	10.71	**Respirator fit tests conducted?**	**√**	**O**	**8.38-8.41 8.44**	**Ensure proper fit tests per regulations and keep records. Workers must perform a positive or negative pressure user seal check in accordance with *CSA Standard before each use.***
	10.72	**Worker's ability to use a respirator in doubt for medical reasons?**	**√**	**O**	**8.42**	**Ensure worker examined by a physician, and advice obtained re the ability of the worker to wear a respirator.**
	10.73	**Self Contained Breathing Apparatus (SCBA) used?**	**√**	**O**	**8.35 8.37 8.45**	**Ensure air quality complies with regulation 8.37. Ensure inspection and testing of compressed air cylinders must be done in accordance with *CSA Standard* and SCBA, including regulators, are serviced and repaired by qualified persons.**
	10.8	**Gloves, Aprons, leg protection**	**√**	**O**	**8.19-8.21**	**Wear protective clothing when performing work that could result in cuts, slivers, abrasions, etc. Check added requirements from MSD Sheets.**
	10.9	**Flame resistant clothing**	**√**	**O**	**8.31**	**Wear when welding or cutting or other hot work hazards**
	10.10	**Welding Goggles**	**√**	**O**		**Wear when welding or cutting**
	10.11	**Welding Clothes (e.g. leather aprons, face shields, leather gauntlet gloves etc.)**	**√**	**O**		**Wear when welding or cutting. Also those working nearby may need to wear protective clothing.**
	10.12	**Vibration Reduction**	**√**	**O**	**7.10-7.16; 5.54**	**Provide written exposure control plan where required by regulation and inform worker of hazards. Employer ensure equipment is labelled to identify hazard. Ensure hands and arms not exposed to cold if also exposed to vibration.**
	10.13	**Radiation Exposure Control**	**√**	**O**	**7.17-7.25**	**Provide written exposure control plan where required by regulation and inform worker of hazards.**
	10.14	**Personal clothing, rings, hair etc. OK**	**√**	**O**	**8.10**	**Ensure workers do not have loose clothing, long hair or rings which could become entangled if operating rotating power tools.**
	10.15	**Apply Sunscreen, to protect against sunburn on exposed skin.**	**√**	**O**		**Wear sunscreen when working outdoors.**
	10.16	**Safety belts, harnesses, lanyards & shock absorbers**	**√**	**O**		**Follow fall protection plan and use prescribed equipment.**
	10.17	**Employees must wear suitable personal clothing for the work they are doing to reduce risk of injury.**	**√**	**S**		**Contractor to ensure workers wear suitable clothing.**

		Note: Check all protective equipment for proper fit and condition.	√	**S**		**Contractor responsible for ensuring proper fit and care of all protective equipment and documentation thereof.**
HEAT STRESS	**11.1**	**Heat Stress Control Required? Followed?**	√	**S**	**7.27**	**To be determined by Contractor's Superintendent based on section 7 WORKSAFEBC regulations (Jan/05), weather conditions, and worker proximity to heat sources and clothing worn.**
	11.2	**Check for heat stress if temp warrants.**	√	**S**	**7.28- 7.30**	**Contractor to monitor environmental conditions and take action accordingly if ACGIH standard requires. If required, conduct assessment and develop exposure control plan. Provide engineering controls if practicable, otherwise reduce exposure or provide admin controls or PPE.**
	11.3	**Potable drinking water nearby?**	√	**O**	**7.31**	**Contractor to supply adequate drinking water for Workers**
	11.4	**Workers & Supervisors trained to recognize?**	√	**O**	**7.32**	**Contractor to ensure Workers and Supervisor recognize symptoms and know proper response. Contractor's F.A. attendant to be instructed to monitor workers for signs. Remove workers exhibiting stress from exposure and provide First Aid or physician treatment.**
COLD STRESS	**12.1**	**Cold Stress Control Required? Followed?**	√	**S**	**7.33**	**Cold stress not likely to be a factor during summer months. Contractor to be aware of conditions under which cold stress could be a concern based on ACGIH standard (Jan /05)**
	12.2	**Check Table 7-4 for conditions**	√	**S**	**7.34- 7.37**	**Contractor to monitor for cold stress risk conditions and take appropriate action. if ACGIH standard requires. If required, conduct assessment and develop exposure control plan. Provide engineering controls if practicable, otherwise reduce exposure or provide admin controls or PPE.**
	12.3	**Workers & Supervisors trained to recognize?**	√	**O**	**7.38**	**Ensure workers trained. First Aid attendant may be asked to monitor for cold stress. Remove workers exhibiting stress from exposure and provide First Aid or physician treatment**

Project Title: **Master.** **Project No.**

CRANES, HOISTS & RIGGING	**13.1**	**Note WorkSafeBC definitions for "critical lift" "duty cycle work", "load bearing component", "sign truck" and "tandem lift"**	√	**S**		**Changes effective 1 Feb./08 to add clarity.**
	13.1a	**Only EGD Operators operate EGD Cranes/hoists or other equipment.**	√	*		**No plans to use any EGD equipment. Contractor to reinforce that only EGD workers are to operate EGD equipment.**
	13.1b	**Contractor supplied crane meets specifications and has required labelling etc per WORKSAFEBC regulation?**			**14.2-14.8**	**Ensure crane is marked with: a) Manufacturer, model, sr# b)rated capacity or load chart. c)boom angle, boom extension and load measure (where applicable) d) any modifications to the crane or components**
	13.1c	**Crane Hoist documentation available?**			**14.12**	**Ensure manufacturer's crane/hoist manual, including instructions for assembly/disassembly, maintenance, and safe operation are readily available on site.**
	13.1d	**Inspection and maintenance carried out and documented including any modifications? Operator to carry out start of shift inspection and document.**	√	**S**	**14.13 to 14.16 14.35**	**(1) Each crane and hoist must be inspected and maintained at a frequency and to the extent required to ensure that every component is capable of carrying out its original design function with an adequate margin of safety. (2) A crane or hoist must not be used until any condition that could endanger workers is remedied. (3) Any repair to load bearing components of a crane or hoist must be certified by a professional engineer or the original equipment manufacturer.**
	13.1e	**Crane properly equipped?**			**14.17 to 14.33**	**Ensure crane/hoist meets all WORKSAFEBC requirements for stops, audible warnings, guards, controls, operator protection, etc. as per WORKSAFEBC regulations**
	13.2	**Weight lifted determined and communicated to operator and all others involved in lift?**	√	**O**	**14.36 14.38**	**Contractor to ensure that load weights are accurately determined and communicated to the crane operator and others involved. Crane operators must not lift if there is any doubt about the safety of the lift.**
	13.3	**Ensure crane operators meet the trade qualification specified by WORKSAFEBC**	√	**S**	**14.34**	**Provide proof of qualification to Project Manager before starting work.**
	13.4	**Ensure workers stay clear of swinging loads and equipment when swinging creates a hazard**	√	**O**	**14.40 14.41**	**Position equipment to ensure 2 ft. clearance or more between crane parts etc. and obstructions in any area accessible to workers.**
	13.5	**Multiple Crane lift? Follow WORKSAFEBC regs**	**NA**	**S**	**14.42**	**No multiple crane lifts planned.**
	13.6	**Travel with load? Follow WORKSAFEBC regs.**	√	**S**	**14.43**	**Follow safe practices.**

Project Title: **Master.** **Project No.**

	13.7	**Prevent passing over workers with load**	√	**O**	**14.44**	**Contractor to ensure loads do not pass over workers.**
	13.8	**Load left suspended and unattended?**	√	**O**	**14.45**	**Do not leave loads suspended & unattended.**
	13.9	**Hook position over load to prevent side loading?**	√	**O**	**14.46**	**Ensure straight lifts are used. If lifts on an angle are necessary observe working load limit (WLL) reduction.**
	13.10	**Designated signalman? Use std signals? Use radio if possible.**	√	**O**	**14.47 to 14.49**	**Ensure trained workers use standard signals when communicating with crane operator. Use dedicated 2-way radio communication on UHF at power assigned and coordinated by the WORKSAFEBC whenever possible.**
	13.11	**High voltage in vicinity? Risk of induced charge? Review and follow WORKSAFEBC requirements.**	√	**O**	**14.51-14.52**	**No lifts planned near high voltage.**
	13.12	**Up-travel limit tested for bridge, gantry & OH traveling cranes? (crane operator daily check)**	√	**O**	**14.55**	**If crane/hoist is not EGD operated equipment, Contractor to ensure operator has tested limits.**
	13.13 a	**Ensure mobile cranes are on surface capable of supporting the load**	√	**S**	**14.69**	**Contractor to check before lift.**
	13.13 b	**Mobile cranes or boom trucks inspected at least annually?**	√	**S**	**14.71**	**Ensure mobile cranes or boom trucks are inspected at least annually. Provide proof to Project Manager.**
	13.14	**Rigging/slinging work done by or under direct supervision of qualified workers familiar with the rigging to be used.**	√	**S**	**15.2**	**Contractor to use trained riggers following accepted good practices when performing lifts and provide a list of trained individuals to the Project Manager.**
	13.15	**Ensure rigging is identified with the manufacturer and Working Load Limit (WLL) as well as any other information required by WORKSAFEBC and meets the WORKSAFEBC requirements for the work to be performed.**	√	**O**	**15.5 15.42 15.46 15.55 15.59**	**Do not use rigging without proper permanent identification. DO NOT EXCEED the designated WLL; also applies to below-the-hook lifting devices.**
	13.16	**Use only rigging permanently marked with an adequate working load limit considering the angle of lift, termination efficiencies, numbers of legs used, conditions for the lift, temperature restrictions and good rigging practices.**	√	**S**	**15.9**	**Follow good rigging practices. Ensure design factors comply with changes Jan/05.**
	13.17	**Ensure any attachments (rings, shackles, couplings etc) are designed for use with the rigging to which they are fastened.**	√	**S**		**Contractor to ensure compatibility in design.**
	13.18	**Slings & attachments must conform with specifications and be visually inspected before use on each shift.**	√	**S**	**15.30 15.31**	**Remove defective equipment from service immediately.**
	13.19	**Do not subject the rigging to dynamic loading.**	√	**S**		**Apply the load slowly & smoothly**

	13.20	**Do not use rope/slings with evidence of wear or distortion, broken strands, kinking, bird-caging, corrosion, heat or arc damage that meets the rejection criteria specified by WORKSAFEBC.**	**√**	**S**	**15.25-15.27 15.48-.49**	**Remove equipment from service immediately if it meets rejection criteria.**
	13.21	**Do not use worn or damaged hooks that fail to meet WORKSAFEBC regulations.**	**√**	**S**	**15.29**	**Remove rejected hooks from service immediately.**
	13.22	**Protect slings from damage if passing over a sharp edge and store properly.**	**√**	**S**	**15.37 15.39**	
	13.23	**Follow WORKSAFEBC rules for slinging to prevent slipping or overstressing the sling and when lifting multiple piece lifts.**	**√**	**S**	**15.40 15.41**	
	13.24	**Hooks must have safety latches unless meeting the exemption of WORKSAFEBC 15.10(2)**	**√**	**S**	**15.10**	
	13.25	**Consider effect of wind on loads**	**√**	**S**		**Crane operator to use judgement and consider wind velocity in determining if lift can be safely made. Crane operator has final decision on making any lift.**

MOBILE EQUIPMENT & TRANSPORT OF WORKERS	**14.1**	**Does the contractor intend to use any mobile equipment on site other than trucks for transporting workers?**	**TBD**	**S**	**PART 16**	**To be determined. Define equipment to be used and any special requirements.**
	14.2	**Are contractor's vehicles safe for transport of worker's?**	**√**	**S**	**16.3**	**Contractor to ensure vehicles are properly equipped and maintained.**
	14.3	**Are workers obeying speed limits? Max speed 20kph**	**√**	*****	**PART 16**	**Cover at start up orientation meeting.**
	14.4	**Are vehicles properly parked?**	**√**	*****	**PART 16**	**Workers will be shown the designated parking areas. Do not park in areas where crane travels, Fire Lanes, blocking fire hydrants, fire/emergency alarm pull stations or fire extinguishers.**
	14.5	**Elevating work platform(s) operations manual and inspection certificate on site? Daily inspection log available?**	**√**	**S**	**PART 16**	**Requirements depend on contractor use of this type of equipment. TBD in final JHA**
	14.6	**Ensure seat belts used and roll over protection provided if required. Note guidelines Nov./08**	**√**	**O**	**PART 16**	**Requirements depend on contractor use of this type of equipment. TBD in final JHA**
	14.7	**Suspended work platforms/chairs used? Conform to specifications? Verify engineering design. Support structures in place?**	**NA**	**S**	**PART 16**	**Generally, not planned to be used. Check WORKSAFEBC regulations if suspended platforms to be used.**

	14.8	**Do not leave delivery vehicles unattended for extended periods.**	**√**	*****		
	14.9	**Do not hitch a ride on forklifts unless proper seats exist for this purpose.**	**√**	*****		**Contractor to enforce.**
	14.10	**Ensure volatile, flammable, or hazardous materials transported in isolated compartment accessible only from outside & properly ventilated & drained**	**√**	**S**	**17.6**	**Contractor to ensure vehicles meet WORKSAFEBC requirements.**
	14.11	**Ensure tools/materials/ equipment are carried in separate designated area for that purpose.**	**√**	**S**	**17.5**	**Contractor to ensure workers cannot be injured by unsecured items in the vehicle.**
	14.12	**Equipment properly secured if elevated? No use of hydraulic or pneumatic lifts as blocks unless collapse not possible.**	**√**	**S**	**16.37**	**Ensure workers do not leave equipment parts unattended in an elevated condition or work under equipment unless properly secured.**
	14.13	**Loads secured according to regulations? Loads do not interfere with lift truck operation?**	**√**	**S**	**16.44-16.46**	**Contractor to ensure loads are properly secured.**
	14.14	**Workers have procedures, equipment and training for tire repairs?**	**√**	**S**	**16.47 16.48**	**Contractor to ensure workers have training & equipment if they will change tires.**

TRAFFIC CONTROL	**15.1**	**Is there any blocking of roadways, or aisles during the project? If so install signs, barricades etc.**	**√**	**S&O**		**Define road blocking and traffic control requirements. Contractor to ensure proper traffic control if temporary road blocking is required to deliver materials etc. Contractor to ensure non-project personnel are kept out of the work area as agreed with the P.M. before starting work.**
	15.2	**Will gantry crane travel through the work area? Coordinate with the crane supervisor.**	**√**	*****		**Workers to be instructed regarding crane travel and alarms during pre-startup meeting as they may encounter them enroute to work location. Ensure work is planned and communicated to crane supervisor before start.**
	15.3	**Is there operations activity near the project site? Ensure coordination and minimize impact.**	**√**	**S&O**		**The Engineer will ensure all supervisors and contractors on site are aware of the work and schedule.**
	15.4	**Control boat traffic and ensure flags and markers are in place.**	**√**	**S&O**		**Provide controls if working near water.**
	15.5	**Is there a need to protect Public Roadways? Review WORKSAFEBC PART 18.**	**√**	**S&O**	**PART 18**	**Define need and document special traffic control measures. Ensure traffic control plan prepared by a qualified person is in place meeting MoTH requirements and WORKSAFEBC regulations. NOTE changes effective 1 Jan/07**

Project Title: Master. **Project No.**

	15.4	Is there a defined inspection program for traffic control devices to ensure they are well maintained and effective under all weather and light conditions? Documentation of inspections & repairs made kept?	√	S&O		Contractor to define an inspection program including repair/replacement procedures, inventory of devices, Contractor to ensure documentation is maintained including follow-up to ensure work has been done.
	15.5	Are pavement markings clear and old markings removed?	√	S&O		Ensure markings are clear and not confusing. Remove old markings.
	15.6	Are markings removed/covered when not in use?	√	S&O		Contractor to ensure markings are removed/covered when not required.
	15.7	Is there an individual assigned supervisory responsibility for traffic control?	√	S&O		Contractor to assign an individual. Ensure all workers and supervisors are trained in safe work requirements and supervisors ensure workers follow prescribed procedures.
	15.8	Are Traffic Control Persons trained?	√	S&O		Contractor to ensure only trained individuals engage in traffic control and that they have written instructions. Provide proof of completion of MoTH approved course.
	15.9	Has the Contractor kept records of changes in traffic control?	√	S&O		Contractor to maintain records to assist investigation in event of an accident.
	15.10	Are there risks to workers due to vehicles/equipment operating on the construction work site?	√	S&O		Contractor to define risks to workers on the construction site due to vehicles and measures to minimize risks of injury. Risks to employees of other companies to be acknowledged, minimized and communicated to appropriate supervisors.
EVACUATION & RESCUE	16.1	Written procedures developed?	√	S&O	4.13	Contractor to ensure need for emergency rescue assessed and procedures for rescue documented. Call 911. Rescue will be by DND/Esquimalt Fire Dept. Ensure all workers understand process to call for assistance and have emergency numbers. Review emergency procedures at orientation session.
	16.2	Simulations/ Training completed?	NA		32.2	Fire Dept. Rescuers are trained.
	16.3	Equipment warranted or P.Eng. certified?	NA		32.3	Fire Dept. responsibility
	16.4	Rope suitable per std.?	NA		32.4	Fire Dept. responsibility
	16.5	Visual & physical inspection by qualified workers after use or training?	NA		32.5	Fire Dept. responsibility
	16.6	Maintenance per manufacturer & records kept?	NA		32.6	Fire Dept. responsibility
	16.7	At least 1 on rescue team Level 1 F.A. Certificate?	NA		32.7	Fire Dept. responsibility
	16.8	Communications between rescuers & support?	NA		32.8	Fire Dept. responsibility

	16.9	**Rescue boat available? Buoy & rope? Sufficient rescuers?**	**NA**		**32.9**	

DIVING/ MARINE OPERATIONS	**17.0**	**Diving /Marine Operations?**	**NA**	**S**		**No diving or marine related work on this project.**
	17.1	**Wharf ladders & condition?**	**√**	**O**	**24.2**	**Ladders are available every 100 feet.**
	17.2	**Marine lifesaving equipment available & condition?**	**√**	**S**	**24.3**	**Contractor will supply own PFD's and other rescue equipment per Part 24 WORKSAFEBC regulations.**
	17.3	**Handrails, bullrails, & markings?**	**√**	**S**	**24.4-24.5**	
	17.4	**Notice of Project submitted for diving projects?**	**√**	**S**	**24.9**	**Required.**
	17.5	**Rescue boat available if required for rescue or evacuation?**	**√**	**S**	**24.6 24.31**	**Contractor will supply rescue boat and sufficient rescuers.**
	17.7	**Medical Certification for each diver available at dive site?**	**√**	**S**	**24.10**	**Required.**
	17.8	**Diving supervisor approves diver as being physically capable of diving?**	**√**	**S**	**24.11**	**Required.**
	17.9	**Divers, standby divers and tenders not fatigued or have consumed drugs/alcohol which could impair their ability to work safely**	**√**	**O**	**24.11**	**Sufficient divers available to prevent fatigue and ensure ability to work safely?**
	17.10	**All divers, diving supervisors and diving tenders trained in CPR, oxygen therapy and diving accident management?**	**√**	**S**	**24.12**	**Entire crew trained and certified?**
	17.11	**Certified competency documents available for each diver at the site?**	**√**	**S**	**24.13**	**Included in divers logs?**
	17.12	**Current chronological dive logs available on site for each diver?**	**√**	**S**	**24.14**	**Available for each diver?**
	17.13	**Dive site has list of hyperbaric chambers?**	**√**	**O**	**24.15**	**Available? Nearest is still at DND across the bay?**
	17.14	**Dive site has location of nearest hospital and phone # ?**	**√**	**O**	**24.15**	**Record on dive plan document.**
	17.15	**Dive site has Level 1 F.A. kit and an oxygen therapy unit of sufficient capacity to reach emergency services?**	**√**	**O**	**24.15**	**Required.**
	17.16	**Dive site has complete set of approved dive tables (not sport type)? Diving computers must not be used instead of tables.**	**√**	**O**	**24.15 24.21**	**Required**

Project Title: **Master.** **Project No.**

	17.17	**Dive site has copy of WORKSAFEBC reg. PART 24?**	√	**O**	**24.15**	**Required**
	17.18	**Is there an appropriate way of entering and leaving the water, including rescuing an incapacitated diver?**	√	**O**	**24.15**	**Contractor to document in rescue plans.**
	17.19	**Dive site has equipment for voice communication with emergency services personnel?**	√	**O**	**24.15**	**Radio supplied by EGD to supervisor for continuous contact to pumphouse for fast 911 call if required. Work will be 7a.m to 4 p.m. only unless agreed ahead of time with Doug Ferrier.**
	17.20	**Divers on a lifeline wear suitable harness? Lifelines not attached to weight belt, free of knots & splices.**	√	**S**	**24.16**	**Contractor has proper equipment and will ensure safe usage.**
	17.21	**Diver tender must tend lines at all times.**	√	**S**	**24.16**	**Agreed by contractor.**
	17.22	**Diving contractor has safety procedures documented and available at dive site?**	√	**S&O**	**24.17**	**Contractor's safety manual will be on site at all times.**
	17.23	**Diving supervisor's detailed plan presented in writing to EGD before work starting?**	√	**S**	**24.18**	**Dive plan to be presented to Doug Ferrier and posted.**
	17.24	**Diving supervisor must not leave the area during diving operations.**	√	**S**	**24.19**	**Entire crew qualified to act as supervisor. Sufficient divers and supervisors will always be in the area during diving operations or no divers will be in the water.**
	17.25	**Before each dive has the crew briefing been carried out? This will include discussion of hazards, planned duration and maximum depth, decompression procedures, location of other divers, work to be done, recall signals and emergency procedures.**	√	**O**	**24.19**	**A briefing will be carried out ahead of the dives.**
	17.26	**Divers made aware of their responsibilities under 24.20?**	√	**O**	**24.20**	**Divers responsibilities to be reviewed with them by contractor as part of pre-start meeting. Diving will be one day only.**
	17.27	**If decompression is required check compliance with WORKSAFEBC regs 24.22- 24.25**	√	**S**		**No decompression planned as part of dives. Depth less than 50 ft.**
	17.28	**Ensure breathing mediums and equipment comply with WORKSAFEBC reg 24.26 to 24.29**	√	**S**		**Contractor will ensure compliance.**
	17.29	**Ensure control of boat traffic and proper warning devices, flags etc.**	√	**O**	**24.30**	**Project manager to ensure ship engines will not be started during this project.**
	17.30	**If a hoisting device is used to raise or lower the diver dedicated for dive duration?**	√	**S**	**24.32**	**Needs to be defined.**

	17.31	**Hoist operator takes directions from diver, supervisor or tender only.**	**√**	**O**	**24.32**	**Needs to be defined.**
	17.32	**Standby diver required? If so, meets requirements and able to enter water in 1 min.?**	**√**	**O**	**24.33**	**Required.**
	17.33	**In event of an accident or incident comply with WORKSAFEBC regs for information and not tampering with equipment.**	**√**	**O**	**24.34**	**Contractor will comply.**
	17.34	**Are all hazardous mechanisms secured against inadvertent movement and locked out?**	**√**	**S**	**24.63**	**Project Manager will ensure no docking/undocking work will take place during this project and that any nearby ship will not start engines.**
	17.35	**If working near or in an intake /pipe/tunnel/duct comply with WORKSAFEBC reg 24.64**	**√**	**S**	**24.64**	**Project Manager will ensure no docking/undocking work will take place during this project.**
	17.36	**If there are exceptional hazards, additional dive team members with independent equipment and capable of effecting rescue must be on site.**	**NA**	**S**	**24.65**	**No exceptional hazards identified.**
	17.37	**If diving in contaminated environments comply with WORKSAFEBC reg 24.66**	**NA**	**S**	**24.66**	

CONSTRUCTION, EXCAVATION & DEMOLITION	**18.1**	**Protection from falling materials**	**√**	**S**	**20.9**	**Requirements to be determined in final JHA based on detailed construction plans.**
	18.2	**Safe access/ egress to worksite? Ramps at least 20" wide with guardrails & cleats.**	**√**	**S**		**Requirements to be determined in final JHA based on detailed construction plans.**
	18.3	**Temporary Floors**	**√**	**S**	**20.5-20.6**	**No temporary floors foreseen. Permanent floor will be built first.**
	18.4	**Fall prevention / protection required? See also group 7 checklist items.**	**√**	**O**	**20.9**	**Required for all work over 7.5ft on unguarded surfaces (CLC requirement). Fall protection plan required.**
	18.5	**Chutes**	**√**	**S**	**20.10**	**Requirements to be determined in final JHA based on detailed construction plans.**
	18.6	**Glass Panels**	**√**	**S**	**20.12**	**Requirements to be determined in final JHA based on detailed construction plans.**

	18.7	**Thrust out Crane landing platforms used?**	√	**S**	**20.13**	**P.Eng. must certify each thrust-out crane landing platform and certify that the building structure can adequately support loads to be imposed by use of the platform. Drawings and certification must be available on site, rated capacity clearly marked on platform and not be exceeded. Control measures acceptable to the Board must be implemented to ensure all loads placed on a thrust-out crane landing platform are safely supported, and can be safely attached to and detached from the rigging. Requirements to be determined in final JHA based on detailed construction plans.**
	18.8	**Temporary support of partially assembled components adequate?**	√	**S**	**20.14**	**Requirements to be determined in final JHA based on detailed construction plans. Ensure partially assembled components are properly supported and braced including for possible wind loading.**
	18.9	**All construction details available on site including drawings, erection procedures, temp. bracing, falsework**	√	**O**	**20.15**	**All drawings and specifications will be available on site at the project office. Contractor will also ensure his Superintendent has latest copies on site.**
	18.10	**Walkways /runways provided on structural members to prevent tripping?**	√	**S**	**20.16**	**Requirements to be determined in final JHA based on detailed construction plans.**
	18.11	**Plans & specs for Concrete Formwork & Falsework approved by P. Eng.?**	√	**S**	**20.17**	**Requirements to be determined in final JHA based on detailed construction plans.**
	18.12	**Qualified Supervisor for erection/use of formwork/ falsework? Workers trained in hazards & proper methods?**	√	**S**	**20.18**	**Contractor to ensure Superintendent qualified to install formwork and workers are trained in the hazards and proper methods.**
	18.13	**Erection drawings, design responsibility, continuity of engineering complies?**	√	**S**	**20.19-20.21**	**PWGSC will ensure continuity of design services.**
	18.14	**Protruding reinforcing steel removed or guarded?**	√	**O**	**20.23**	**Guard or remove during construction.**
	18.15	**Worker access restricted under formwork when steel or concrete has just been placed?**	√	**O**	**20.23**	**Requirements to be determined in final JHA based on detailed construction plans.**
	18.16	**Formwork inspected before pour?**	√	**O**		**No pouring until Qualified Supervisor has performed final inspection and OK given.**
	18.17	**Formwork exhibits any weakness, excess distortion, or undue settlement?**	√	**O**	**20.23**	**Superintendent to monitor and take appropriate action.**
	18.18	**No loads on uncured concrete except as per dwgs or specs.**	√	**S**	**20.23**	**Superintendent to ensure drawings/specifications followed regarding loading.**

	18.19	**Erection and temporary bracing of pre-manufactured open web joists and trusses or laminated beams must be according to written instructions from a P.Eng. or the manufacturer detailing safe erection procedures.**	**√**	**O**	**20.72**	**Contractor to ensure documentation is on site and that all workers have been trained in the prescribed erection procedures before work starting.**
	18.20	**Ensure crawl boards/ladders used for roof work are securely fastened**	**√**	**O**	**20.74**	
	18.21	**Work on roofs having slope 8 vertical to 12 horizontal or greater require nailed toeboards in conjunction with personal fall protection or safety nets.**	**√**	**S**	**20.75**	**Toe-holds must be used if the roofing material allows for it. Note: Exposed horizontal roof strapping may be used as toe-holds as long as it provides safe footing.**
	18.21a	**Roof edge guarded?**	**√**	**S**	**20.76**	**The roof edge about a chute, bitumen spout and material hoist must have guardrails meeting the requirements of Part 4 (General Conditions) or barriers of at least equivalent strength to at least 2 m (6.5 ft) on each side of such a work area.**
	18.22	**Mechanical or powered equipment that has the potential to push or pull a worker over an unguarded roof edge, must not be used unless operated according to procedures acceptable to the Board.**	**√**	**S**	**20.77**	**Secure WORKSAFEBC approval of procedures if using this equipment.**
	18.23	**Loose insulation, polyethylene, roofs with smooth surfaces, asphalt and surfaces with water, snow, ice or frost increase the risk of losing footing.**	**√**	**S**		**Work under severe weather conditions will be under the control and advisement of their supervisor**
	18.24	**Avoid walking backwards on roofs.**	**√**	**S**		**Contractor's Supervisor will advise all workers of safe working practices**

EXCAVATION /DEMOLITION	**19.0**	**Excavation work to be carried out?**	**NA**		**S**	**No excavation on this project.**
	19.1	**Written instructions/ drawings by P.Eng. available for excavation work ?**	**√**	**O**	**20.78**	**Keep all instructions/ drawings readily available at the site. Train workers to follow instructions.**
	19.2	**All utilities accurately located & danger determined?**	**√**	**S&O**	**20.79**	**Contractor to get details on utility location and necessary approvals before digging.**
	19.3	**Utilities instructions followed regarding excavation?**	**√**	**S**	**20.79**	**Obtain necessary approvals and instructions.**
	19.4	**Nearby objects secured or removed if hazardous?**	**√**	**S&O**	**20.80**	**Ensure any objects are removed as required to meet regulations depending on depth of excavation etc.**
	19.5	**Sloping/shoring requirements met as defined by P.Eng. or Geoscientist ?**	**√**	**O**	**20.81-**	**Follow requirements of P.Eng. or Geoscientist**

	19.6	**Control of water addressed?**	**√**	**O**		**Ensure water in excavation is controlled to prevent possible trench wall collapse.**
	19.7	**Ladder provided in immediate work area extending min. 3' above ground?**	**√**	**S**		**Requirements to be determined in final JHA based on detailed construction plans.**
	19.8	**Barricades in place to prevent fall into trench if over 7.5' deep? If excavation is a hazard to workers, cover or guard it.**	**NA**	**O**	**20.88**	**No trenching over 7.5ft deep foreseen. Barricade work area and position flashing warning signs to prevent accidental falling into trench.**
	19.9	**End shoring in place equal to depth of excavation?**	**√**	**S**		
	19.10	**Loose excavated materials well back from slopes/ trenches in use?**	**√**	**O**	**20.90**	**Keep at least 2' from excavation and 4' from any other excavation**
DEMOLITION/EXCAVATION	**19.11**	**Are there soil contaminants expected or chance of encountering archeological materials?**	**√**	**O**		**Workers to be shown sample of archeological materials and instructed to stop excavating if they encounter possible archeological materials. Also provide workers with details of soil contaminants and potential risks. Stop work and immediately report to P.M. if anything is encountered including suspected soil contaminants.**
	19.12	**All Workers must be aware that soils on the site may contain hydrocarbons and metals such as arsenic, zinc, copper, lead.**	**√**	**O**		**All excavation and management of soils must be in compliance with the Interim Soil Management Plan for Munroe Head, Esquimalt Graving Dock and North Naden - stored fully contained, sampled, and disposed off-site if above federal industrial criteria. Project Manager to provide guidance for specific project.**
	19.13	**Ensure structure and adjoining structure are properly supported during demolition to the extent and manner prescribed by a P. Engineer IF Workers could be endangered by the demolition or adjoining structures could have their stability compromised.**	**√**	**S&O**	**20.111**	**Follow demolition/ temporary support procedures and detailed schedule as defined by an Engineer in writing. Copy of the plan must be available on site.**
	19.14	**Ensure hazardous materials are identified before beginning demolition or salvage of machinery, equipment, buildings or structures.**	**√**	**S**	**20.112**	**Hazardous substances will be defined in the Environmental Assessment as well as by inspection with the Contractor. Details will be available at the site and procedures identified for safe containment and removal.**
	19.15	**Stop all work if hazardous materials are discovered during demolition and not previously identified.**	**√**	**O**		**Report to Project Manager immediately.**

	19.16	**Ensure all electric, gas, water and other services are disconnected**	√	**O**	**20.113**	**Contractor to ensure all services are properly disconnected before starting work.**
	19.17	**Glass must be removed from top to bottom and before other work commences.**	√	**S**	**20.114**	
	19.18	**Ensure floors are not overloaded by materials and equipment.**	√	**O**	**4.2**	
	19.19	**Protect workers from falling materials including covering floor or roof openings and barricading areas where materials will be dropped.**	√	**O**	**20.116 20.117**	
	19.20	**Dangerous or unstable walls must be adequately braced.**	√	**O**		**Follow Engineer's demolition plan.**
	19.21	**Do not let debris accumulate if it will in any way endanger workers**	√	**O**	**20.120**	**Follow Engineer's demolition plan.**
	19.22	**Stairways and handrails must be left intact until access to the level they serve is no longer required.**	√	**O**	**20.121**	**Follow Engineer's demolition plan.**
	19.30	**Restrict access to pile driver when hoisting piles**	√	**O**	**20.103**	**Only workers engaged in the operation to remain on superstructure or any area where pile could fall. Control general access to site with barricades and signs.**
	19.31	**Operator protected from falling objects, rigging failures & weather?**	√	**S**	**20.104**	**Contractor to ensure suitable roof or shelter.**
	19.32	**Any air or steam discharge controlled to prevent injury to workers or impair ability to see operation?**	√	**S**	**20.105**	**Contractor to control discharge.**
	19.33	**Chock suspended hammer securely when not in use.**	√	**O**	**20.106**	**Operator to ensure.**
	19.34	**Do not raise hammer with swinging/suspended leads until necessary.**	√	**O**	**20.106**	**Operator to ensure.**
	19.35	**Wooden piles properly prepared?**	√	**O**	**20.107**	**Cut wooden pile square, clean of debris, bark & slivers before driving. Trim pile to fit the follower or pile driving cap.**
	19.36	**Follower or pile driving cap being used correct size & type?**	√	**O**	**20.107**	**Ensure suitability for type of piling being driven.**
	19.37	**Do not use a cracked drop hammer.**	√	**O**	**20.108**	**Remove defective hammer from service immediately.**
	19.38	**Do not use spliced ropes to support a pile driver hammer.**	√	**O**	**20.109**	**Contractor to ensure.**

HOUSEKEEPING; MATERIALS STORAGE	**20.1**	**Refuse spills and waste materials not allowed to accumulate and create a hazard**	√	**O**	**4.41**	**Cover at start up orientation meeting.**
	20.2	**No use of compressed air to clean clothing of any potentially hazardous dusts etc.**	√	**O**	**4.42**	**Compressed air can penetrate skin, enter bloodstream and result in death. Do not use compressed air to clean work surfaces. Cover at start up orientation meeting.**
	20.3	**Check state of repair of floors, ramps, stairs and free of tripping and slipping hazards**	√	**O**	**4.39**	**Cover at start up orientation meeting.**
	20.4	**Material stacked securely and stable?**	√	**S**	**4.43**	**Check plans for stacking materials. Also Inspection item.**
	20.5	**Are areas free of risk of entrapment or falling materials? If not take appropriate measures per 4.44 and 4.45**	√	**S**	**4.44-4.45**	**Evaluate risks. Also Inspection item.**
	20.6	**Use metal containers with tight fitting lids for oily or painting rags & empty daily.**	√	**O**		**Oily or paint soaked rags can ignite through spontaneous combustion. Store properly. Also Inspection item**
	20.7	**Use proper containers for refuse.**	√	**O**		**Inspection item**
	20.8	**Are work areas free of protruding nails?**	√	**O**		**Ensure nails are either removed or bent over to eliminate the hazard of stepping on them.**
	20.9	**Are nuts/bolts etc. stored in containers to reduce tripping hazards?**	√	**O**		**Clean up components frequently to reduce risks.**
	20.10	**Returned tools to proper place after use.**	√	**O**		**Ensure tools are properly stored.**

EQUIPMENT MAINTENANCE & USE	**21.1**	**Equipment operator's manuals at site?**	√	**S**		**Keep manuals on site with equipment. Includes equipment like concrete pumping trucks**
	21.2	**Equipment operated by qualified persons?**	√	**S**		**Contractor to provide proof of qualification of equipment operators.**
	21.3	**Equipment maintained according to manufacturer's instructions?**	√	**S**		**Maintain equipment as specified by manufacturer and maintain a record of maintenance.**
	21.4	**Equipment inspection before use carried out?**	√	**S**	**16.34**	**Operators inspect equipment before use, record results (where required by WORKSAFEBC) and report any defects to Supervisor. Do not use defective equipment until defect is remedied.**
	21.5	**Explosive operated tools maintained, and used properly? Operator's trained? Equipment & shots stored in restricted area?**	√	**S**		**Provide proof of training to Project Manager for users of this equipment before starting work. Check with P.M. for Hot Work permit requirement also.**
	21.6	**Air operated nailing guns trigger mechanism working properly?**	√	**S**		**Ensure safety mechanisms working properly.**

	22.0	**Follow safe lifting practices. Use mechanical lifting assist wherever feasible or get assistance.**	**√**	**S**		**Contractor to train all workers in safe lifting practices and monitor for compliance.**

CONCRETE PUMPING	**23.1**	**Placing boom certified safe within last 12 months?**	**√**	**S**	**20.47**	**Serious injury could result due to failure of components, couplings etc. if pressures or other loads are exceeded. Contractor provide certificate copy to P.M.**
	23.2	**Permanent equipment labels on pump, boom and mast per WORKSAFEBC requirements?**	**√**	**S**	**20.27**	**Inspection item.**
	23.3	**Outriggers used properly and within maximum extension and load?**	**√**	**S**	**20.40**	**Inspection item**
	23.4	**Ensure concrete delivery pipe meets boom manufacturer's specs and is rated at greater than maximum pressure pump can generate. Ensure pipe clamps are of proper rating and properly installed per regulations.**	**√**	**S**	**20.42 20.43 20.44**	**Inspection item.**
	23.5	**Ensure agitator guards meet WORKSAFEBC specifications & are properly used and maintained. Do not stand on the grill when agitator is running.**	**√**	**S**	**20.37**	**Inspection item**
	23.6	**Ensure discharge line couplings are guarded and attachments to placing boom restrained**	**√**	**S**	**20.45 20.46**	**Inadvertent disconnection could cause injury from flying concrete. Inspection item**
	23.7	**Weight of each removable section of placing boom marked?**	**√**	**S**	**20.49**	**Inspection item.**
	23.8	**Placement boom not to be used for hoisting loads**	**√**	**S**	**20.50**	**Contractor to instruct workers in proper use. Inspection item.**
	23.9	**Clean out operations are to be done off site**	**√**	**S**	**20.51**	**Excess concrete to be properly disposed of by Contractor off site unless agreed with Project Manager. If cleanout on site is agreed follow WORKSAFEBC restrictions**
	23.10	**Pumper operator must have full control and no other duties while operating or placing boom or mast.**	**√**	**S**	**20.52**	**Contractor to ensure control.**
	23.11	**If operating near H.V. lines or exposed energized conductors, comply with WORKSAFEBC PART 19**	**√**	**S**	**20.53 PART 19**	**No operation near electrical conductors foreseen.**
	23.12	**Operator must see hopper on concrete pump at all times or means of signalling a problem must be provided.**	**√**	**O**	**20.54**	**Contractor to enforce.**

	23.13	**Wear eye protection at all times when pumping concrete. Wear gloves to protect against concrete.**	√	**O**		**Contractor to ensure protective equipment is used.**
	23.14	**Controls have functions identified and emergency shutoff to stop pumping?**	√	**S**	**20.31** **20.36**	**Inspection item.**
	23.15	**Hydraulic valves have pressure relief and holding valves?**	√	**S**	**20.32**	**Inspection item.**

BLASTING	**24.0**	**Blasting operations are not usually permitted at EGD.**	√	**S**	**PART 21**	**Use drilling and hoe-ram methods to break up rock.**
	24.1	**Ensure only competent workers trained in the proper methods of blasting, hazards of fire and mishandling and procedures to follow in event of fire or explosion are to be involved in blasting operations.**			**21.2, 21.7**	**Provide proof of formal training program and documentation of training session signed by workers trained and authorized to assist the Blaster of Record.**
	24.2	**Provide a qualified "Blaster of Record" who will exercise authority and visual supervision over all assistants or others involved during explosive loading, priming, fixing or firing.**			**21.5**	**Provide copy of blaster's certificate for anyone planned to conduct or direct blasting operations as the Blaster of Record. Ensure scope of the certificate is valid for the planned work. Keep ORIGINAL certificate at job site.**
	24.3	**Maintain records of blasting operation as required by regulations.**			**21.4**	**Blaster of Record maintain personal log of pre-blast loading details and results of post-blast inspection and log available for inspection at the site.**
	24.4	**Any dangerous incident, including unexpected result or problem with explosive products, or Blaster has failed to comply with regulations or safe practices, must be reported and all blasting operations and duties of the Blaster of Record will be suspended until agreed with Project Manager/WORKSAFEBC to continue.**			**21.3** **21.13**	**Notify Project Manager and WORKSAFEBC immediately and complete required reports.**
	24.5	**Comply with all other legislation besides WORKSAFEBC regulations including Explosives Act (Canada), Transportation of Dangerous Goods Act, 1992 (Canada) governing storage, handling and use of explosives.**			**21.6**	**Contractor to ensure understanding of regulations and comply with them.**

	24.6	**Keep explosives and detonation materials separated until the last practical moment before bringing them together.**			**21.16-21.17, 21.20 21.21**	**Contractor to ensure safe and secure storage of explosives and detonation materials.**
	24.7	**Ensure signage is in place to identify magazines, day boxes, vehicles containing explosives and that all workers are aware of the location of storage and restrictions on access and activities around explosives and detonators.**			**21.18**	**Contractor to provide signage meeting regulations and ensure effective communication.**
	24.8	**No passengers in explosive vehicles other than those assigned to assist in handling explosives.**			**21.22**	
	24.9	**Ensure vehicles meet the transport requirements with proper separation of flammables and detonation devices from explosives. Ensure exposed ferrous metal in a conveyance is prevented from contacting packages containing explosive**			**21.23 21.24 21.25 21.27 21.32**	**If transporting on a mobile drill rig, ensure special restrictions are met including attending by the Blaster of Record at all times. No trailers. If a semi-trailer is used, ensure power brakes can be operated from inside cab.**
	24.10	**Provide written procedures to address emergencies while transporting or working with explosives and ensure all workers are adequately instructed.**			**21.28**	**Provide documentation to Project Manager**
	24.11	**Operate vehicle transporting explosives according to regulations but not exceeding 90 km/h; do not exceed 80% of manufacturer's load rating; follow special railway crossing requirements; ensure vehicles have been serviced before loading.**			**21.29 21.30 21.33 21.34**	
	24.12	**Ensure vehicles containing explosives are parked away from habitation and bldgs containing flammables; premises are used for a purpose unlikely to cause an explosion or fire; vehicle is at all times attended by a qualified person.**			**21.35**	**Define overnight parking location(s) and ensure vehicles are attended.**
	24.13	**Follow manufacturer's recommended practices for storage, transport, handling and use of explosive materials. Do not use materials believed to be defective.**			**21.36 21.37**	

Project Title: Master. **Project No.**

	24.14	No smoking or open flame ignition sources on this project work site. Dispose of empty containers as recommended by manufacturer.			21.40 21.41 21.42	Project manager will define designated smoking areas well away (min. 15m.) from where explosives are stored, handled or loaded into holes. Hot work permit required from Project Manager for this kind of work.
	24.15	Follow safe drilling procedures including location of utilities, stabilizing slopes to prevent slides and checking blasted areas for misfires before continuing.			21.42 21.43 21.44	Ensure hole sizes are adequate and don't drill within 6m. of a hole containing explosives or within 15cm of a bootleg
	24.16	Follow proper loading practices including making up primers just before use, no carrying explosive material in clothes, no removal of wrappers,			21.45- 21.48 21.67 21.68	Ensure tools are non-spark generating materials. Don't attach blasting circuit until just before being ready to fire and ensure logical sequence of detonation is used.
	24.17	If there is a sign of thunderstorm, suspend blasting			21.49	Lightning can result in an unplanned explosion. Suspend all blasting, clear the danger area and guard it.
	24.18	Loaded holes present a hazard in that someone could drive over them or tamper with them.			21.50	Do not leave loaded holes unattended overnight. Post a worker whose sole responsibility is the security of explosives.
	24.19	No driving vehicles over loaded holes an explosion could accidentally result.			21.51	
	24.20	Holes are hot after being "sprung" and could result in accidental explosion if loaded too soon.			21.52	Allow ample time for cool down.
	24.21	Accidental explosion could result if detonators are attached sooner than necessary			21.53 21.54	Don't interconnect detonating cords or attach detonators or detonator connectors until everything is in readiness for the blast.
	24.22	Static electricity or hazards from stray currents could result in accidental explosion if loading explosives pneumatically.			21.55 21.56	Define procedures and ensure equipment used will prevent this hazard. Use only safety fuse assemblies with antistatic protection.
	24.23	Inadequate or damaged fuse assemblies can result in faster than planned ignition.			21.56 21.57	Follow safe practices when lighting safety fuses.
	24.24	Stray currents or static electricity may cause unexpected detonation resulting in injury or death.			21.58 21.59 21.60	Follow safe practices to prevent unplanned detonation. Do not use electric detonators if extraneous current exceeds 50 milliamps.
	24.25	Radio frequency transmitters, including mobile units, can cause unplanned detonations.			21.61 to 21.65	Contractor to provide details demonstrating that all regulations are being met and get prior approval from Project Manager if electrical blasting circuits are to be used.

	24.26	**Accessing the blasting area during a detonation could result in serious injury or death.**			**21.66**	**The Blaster of Record will ensure proper covers are used to control flying materials and that workers are posted at all necessary points to ensure no one enters the area and that a warning system is in place.** **Provide written warning procedures and blasting signals and post conspicuously. Ensure workers are trained in procedures and provide documentation to Project Manager.** **Project Manager will ensure all EGD occupants are made aware of the procedures and signals.**
	24.27	**Misfires or other hazards could injure workers if they enter the area after a blast. The Blaster may be hurt if entering the area as a result of electrical detonation of unexploded loads.**			**21.71** **21.81**	**Ensure the area is inspected by the Blaster before allowing anyone to enter. Blasters must disconnect all circuits and short circuit leads, and ensured the blasting machine switch is locked open.** **In the event of misfire, follow standard practice including waiting at least 10 minutes before anyone enters the blast area.** **Contractor to provide written procedures for the standard handling of misfires and ensure all workers understand the process.**
	24.28	**Ensure procedures are well defined and regulations reviewed if blasting is to involve underwater blasting, or seismic blasting**			**21.82-** **21.85**	

ASBESTOS	**25.1**	**Workers possibly exposed to potentially hazardous levels of asbestos? E.g.** **- workplace has asbestos-containing materials present or used** **- operation involves abatement of asbestos-containing materials** **- exposure to asbestos fibre in excess of 50% of exposure limits may occur**	**√**	**O**	**PART 6** **6.2**	**Should the Contractor encounter any questionable situation involving asbestos, lead paints or other potentially hazardous substance, immediately stop work and report to Project Manager for direction.**

Project Title: **Master.** **Project No.**

ASBESTOS	**25.0**	**Workers possibly exposed to potentially hazardous levels of asbestos? E.g.** **- workplace has asbestos-containing materials present or used** **- operation involves abatement of asbestos-containing materials** **- exposure to asbestos fibre in excess of 50% of exposure limits may occur**	**NA**	**O**	**PART 6 6.2**	**No exposure to asbestos is foreseen under this JOB ORDER. Should the Contractor encounter any questionable situation, immediately stop work and report to PWGSC Representative for direction.**
	25.2	**Workplace exposure monitoring done and results provided to workers**	√	**O**	**5.53**	
	25.3	**Contractor exposure control plan developed meeting WORKSAFEBC 5.54?**	√	**O**	**6.3**	**Plan to include:** **- Purpose & Responsibilities** **- Risk identification; assessment & control** **- Education & training** **- Written work procedures** **- Hygiene facilities & decontamination procedures, when required** **- Health monitoring, when required** **- Documentation, when required**
	25.4	**Qualified person prepare and keep current an inventory of all asbestos-containing materials; identify all such materials by signs, labels etc.**	√	**O**	**6.4 6.5**	
	25.5	**Qualified Risk assessment conducted by qualified person before any demolition, repair, etc work where asbestos-containing materials may be disturbed.**	√	**O**	**6.6**	
	25.6	**Procedures documented providing task-specific work direction addressing both hazards & controls and eliminating or minimizing the airborne release of asbestos fibres**	√	**O**	**6.7 6.8**	**WORKSAFEBC publication "Safe Work Procedures for Handling Asbestos" provides procedures acceptable to the Board.**
	25.7	**No use of pressure spraying to remove asbestos-containing materials from buildings/structures**	√	**O**	**6.9**	
	25.8	**No use of compressed air to clean up or remove asbestos-containing materials, dusts, fibres. Also no dry sweeping or dry mopping.**	√	**O**	**6.9**	
	25.9	**Employer must substitute material less hazardous than asbestos where practicable**	√	**O**	**6.10**	**If not practicable, document why and make available to workers and health & safety representative**

	25.10	**Workers trained in hazards, means of identification, procedures, correct use of protective equipment, operation of engineering controls, and purpose/significance of health monitoring**	**√**	**O**	**6.12**	
	25.11	**Monitoring carried out as req'd by PART5?**	**√**	**O**	**6.12**	
ASBESTOS	**25.12**	**Monitoring during high risk activities carried out and provided to workers within 24 hrs?**	**√**	**O**	**6.12**	**During high risk activities, provide regular sampling of workers, areas outside the containment area but nearby, clean room, contaminated area as required by regulations.**
	25.13	**Glove bags used for containment? Adhere to requirements of WORKSAFEBC 6.15**	**√**	**O**	**6.15 6.12(4)**	**If not, provide sampling as defined in WORKSAFEBC 6.12 (4)**
	25.14	**Work area boundary defined, all objects not required for the work removed, openings secured to prevent release of fibres?**	**√**	**O**	**6.13**	**Prepare area before starting work**
	25.15	**Signs posted restricting entry?**	**√**	**O**	**6.13**	
	25.16	**For HIGH RISK WORK provide maintain & inspect a containment and a decontamination facility**	**√**	**O**	**6.16**	**Not required if using glove bag containment. See detailed requirements in 6.16**
	25.17	**Ventilation airflow from clean area into contaminated area only?**	**√**	**O**	**6.17 6.18 6.19**	**Airflow through decontamination exhausted through containment area. Exhaust from containment thru effective HEPA filter. All ventilation exhaust thru HEPA filter tested maintained and used per manufacturer instructions.**
	25.18	**Is asbestos spread being controlled/**	**√**	**O**	**6.20 6.21 6.22 6.23**	**Use measures to keep work surfaces and other work areas adjacent to containment area, as free as practicable from dust accumulation. Wet asbestos containing material before and during work whenever practicable Repair damaged asbestos-containing materials**
	25.19	**Proper waste collection and disposal measures followed?**	**√**	**O**	**6.25**	**All asbestos waste and asbestos contaminated material including clothing, cleanup equipment etc. place din sealed containers identified as containing Asbestos.**
	25.20	**Clean up equipment.**	**√**	**O**	**6.26**	**Ensure exterior of waste containers, reusable equipment cleaned after work complete**
	25.21	**Work area cleaned?**	**√**	**O**	**6.27 6.28**	**Ensure work area is cleaned after each shift and at completion of work involving asbestos and dispose of containers promptly.**

	25.22	**Proper respiratory protection used? Fit checked?**	√	**O**	**6.29**	**No single-use respirators permitted. Ensure adequate protection and enforce usage.**
	25.23	**Proper protective clothing supplied and worn & maintained?**			**6.30**	**Ensure asbestos resistant clothing with proper coverage and fit is used. Repair/replace damaged clothing immediately.** **Clean clothing using HEPA filter vacuum before removal.** **Remove protective clothing/equipment before leaving designated work area.** **Protective clothing being sent to an acceptable laundry must be HEPA vacuum cleaned, placed in a soluble plastic bag, sealed and labelled before being sent.**
	25.24	**Workers to launder own clothing?**			**6.31**	**Ensure workers informed of hazards of asbestos and precautions required.**
	25.25	**Documentation maintained?**			**6.32**	**Employer to keep records of inventories, risk-assessments, inspections and air monitoring results at least 10 yrs.** **Keep records of corrective actions to control release, training/instruction to workers, work procedures and notification to WORKSAFEBC for at least 3 years.**

TREE REMOVAL	**26.1**	**Risk of injury due to tree falling practices**	√			**The hazards associated with removing large trees exist. To ensure workers and passers-by are not injured:** - **Coordinate with all concerned and barricade off all potential fall areas.** - **Document the tree falling plan Employ only qualified / experienced fallers to do this work** - **Define tree falling plan and agree with P.M. Drop in sections not entire tree.** - **Check trees for internal rot that could put persons at risk if scaling tree.** - **Clean up and remove trees from site immediately after falling and cutting up.**
	26.2	**Are workers trained to carry out tree removal?**	√		**26.3**	**Ensure workers meet WBC training requirements and provide documentation to the Project Manager.**
	26.3	**Are workers using all required PPE for tree removal operations?**	√		**26.7**	**Ensure workers using chainsaws use leg protective devices in addition to other PPE. Also ensure all PPE is checked for wear, fits the users and is in serviceable condition**

	26.4	**Have workers been trained in the hazards of operating chain saws?**				**Contractor to ensure workers are aware of hazards, safe working practices and protective equipment to be used.**

WELDING & CUTTING	**27.1**	**Are workers qualified to perform welding/cutting work and work performed according to standard?**	√		**12.112**	**Contractor to provide proof of qualification.** **Perform work according to CSA Standard W117.2-94 Safety in Welding, Cutting and Allied Processes or other standard acceptable to WORKSAFEBC and manufacturer's instructions for equipment being used.**
	27.2	**Workers must be aware of the health effects of exposure to welding smoke. The combination of base materials, coatings, shielding gases and other factors can create many different substances that can potentially have an adverse effect on almost any part of the body.**	√		**12.124**	**Contractor to identify the specific hazards associated with a particular welding operation and the environmental conditions and ensure workers understand the short-term and long-term health effects of exposure to welding smoke and how to protect him or herself.** **Undertake appropriate engineering controls or work practices to control/remove welding fumes.** **Ensure respirators are the correct type and fit-tested.**
	27.3	**Coatings must be removed from base metal before welding/cutting.**	√	**S**	**12.115** **12.129**	**Coatings could emit harmful contaminants during welding or cutting. Remove coatings and wear protective equipment.** **Do not apply paint to materials about to be welded.**
	27.4	**Workers must be aware of the risk of burning due to contact with hot slag, metal chips, sparks and hot electrodes.**	√		**12.125**	**Contractors to ensure workers protect themselves and others against the risk of burns. Wear suitable protective clothing.** **Ensure recently welded or flame cut work is marked "HOT" or guarded to prevent accidental contact.**
	27.5	**Workers must be aware of the risks associated with exposure to ultraviolet or infrared light from welding which can damage the eye and result in skin burns.**	√		**12.122**	**Contractors to ensure workers understand the hazards of exposure to the welding arc and how to protect themselves. Be sure the lens shade number is adequate for the type of welding/cutting being performed. Hand-held screens are not acceptable.** **Use barriers of flame resistant non-reflective material to protect other people from exposure to the arc, heat, and hot spatter.** **Also use signs to warn of the dangers of looking at the arc.**
	27.6	**Workers must be aware that exposure to the noise of welding can permanently damage hearing, cause stress leading to increased blood pressure.**	√			**Contractor to ensure workers have regular hearing test and that wearing protective equipment is enforced.**

	27.7	**Workers must be aware of the risks of electrical shock especially in wet or cramped conditions. Even a small shock can lead to a fall or other accident. Brain damage or death can result from a large shock.**	√			**Ensure workers use dry gloves, rubber-soled shoes or an insulating layer. Ensure work piece and frame of electrically powered machines are grounded. Keep electrode holders and cables dry and in good condition.** **Electrodes should not be changed with bare hands, with wet gloves or if standing on grounded surfaces or wet floors.**
	27.8	**Workers must be aware of dangers of welding on containers, pipes or structures or in any place that has held flammable or combustible materials unless thoroughly cleaned.**	√		**12.116**	**Fires, explosions or release of toxic vapours can result. Containers with unknown contents should be assumed flammable or combustible. Ensure a qualified person has tested**
	27.9	**Beware of backfires and flashbacks when using compressed gases.**	√		**12.120**	**Do not ignore these warnings. Undertake immediate corrective action. Ensure safety devices are used to prevent reverse flow and arrest flashbacks on oxyfuel systems**
	27.10	**Ensure fire prevention and fighting capabilities before welding/cutting.**	√		**12.121**	**Suitable fire extinguishing equipment must be available close to the work. Use a firewatcher if work is being done where other than a minor fore might develop. Maintain the fire watch at least ½ hour after welding or cutting work is completed to detect smouldering fires.** **Keep areas clear of combustibles and cover those that cannot be removed with flame-resistant materials, Cover doorways, windows and cracks.** **Provide and use receptacles for electrode stubs.**
	27.11	**Welders must wear required personal protective equipment including flame resistant clothing, gauntlet gloves, etc.**	√		**12.123**	**Ensure welders wear all required special PPE**
	27.12	**Check Gas Cylinder Condition & Securing/Upright storage, & protection from sparks, flames, heat, physical damage or corrosion. Ensure pressure relief valves are present.**	√	**S**	**5.36**	**Cylinders of compressed gas can explode or become projectiles if exposed to excessive heat, or if the valve stem were to break should the tank be knocked over from a vertical position. Inspection item**
	27.13	**Ensure empty gas cylinders have regulator removed, capped & are tagged as empty.**	√	**S**		**Identify empty tanks. Inspection item**
	27.14	**Ensure Cylinders are identified re type of gas and valid testing.**	√	**S**	**5.37-5.39**	**Cylinders must be pressure tested to ensure ability to perform safely and the test date recorded. The cylinder must be identified regarding the type of gas in the cylinder to prevent confusion and potential accidents. Inspection item Do not use cylinders or contents for other than intended purpose.**

	27.15	**Ensure Cylinder valves are closed when not used.**	√	**S**		**Do not rely on the welding torch or other device to control the release of gas other than when manned by an operator. Dangerous leakage could occur with gas building up inside buildings, vessels etc. with potential for explosion or other hazards. Inspection item**

LEAD	**28.1**	**Worker exposure to lead?**	√	**S**	**6.60 6.67**	**Develop and implement an exposure control plan meeting the requirements of section 5.54 if workers are or may be exposed to lead in excess of 50% of the exposure limits, or if exposure through any route of entry could result in elevated lead body-burdens. Develop and maintain a health protection program.**
	28.2	**Airborne exposure possible?**	√	**S**	**6.61**	**Provide monitoring per regulation.**
	28.3	**Warning signs**	√	**S**	**6.62**	**Post signs at the boundary of any work area where hazardous lead exposures could occur**
	28.4	**Contamination of exposed skin and/or clothing possible?**	√	**S**	**6.63 PART 5**	**Follow personal hygiene requirements**
	28.5	**Work surfaces protected?**	√	**S**	**6.64 6.65**	**Protect work surfaces from finely divided lead; prevent dispersal of finely divided lead into work area**
	28.6	**Workers trained?**	√	**S**	**6.66**	**Provide training in hazards of lead, written work procedures, correct operation and use of any required engineering controls and personal protective equipment, personal hygiene and decontamination procedures, and purpose and significance of any health monitoring.**
	28.7	**Records maintained?**	√	**S**	**6.68**	**Maintain records of risk assessments, worker exposures and worker training. Produce for Project Manager if requested.**

NON-IONIZING RADIATION	**29.0**	**Is there exposure to microwave radiation?**	**TBD**	**S**		
						Get safety procedures from Rogers
						No approach within 3 meters

Project Title: **Master.** **Project No.**

ROCK DUST	**29.1**	**Rock crushing, drilling, mucking, excavation, loading, transportation, road grading, road construction or conveying of rock or similar operations?**	**√**	**S**	**6.110** **6.111**	**Ensure that dust concentrations to which a worker may be exposed are maintained at or below the established exposure limits, by one or a combination of** **(a) mechanical ventilation,** **(b) the use of water spray,** **(c) other equally effective methods.**
	29.2	**Access restricted?**	**√**	**S**	**6.112**	**Restrict access to area of exposure**
	29.3	**A rock drill, other than a manually-powered rock drill used?**	**√**	**S**	**6.113**	**Must be equipped with a dust suppression system, that uses water jet, spray, or other equally effective means to suppress drilling dust.**
MUSCULOSKELETAL INJURY	**30.1**	**Is there a risk of musculoskeletal injury?**	**TBD**	**S**	**4.47**	**Contractor to eliminate or control risk**
	30.2	**Are controls required?**	**TBD**	**S**	**4.50-4.52**	**Contractor to define control measures and train workers in risks and safe work procedures, use of PPE etc.** **Contractor to monitor for compliance and effectiveness.**

Contractor's Superintendent: _____ **Date:**_____.

Distribution:

EGD Operations Manager
EGD Supervisors
Engineer-of Record
Resident Engineer/Construction Coordinator
Project File

ESQUIMALT GRAVING DOCK

ESU SSSR

ESQUIMALT, BRITISH COLUMBIA

APPENDIX E

ARCHAEOLOGICAL OVERVIEW ASSESSMENT OF THE ESQUIMALT GRAVING DOCK

March 30, 2012

NON-PERMIT REPORT

Archaeological Overview Assessment of the Esquimalt Graving Dock, Public Works and Government Services Canada, Esquimalt, BC

Submitted to:

Ms. Melissa Piasta
Environmental Coordinator
Public Works and Government Services Canada
825 Admirals Road
Victoria, BC
V9A 2P1

REPORT

A world of capabilities delivered locally

Report Number: 10-1477-0051/4000

Distribution:

2 Copies - Public Works and Government Services Canada
(1 electronic)
1 Copy - Esquimalt Nation
1 Copy - Songhees Nation
2 Copies - Archaeology Branch (1 electronic)
2 Copies - Golder Associates Ltd.

Golder Associates

GRANT OF LICENSE

I, Golder Associates Ltd., confirm that I am the copyright owner (or a copyright owner) of this non-permit report, and for good and valuable consideration I irrevocably grant a non-exclusive license to the Province of British Columbia, for a term equal to the life of the copyright commencing on the date of execution below, to make copies of the reports, including all appendices and photos, and to provide such copies to anyone, at the discretion of the Province, either at no charge or at the cost incurred by the Province in making and distributing the copies. All parties, except the party for whom the report was prepared, acknowledge that any use or interpretation of this report is at the sole risk and liability of the subsequent user(s).

Executed this ___day of _____ 2012, by

ORIGINAL SIGNED

_____

Signature of Copyright Owner

CREDITS

Project Director	Ben Hjermstad, M.A.
Report Author	Dana Dalmer, B.A.
GIS Modelling	Rick Dixon Colin Bakermans, B.Sc.
Report Review	Ben Hjermstad

EXECUTIVE SUMMARY

At the request of Public Works and Government Services Canada, Golder Associates Ltd. undertook an archaeological overview assessment of Department of Public Works and Government Services Canada property at the Esquimalt Graving Dock, as well as Department of National Defence properties at Munroe Head and the Canadian Forces Sailing Association and leased Lot 203 on the New Songhees Indian Reserve No. 1A. The Project Area encompasses 37.7 hectares along the north shore of Constance Cove in the Esquimalt Harbour, Esquimalt, British Columbia. This location is within the asserted traditional territories of the Esquimalt Nation and Songhees Nation.

The purpose of the overview is to provide Public Works and Government Services Canada with geographic information system based maps illustrating locations of potential archaeological sensitivity and risk management strategy for proceeding with future development within the Esquimalt Graving Dock. The overview provides recommendations regarding the need for, and scope of, further archaeological work.

The archaeological overview assessment consisted of a review of readily available data regarding local and regional prehistory, history, ethnography, and the environment of the Project Area. Included in this review were archaeological site records, archaeological overview and impact assessment reports on file with Public Works and Government Services Canada, as well as with the Archaeology Branch at the Ministry of Forests, Lands and Natural Resource Operations. Geotechnical studies, aerial photos, and historical maps specific to the Project Area were included in the literature review.

Four previously recorded archaeological sites are located within the Project Area. DcRu-12 is a shell midden site containing human burials that is located in the northwest portion of the Munroe Head property and extends north to Ashe Head and Lot 203 on the New Songhees Indian Reserve No. 1A. DcRu-6 is located on the south side of the Esquimalt Graving Dock and extends south and west around Pilgrim Cove. Cultural material from this site is also located immediately east of the Graving Dock and north of the Guard House. The site contains human remains, as well as stratified deposits containing diagnostic materials dating back 2,000 years. DcRu-789 and DcRu-790 consist of small intact shell midden deposits located west and northeast of the Pump House.

Borehole logs from previous geotechnical investigations suggest that buried shell midden deposits may be present elsewhere in the Project Area. Intact soils and sediments were also encountered below fill at depths ranging from approximately 0.25 m to 2.9 m at various locations within the Project Area. Therefore, the potential for encountering further buried intact archaeological deposits exists within select locations within the Project Area.

A geographic information system based archaeological potential model and management system was designed for the Project Area. This model provides predictions of archaeological sensitivity and serves as a guide for application of the management system. This management system consists of a series of alternate responses that are proposed for known archaeological sites, locations of archaeological potential, and different degrees of development impact. The system proposed highlights avoidance when this is feasible, but includes provisions for archaeological impact assessment, archaeological mitigation and/or archaeological monitoring of select areas by professional archaeologists where appropriate. Archaeological responses to development would be dependent on the severity of the proposed impacts and the archaeological sensitivity of the terrain. For instance, pre-development archaeological impact assessment is proposed when previously recorded archaeological sites would be affected, or when proposed development activities may affect landforms considered to be of high archaeological potential. Monitoring would take place in areas of moderate heritage sensitivity as a means of discovering archaeological sites that might require further assessment and/or mitigation. It is recommended that future archaeological assessment and mitigation results be incorporated into the model to increase the effectiveness of subsequent stages of system implementation.

Table of Contents

TABLES

FIGURES

APPENDICES

APPENDIX A

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been contracted by Public Works and Government Services Canada (PWGSC) to develop an archaeological overview assessment for PWGSC property at the Esquimalt Graving Dock (EGD), as well as Department of National Defence (DND) properties at Munroe Head and the Canadian Forces Sailing Association (CFSA) and leased Lot 203 on the New Songhees Indian Reserve (IR) No. 1A, all located in Esquimalt, BC (Figures 1 and 2). The purpose of this assessment is to provide PWGSC with a process for managing archaeological sites within this Project Area. As such, this report presents a model that can be used by PWGSC to determine where archaeological resources can reasonably be expected to be identified in the Project Area. Strategies are then identified that will allow planners to best manage potential archaeological risks in advance of future development activities.

This report provides a summary of the results of the AOA, including the archaeological predictive model and management program developed for the Project Area. Section 2.0 provides a summary of current federal legislation and policy for the protection of archaeological sites. Section 3.0 describes the location of the Project Area, including local and regional environmental characteristics and the cultural history of the region. Emphasis is placed on previous archaeological research in the Project Area. Section 4.0 presents a summary of the methodologies employed and descriptions of the quantitative and qualitative techniques used in identification and analysis of the archaeological potential throughout the Project Area. Section 5.0 describes the results of the background review and the predictive model. Section 6.0 provides recommendations for the future management of archaeological resources and archaeological resource potential in the Project Area. Maps showing the Project Area, previous investigation areas, borehole locations and the potential model can be found at the end of the report.

2.0 HERITAGE LEGISLATION

The proposed Project Area is situated on federally owned and leased lands. Federal legislation applies to all properties that fall under federal jurisdiction, including lands belonging to federal departments such as PWGSC, or locations where the federal government has some regulatory control. There is no comprehensive federal statute directing how (or whether) a given department is supposed to treat archaeological issues on its lands (Government of Canada 1988). In the absence of comprehensive cultural resource management legislation, federal land managers rely on general policies applicable to all departments and the specific directives, if any, of their own department (Canadian Environmental Assessment Agency 1996; Department of National Defence 1999).

Legislative protection for archaeological sites on federal lands exists within the somewhat limited provisions of the *Canadian Environmental Assessment Act* (CEAA). The CEAA states that one of the purposes of the Act is "to ensure that projects are considered in a careful and precautionary manner before federal authorities take action in connection with them, in order to ensure that such projects do not cause significant adverse environmental effects" (s.4(1)(a)). Under the CEAA, environmental effects include archaeological and historical resources and the current use of lands and resources for traditional purposes by Aboriginal persons (*i.e.*, traditional use sites). This "protection" is somewhat limited by the absence of statutory directives with respect to how these resources and features are to be 'considered' (*i.e.*, managed).

Given the absence of a federal statute outlining how archaeological impact assessments (AIAs) are to be undertaken on federal lands that do not fall subject to a federal Act (*e.g.*, CEAA), this archaeological overview assessment (AOA) was conducted in general accordance with DND's (1999) *Contracting Manual for Land Archaeology* and the British Columbia Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operation's (2009) *Archaeological Overview Assessments as General Land Use Planning Tools – Provincial Standards and Guidelines* to demonstrate due diligence. As outlined by the Provincial government, the objectives of an AOA study are to (1) assess the archaeological potential of the Project Area; (2) identify the need and appropriate scope of further archaeological assessment, and (3) identify areas where archaeological sites are apparently absent, implying low or no archaeological potential (Archaeology Branch 2009).

Under the terms of the British Columbia *Heritage Conservation Act* (*HCA*), all archaeological sites that predate AD 1846 are automatically protected. Certain sites, including burials and rock art sites, that have historical or archaeological value are protected regardless of age. Heritage wrecks, consisting of the remains of vessels or aircraft after two or more years have passed since they sank, crashed, or were abandoned, are also protected under the *HCA*. Wreck sites may also be protected under federal statute if it is determined that they possess characteristics of national historic significance (Historic Sites and Monuments Board of Canada 2000).

3.0 PROJECT AREA

The Project Area encompasses approximately 37.7 hectares along the north shore of Constance Cove in the Esquimalt Harbour, Esquimalt, BC. The Project Area encompasses the EGD and associated waterlot, which is maintained and managed by PWGSC, as well as DND properties at Munroe Head, including the intertidal zone, the CFSA and the associated waterlot, Pilgrim Cove and leased Lot 203 located on the New Songhees IR No. 1A (Figure 2). It is bounded on the east by the E&N rail bed, on the south by the south shore of Pilgrim Cove and on the north by the Esquimalt Indian Reserve. Water depths in the Project Area range from the upper intertidal in specific locations like Munroe Head and Pilgrim Cove to a general offshore depth of just over 12 m Chart Datum.

The Project Area has been extensively developed over the past 150 years resulting in substantial alterations to the shore line through cutting, blasting and filling, and to the ocean floor through dredging. Today the Project Area is a mix of landscaped green space with intact Garry oak stands and natural rock outcrops, and developed areas consisting of gravel, asphalt and concrete covered roads, parking areas and work areas underlain with fill to varying depths over either native soils and sediments or bedrock. Numerous administrative, maintenance and storage buildings are located throughout the Project Area, as well as portable trailers and temporary structures. The most dominant industrial feature is the graving dock itself, which at 357 m long and 38 m wide, is the largest solid-bottom commercial dry dock on the west coast of North America.

3.1 Physical Setting

The Project Area is situated within the Eastern Vancouver Island Ecoregion, within the Nanaimo Lowland Ecosection. The Project Area is located in the Coastal Douglas-fir (CDF) Biogeoclimatic Zone (Nuszdorfer et al 1991; Meidinger and Pojar 1991). The CDF Biogeoclimatic Zone is limited in extent, encompassing portions of southeast Vancouver Island, several of the islands in the Strait of Georgia, and a narrow strip of the adjacent mainland (Nuszdorfer et al 1991:82-83). The CDF lies within the rain shadow of the Vancouver Island and Olympic Mountains. As such, climate in the CDF is characterized by warm dry summers and mild wet winters; mean annual precipitation values are relatively low when compared with those of the adjacent Coastal Western Hemlock Biogeoclimatic Zone (Nuszdorfer et al 1991:82-83).

Douglas fir (*Pseudotsuga menziesii*) is the most common tree species found within CDF forests. Other common forest constituents include Western redcedar (*Thuja plicata*), grand fir (*Abies grandis*), arbutus (*Arbutus menziesii*), Garry oak (*Quercus garryana*), and red alder (*Alnus rubra*). Western hemlock (*Tsuga heterophylla*) occurs infrequently within the CDF (Nuszdorfer et al 1991:82-83). The use of cedar by First Nations was common in the past and is evidenced, for example, by bark strip and plank removal scars on trees. The slow burning bark of Douglas fir would have served as an excellent source of fuel, and the wood would also be used for many utilitarian purposes.

Many of the plants and animals found within the CDF were, and continue to be, important to First Nations. Particular locations within the landscape would be seasonally attractive due to various factors such as the ripening of berries, seasonal migrations of fish or waterfowl, and availability of potable water. Additional information regarding the use of local floral and faunal resources used by First Nations can be found in Barnett (1955), Suttles (1958, 1960, 1968, 1987, 1990), Turner (1995), and Turner and Bell (1971).

Fish and shellfish were very important to coastal First Nations subsistence. Rockfish (family *Scorpaenidae*), greenling, flatfish (family *Pleuronectidae*, sculpins (family *Cottidae*) clams (family *Veneridae*), mussels (family *Mytilidae*) and cockles (family *Caridiidae)* among others, were available year-round in the estuaries (Barnett 1955; Suttles 1968, 1987, 1990). Herring (*Clupea pallasi*) were harvested in vast quantities in sheltered waters in the late winter during the spawning season (Barnett 1955; Suttles 1968, 1987, 1990). Freshwater fish, such as trout (*e.g.*, *Oncorhynchus mykiss)*, were available in the lakes, streams, and marshes. However, the most culturally significant fishes were the five species of salmon: Coho, Chinook, Pink, Sockeye, and Chum (*Oncorhynchus kisutch, Oncorhynchus tshawytscha, Oncorhynchus gorbuscha, Oncorhynchus nerka, and Oncorhynchus keta)* that spawn in the region's rivers and streams. Salmon were taken in large quantities by reef netting in Juan de Fuca and Haro Straits and during the fall spawning season in local streams and rivers (Duff 1964; Barnett 1955; Suttles 1990). These fish were smoked and stored for use during the winter months.

Additional information regarding First Nations use of local floral and faunal resources can be found in Barnett (1955), Suttles (1987, 1990), Turner (1995), and Turner and Bell (1971).

3.2 Potential Impacts

Alteration of the landscape can result in the damage or complete destruction of all or portions of archaeological sites. These alterations often involve the displacement of artifacts, resulting in the loss of valuable contextual information, or may involve the destruction of the artifacts and feature themselves, resulting in complete information loss. While these losses are permanent and irreversible, they can be offset through implementation of effective mitigation procedures.

No specific activities have yet been planned that have the potential to impact archaeological sites in the Project Area. Future development activities have the potential to impact archaeological sites by disturbing cultural deposits and features, damaging artifacts and fossils, hindering or increasing access to sites and destroying contextual information that is essential for interpreting site function and/or age. Development and operational activities that would be considered to have a high impact on archaeological sites would include, but not be limited to, excavation, grading, levelling, landscaping, dredging and demolition. Developments considered to have a moderate impact to archaeological sites include paving and augering. Low impact activities include on-going operational activities such as vehicle use that will not disturb surface soils and sediments.

3.3 Cultural Setting

3.3.1 Archaeological Setting

A great deal of terrestrial-based archaeological research and assessment has taken place in the southern Strait of Georgia region, particularly in the Victoria area and the Lower Mainland. The research undertaken has contributed to the development of a regional chronology that spans over 8,500 years (Matson 1976, 1992). Comparatively little is known about the early occupation of southern Vancouver Island. However, the archaeological record over the past 5,000 years or so reveals an increasing reliance on salmon, along with the corresponding development of complex societies, with evidence of wealth accumulation, hereditary status, social

stratification, semi-sedentism and population aggregation. Expected precontact archaeological sites in the Project Area would include shell middens, house structures, lithic scatters, trails, canoe runs and human burials.

Marine-based archaeological research and assessment activity in the southern Strait of Georgia region has not matched that of terrestrial-based archaeology. However, an understanding of general sea level change since the early Holocene and the precontact use of intertidal areas indicate that archaeological sites are found below the modern tide level. Expected archaeological site types that may be encountered, include, but are not limited to canoe runs, remnants of reef net fishing, and clam harvesting locales. Canoe runs are located in the intertidal zone and are characterized by linear areas cleared of stones that are often associated with village sites (Petzelt 2004: 5). Clam beds are represented by terrace-like modifications created with rock placement, also located in the intertidal zone (Williams 2006). Reef net sites are characterized by anchor stone accumulations located on the shallow sub-tidal seafloor typically in areas with reefs and active tidal currents (Easton 1985a, 1985b, 1986; Moore and Mason 2010).

Heritage wrecks can also be found in areas covered by water. The most common form of vessel loss in protected environments, and especially in anchorages or near docks, is abandonment (Richards 2008). Abandoned vessels are often located in shallow or intertidal water. In urban or industrial settings these wrecks may eventually be covered with landfill placed as part of foreshore development. In all conditions, they become protected under the *HCA* two years after sinking.

A considerable amount of AIA has been previously completed in Esquimalt Harbour in general, and in the Project Area specifically (Figure 3). These include multiple AIAs at the Munroe Head/CFSA Property and at EGD. An AOA of the CFSA, Munroe Head and EGD waterlots has also been developed. A summary of this previously completed archaeological work is found in the following Sections.

3.3.1.1 Esquimalt Graving Dock

In 2003, Millennia (2003c) conducted an archaeological inventory and mitigative data recovery at the EGD (Figure 3). Millennia conducted a data recovery program at DcRu-6 (originally registered as DcRu-760) prior to the construction of a new access road at this location. Observed cultural materials suggest that a permanent or semi-permanent village was located at this shell midden site (Millennia 2003c). Excavation resulted in the recovery of evidence of house features, as well as over 200 artifacts indicative of a late Locarno Beach occupation that were radiocarbon dated to 2090 ± 80 BP. Millennia was unable to determine the total number of dwellings present, or their size and orientation, due to the limited area of the site exposed during excavation. Human remains from at least six individuals were also collected during the mitigation and were reinterred adjacent to the site. To minimize disturbances to this significant archaeological site, the access road was re-engineered to cap the archaeological deposits.

As part of the inventory, all of the approximately 220 cubic metres of soils and sediments machine excavated during construction were passed through a 1.9 cm (¾ inch) wire mesh screen to recover any remaining cultural materials, including human remains. Portions of the screened material were then placed along the boulevard on the north side of the South Jetty Access Road (Millennia 2003c). The remainder was used as fill in the "gully portion" of the sloped area to the east of the graving dock (Figure 5).

The following year, Millennia (2004a) monitored the installation of a fence on the south side of the EGD South Jetty Access Road within the known boundary of site DcRu-6. Fifteen fencepost holes and two gatepost holes were excavated. Thirteen contained cultural deposits including one which contained intact cultural deposits. Millennia recommended that DcRu-6 be avoided and that where avoidance is not possible, modifications to the development should occur to minimize disturbance to archaeological deposits and an AIA should be completed prior to development.

Millennia (2004a) conducted an archaeological inventory of the EGD in 2004 (Figure 3). Two previously unrecorded archaeological shell midden sites were located during the inventory study, DcRu-789 and DcRu-790. Faunal remains, shell, fire-cracked rock, and a carved siltstone artifact were recovered from DcRu-789 (Millennia 2004a:11). Intact shell midden deposits were observed at DcRu-790 near the remains of a building foundation (Millennia 2004a:13). Millennia concluded that these midden deposits either underlie the building foundation or that they were removed when the building was constructed (Millennia 2004a:17). Millennia recommended an AIA be completed prior to any ground altering activity in or near these known archaeological sites.

Millennia conducted further archaeological monitoring at DcRu-6 in 2005 (Figure 2). Work was initiated after possible shell midden deposits were observed during the excavation of a trench to replace an existing drainage pipe east and south of the graving dock (Millennia 2005). Millennia screened the impacted cultural deposits and monitored the excavation of the remaining trench, as well as a utilities trench along the north side of the entrance road located northeast of the dock. Disturbed and intact cultural material was observed during the monitoring program. The observed stratigraphy at DcRu-6 consisted of layers of fill lying atop undisturbed cultural deposits (Millennia 2005:12-16). Bone, antler, and lithic artifacts were recovered during monitoring of the drainage pipe, including a rare elk antler comb (Millennia 2005:21). Given the small area examined and the inability to excavate evaluative test units, Millennia could not assess the significance of the cultural deposits. As a result, Millennia recommended that an AIA be conducted in advance of any future work on both the north and south sides of the EGD that may result in disturbance to surface soils and sediments (Millennia 2005: 22).

At the request of Stantec Consulting Ltd. (Stantec), Golder (2009a) undertook an AIA of that portion of the proposed E&N Railway Trail which is located on federal lands (Figure 3). The proposed trail right-of-way (ROW) parallels the west side of the E&N Railway along the length of PWGSC EGD property, extending approximately 2 m inside the PWGSC property line. No archaeological materials were observed as a result of the AIA. Due to its proximity to previously recorded archaeological site DcRu-12, Golder recommended monitoring by a qualified archaeologist during construction of the portion of the trail which traverses the North Parking Lot within the EGD.

At the request of PWGSC, Golder (2009b) undertook archaeological monitoring of a geo-environmental testing program in select areas across the EGD (Figure 3). Geo-environmental samples were collected using hand augers, mechanical drilling and vacuum extraction. Shell fragments representing both intact and disturbed midden were observed in 17 of 113 test locations. Crushed shell deposits were observed eroding from exposed soils at four additional locations adjacent to these geo-environmental test locations. The cultural deposits observed in this monitoring program are likely associated with previously recorded archaeological sites DcRu-6, 12 and 790. Golder recommended that archaeological impact assessment and/or archaeological monitoring be conducted in locations of high archaeological potential in advance of future developments that have the potential to impact intact soils and sediments in the location of these observed cultural deposits.

At the request of PWGSC, Golder (2010a) undertook an AIA of proposed upgrades to the North Area Parking Lot within the EGD (Figure 3). The Project Area was located within the boundaries of previously recorded archaeological site DcRu-12 at the north end of the parking lot. Proposed Project works involved the removal (through blasting, chipping and grading) of approximately 1,950 m^3 of bedrock and approximately 300 m^3 of soil overburden. Subsurface archaeological shell midden associated with charcoal and highly fragmentary faunal remains, including elk (*Cervus canadensis*), were observed in one of the shovel tests. Golder recommended archaeological monitoring of any disturbances to intact or previously disturbed archaeological deposits along the west margin of the Project Area, in the vicinity of the observed deposits.

At the request of PWGSC, Golder (2010b) undertook an AOA of five Areas of Environmental Concern (AEC) within the EGD prior to soil remediation involving the removal of contaminated soils: AEC 10; AEC 14; AEC 18; AEC 22 and AEC 23 (Figure 3). In addition, PWGSC required an AIA be conducted at AEC 14 in advance of the proposed east end extension of the graving dock. During the AIA, Golder delineated the vertical and horizontal extent of relocated shell midden deposits from site DcRu-6, which had been used as fill along the top of the slopes east and south of the EGD. Golder recommended consultation between PWGSC and the Esquimalt and Songhees Nations regarding the final disposition of the cultural deposits prior to their removal. Golder also recommended monitoring of the North Parking Lot (AEC 22) in the area where subsurface cultural deposits were observed (Golder 2010a), and along the north end of the decommissioned rail spur line (AEC 23), adjacent to Maple Bank Road, where possible shell midden deposits were observed during monitoring of geo-environmental drilling (Golder 2009b). Remediation of the two remaining AECs (10 and 18) was determined to have no impact on archaeological deposits due to the shallow depth of the soils to be removed. Golder recommended that a chance find management procedure be developed and implemented so that the appropriate steps could be taken in the event that archaeological materials are inadvertently impacted or exposed during remediation.

At the request of PWGSC, Golder (2010c) undertook an AIA for security upgrades to the Front Guardhouse located at the east end of the EGD (Figure 3). Project works involved machine excavation of soil and sediments within a 53 m by 10 m area along the north side of the main access road. Blasting of a bedrock outcrop at the west end of the Project Area was also required to accommodate road widening and sidewalk construction. Machine excavation of the sod layer (from the ground surface to approximately 40/50 centimetres below surface) within the majority of the Project Area had occurred prior to the assessment. During the subsequent construction monitoring, previously disturbed, low density shell midden mixed with clay fill was observed in approximately 75% of the Project Area, with a concentration in the eastern portion. These deposits likely represent redeposited shell midden from site DcRu-6 (Golder 2010c). Based on the results of this monitoring program, no further archaeological assessment is considered warranted at this location. Materials exhumed from construction, including midden deposits, were redeposited along the top of the slope immediately east of the graving dock.

During remediation of soils in AEC 14 at the head of the graving dock, a single human bone element was unearthed (Millennia 2010a). Subsequent monitoring of soil remediation on the south side of the staircase exposed several thin (10-15 cm) pockets of disturbed, redeposited shell midden. No intact cultural deposits were observed. In addition to the human remains, four artifacts were collected: one small core, two secondary-stage reduction flakes, and a large sandstone cobble with evidence of pecking (Millennia 2010a:5). As a result of the monitoring, the existing site boundary for DcRu-6 was expanded to the south to include the area of disturbed midden. Recommendations include a review by an archaeologist of any proposed ground altering work within or adjacent to site DcRu-6 (Millennia 2010a: 9).

During construction of the East End Extension Project at EGD, Golder (2011b) conducted archaeological monitoring of two areas containing cultural deposits previously identified by Millennia (2010a) associated with site DcRu-6, as well as a nearby shell exposure observed by workers following vegetation clearing (Figure 3). Disturbed, diffuse and highly fragmented shell midden was observed up to 30 cm dbs at the top of the slope near the southeast corner of the graving dock, below which was sterile fill material (Golder 2011b). During removal of the concrete slab south of the staircase shell midden was observed over a 5 m by 1.5 m area. The deposit was 5-8 cm thick comprised of clam shell in a black matrix along with historical rubbish. The shell exposure observed by workers was in a 1.5 m by 0.5 m area and was 10 cm thick. No dark organic soil was associated and no artifacts were observed although the shell was fragmented and discoloured in a manner consistent with cultural processing (Golder 2010b: 4). All cultural deposits were relocated to the top of the slope at the head of the graving dock where other cultural materials from site DcRu-6 have been deposited. Golder recommended PWGSC consult with the Esquimalt and Songhees Nations regarding the disposition of any further cultural deposits removed from their current location during the Project (Golder 2011b: 5).

Golder (2011a) conducted a post-impact assessment of a 75 m by 25 m area adjacent to site DcRu-790 within AECs 18 and 19 following ground disturbance associated with mechanical vegetation clearing (Figure 3). Pedestrian reconnaissance of the entire partially graded area identified four concentrations of crushed shell. Three of these were on berms formed along the east and south edges of the cleared area, and a fourth was located in a machine cut along the north edge of this project area. The remaining cleared area exhibited very sparse, scattered crushed shell. No artifacts or features, including charcoal or fire cracked rock, were observed during the surface reconnaissance or during screening of the four shell concentrations. Considering the absence of any cultural materials, including features, artifacts, faunal elements, fire broken rock or charcoal, it was concluded that the observed shell was naturally occurring, and not related to the cultural deposits observed at site DcRu-790 located to the east of this project area. No further archaeological work was recommended within the disturbed area.

During remediation of a bedrock knoll in the North Area Parking Lot (AEC 22), within the recorded boundary of site DcRu-12, thin pockets of shell midden were observed (Figure 3). Subsequent inspection by Millennia (2010c) confirmed the presence of 5 cm to 20 cm thick patches of shell midden containing butter and littleneck clam, along with fire cracked rock. All five of the shovel tests that were subsequently excavated in this project area contained medium density shell mixed with modern refuse. One of the tests also produced four mammalian bone fragments and one avian bone fragment. Soils containing shell midden were segregated and deposited adjacent to AEC 23, approximately 100 m to the east. The bedrock knoll has since been removed and paved over. No further archaeological work was recommended for this location.

Two discrete pockets of disturbed shell midden were observed during remediation of the abandoned rail spur (AEC 23) located along the southwest edge of the North Area Parking Lot (Figure 3). The pockets were located approximately 35 m apart and contain disturbed shell midden mixed with fill material, native clay and historical debris (Millennia 2011a). The southern deposit was left *in-situ*, while the northern deposit was removed with heavy machinery under the direction of an archaeologist. This latter cultural deposit, located adjacent to Maple Bank Road, measured approximately 12 m in diameter with a maximum thickness of approximately 20 cm. No intact cultural deposits, and no artifacts or faunal materials, were identified during removal. No further archaeological work was recommended at this location, but due to the presence of nearby cultural deposits (Golder 2010b), it was recommended that any future ground disturbing activities be monitored by a qualified archaeologist.

Following an AIA (Millennia 2011b) initiated after shell midden deposits were observed during remediation at AEC 10, Millennia (2011c) conducted archaeological monitoring and mitigative data recovery. Two layers of predominantly disturbed shell midden were observed at depths of approximately 40 cm and 100 cm dbs across the project area and into adjacent locations to the north, west and south. The disturbed shell midden deposits varied in thickness from 1 cm to 40 cm and were mixed with fill material and modern refuse. An intact hearth feature in the northwest corner of AEC 10 was systematically excavated. Intact midden was also observed below fill at either end of a 24 m storm drain trench which extended from the northwest corner of AEC 10. Four distinct cultural strata were observed overlying a sterile clay layer. In total, 20 artifacts were recovered during monitoring and subsurface testing, and include the following: five basalt projectile points, seven pieces of debitage, seven worked bone and one worked antler fragment. Two of the worked bone pieces and three pieces of debitage were found *in-situ*. In addition, numerous faunal remains, dominated by harbour seal (*Phoca vitulina*), were recovered. Four fragments of human bone, representing at least two individuals (one adult, one child), were also recovered from disturbed matrices. Remediation of the soils within AEC 10 and the associated storm drain trench has removed all sediments containing archaeological deposits. No further archaeological work was recommended within these areas. For adjacent areas, it was recommended that an archaeologist be contacted prior to any ground disturbing work.

Four pockets of shell midden deposits were identified during archaeological monitoring of machine excavation associated with remediation efforts within AEC 18 (Millennia 2011d). All deposits were described as "heavily disturbed, mixed with modern refuse and overlaying more modern fill materials" (Millennia 2011d: 4). The four pockets were observed in Parking Lot A and along the road adjacent to the E&N rail right-of-way which connects Parking Lot A to Parking Lot B. The largest deposit was observed in Parking Lot A and measured approximately 5 m by 1.5 m and varied in thickness from 2 cm to 15 cm; remaining deposits are described as, "small mottled midden lenses" (Millennia 2011d: 4). No archaeological materials or features were observed. All contaminated soils have since been removed from AEC 18 and those containing cultural materials have been moved to the on-site storage location. No further archaeological work was recommended.

3.3.1.2 Munroe Head and Canadian Forces Sailing Association Properties

In 2003, Golder (2003b) undertook an AIA in advance of improvements proposed for the Canadian Forces Sailing Association (CFSA) property (Figure 3). The objective of the AIA was to assess whether the proposed developments would impact archaeological resources, including the previously recorded archaeological site DcRu-12. During the course of the assessment, 17 boreholes were machine augered. Disturbed shell midden was present in 13 of the 17 boreholes. Intact shell midden was observed immediately west of the existing CFSA Clubhouse in the west central portion of the CFSA property; probable intact shell midden was observed in a vegetated area near the northeast corner of the CFSA property. In general, disturbed midden was present from the surface to depths of up to 4.50 m; intact shell midden was present from 0.70 m to 2.10 m below surface.

Based on the results of the 2003 AIA, Golder concluded that remnants of archaeological shell midden associated with the previously recorded archaeological site DcRu-12 are situated on the CFSA property, primarily inland from the 1924 high water mark. The observed shell midden deposits exhibit variable degrees of previous disturbance, with the highest degree of apparent disturbance situated in the south portion of the CFSA property. Possible intact shell midden was observed at the north end of the CFSA property. Golder (2003b) recommended the following mitigative measures for the protection of the observed archaeological deposits,

archaeological data recovery and archaeological monitoring of construction activities that have the potential to disturb surface soils and sediments. It was also recommended that, where possible, archaeological shell midden removed during construction should be re-used on site and re-deposited as near to the point of excavation as possible to limit the displacement of human remains (if present) or other archaeological remains. Furthermore, these re-deposited cultural materials should be mapped on base drawings and included in an updated BC. Archaeological Site Inventory Form to avoid future confusion regarding the origin of these cultural deposits.

Millennia Research Limited (Millennia 2004b) conducted archaeological monitoring of water main and storm drain trenches between Buildings 2 and 14 on the Monroe Head property in 2004 (Figure 3). Discontinuous disturbed shell midden deposits were observed between 3 m and 28 m west of the water main valve chamber near Building 2 at a depth of approximately 0.40 m below road surface. Intact cultural deposits were identified from 0.53 m to at least 1.70 m below surface (the maximum depth of the shovel test) within both trenches. The cultural deposits were not uniformly distributed across the Project Area. Millennia recommended archaeological monitoring of construction within the "Area of Potential Archaeological Concern" as identified by Bailey (2003).

Golder (2008a) undertook additional archaeological assessment within the CFSA property to better delineate cultural deposits associated with archaeological site DcRu-12 along the eastern extent of the property in advance of future development of the area (Figure 3). Seven boreholes were machine augered within the area; no archaeological materials were observed. Systematic surface inspection of the shoreline and upland areas in the north (Munroe Head) and west sections of the CFSA property revealed deep and intact shell midden deposits. In addition, one hearth feature and six lithic artifacts were observed along the shoreline of Munroe Head. Golder recommended an AIA be conducted in areas where intact and previously disturbed archaeological deposits have been identified that might be impacted by any proposed development within the CFSA property. Because of the presence of human remains at other locations within DcRu-12, archaeological monitoring of any disturbances to intact or previously disturbed archaeological deposits during development was also recommended.

On behalf of Victoria Shipyards Company Ltd. and PWGSC, The Bastion Group Heritage Consultants (Bastion 2010) conducted archaeological monitoring associated with the construction of the Submarine Repair and Maintenance Facility (RMF) located on Munroe Head near the north end of EGD lands and adjacent to previously recorded archaeological site DcRu-12 (Figure 3). Six areas were chosen for monitoring based on the results of an earlier geotechnical drilling program. During construction monitoring of these six areas, nine locations were identified containing both intact and disturbed shell midden (Bastion 2010). Subsequent testing at some of these locations resulted in the identification of an intact dog skeleton and a rock feature. Numerous lithic and bone artifacts were also recovered from four of the six monitored areas, including small triangular chipped stone projectile points and ground slate tools. These artifacts, along with the canine remains and collected soil samples were reburied at the request of the Esquimalt Nation in the green space to the east of the RMF without analysis. As a result of the monitoring program the site boundary for DcRu-12 was extended 70 m to the southeast. Bastion recommended monitoring by a professional archaeologist during the course of any future ground disturbing activities in the area (Bastion 2010).

On the east side of the Dry Dock Company building (Building 2), disturbed and possibly intact shell midden was observed in seven of 10 boreholes during archaeological monitoring of soil sampling for contaminants (Millennia 2010b) (Figure 3). Midden was observed on the surface and at 43 cm depth below surface (dbs) and varied in thickness from 5 cm to 70 cm. Millennia recommended avoidance of cultural deposits and consultation with an archaeologist prior to any subsurface work at his location (Millennia 2010b: 6).

Golder (2011a) undertook archaeological monitoring of a 30 m long trench associated with upgrades to the North Security Gate at Munroe Head (Figure 3). Intermittent, partially disturbed shell midden was observed in the trench between 35 cm and 60 cm below surface from approximately 10 m to 20 m southwest of Building 2. Cultural deposits were determined to be *in-situ,* but disturbed through compaction from overlying sand and gravel fill. No artifacts or features were observed. All sediments containing cultural deposits were screened for artifacts and redeposited in the green space at the head of the graving dock. Recommendations included monitoring by a professional archaeologist during activities that have the potential to disturb buried archaeological deposits.

3.3.1.3 Pilgrim Cove, CFSA, Munroe Head and EGD Waterlots

Golder (2011c) conducted an AOA for the EGD waterlot and adjacent areas in advance of sediment remediation (Figure 3). Background research indicates the area around the graving dock and Pilgrim Cove has been largely disturbed by dredging. A review of ship and aircraft wreck data indicated no heritage wrecks are located within the Project Area. Analysis of historical aerial photographs, hydrographic surveys and towed video indicated no wrecks or archaeological materials or features within the Project Area. Archaeological monitoring of 17 offshore machine excavated sediment samples at the CFSA and Pilgrim Cove and two in the intertidal at Munroe head did not identify any cultural deposits (Golder 2011c, 2011d). Previous disturbance to marine sediments was noted as deep as 8.5 m below surface at Munroe Head where a steel spike was recovered during drilling. One area of archaeological potential was identified along the subtidal zone adjacent to site DcRu-12 where evidence of down-slope migration of sediments was observed. If erosion and redeposition is occurring from DcRu-12, there is potential for the seabed in the sloped area adjacent to Munroe Head and the CFSA to include disturbed archaeological materials (Golder 2011c). It was recommended that either AIA with sub-tidal testing be conducted to determine if the boundaries of DcRu-12 extend off shore or that monitoring by a professional archaeological occurs during dredging.

3.3.1.4 Lot 203, Songhees IR No. 1A

Golder (2011e) undertook an AIA, including archaeological monitoring of geo-environmental testing of the proposed lease site at Lot 203 Songhees IR No. 1A, Section 2A, Esquimalt District (Figure 2). Intact and partially disturbed shell midden was observed in 11 of 45 shovel tests and in 1 of 7 surface scrapes associated with monitoring of the Phase 1 Environmental Assessment. No cultural deposits were observed in the four boreholes located within the trailer park; the positive tests were all located in the south half of the lease lot. Shell midden deposits were generally confined to the upper 30 cm of sediment, with cultural deposits in one test extending to 70 cm dbs (the maximum depth of the test). Intact cultural deposits were only observed east of the E&N rail spur. In addition, shell midden deposits were observed in four surface exposures along the abandoned E&N rail spur, as well as within the trailer park and along the west facing slope north of the park. No artifacts or

features were observed during the assessment. An on-site meeting with Grant Keddie (curator Royal BC Museum) indicated human remains recovered during a post-impact surface reconnaissance in the early 1980s may be buried within or adjacent to the south border of Lot 203 (Keddie, personal communication, September, 2011). Recommendations included archaeological monitoring during ground disturbing activities within areas previously assessed, and AIA preceding development in areas not previously assessed.

3.3.2 Ethnographic Setting

The Project Area lies within the asserted traditional territories of the Songhees Nation and Esquimalt Nation. These First Nations speak Northern Straits Salish, one of five language groups that form part of the Central Coast Salish culture area (Suttles 1990). Northern Straits Salish was spoken on the southeast corner of Vancouver Island, the San Juan Islands, and along the mainland from Point Roberts and Boundary Bay to Deception Pass (Duff 1969; Suttles 1987, 1990).

Prior to contact with Euro-Canadians, these groups lived in a relatively independent household groups, each of which had a main winter village, but who moved seasonally to undertake a variety of subsistence activities (Barnett 1955; Suttles 1990). After contact, these groups became collectively known as the Songhees (or Songish), although they were not politically joined as a single tribe (Duff 1969). The Northern Straits Salish term for all Songhees local groups was Lekwungen, which today is represented by the Songhees Nation and Esquimalt Nation.

Detailed information on Songhees and Esquimalt culture, including social structure, political organization, demographics, treaties, material culture, medicine, life cycle, effects of disease, subsistence, ethnobotany, language, beliefs and customs, secret societies, food preparation, pastimes and other aspects can be found in: Barnett (1955), Boas (1890), Duff (n.d., 1964, 1969), Galois and Harris (1994), Hill-Tout (1907), Kennedy and Bouchard (1995), Mitchell (1968), Suttles (1951, 1958, 1960, 1968, 1987, 1990), Turner (1991), and Turner and Bell (1971).

3.3.2.1 First Nations Place Names and Esquimalt Harbour

Duff (1969) interviewed local elders and recorded Lekwungen place names in the Victoria area. When discussing Esquimalt harbour, *swhaymalthelth* was used by the elders to refer to the harbour, the village, and the people (Duff 1969:32). However, after further thought the elders indicated that when properly applied the name refers only to Duntze Head, the site of the present day dockyard. While the elders were not able to translate the name (Duff 1969:32), Suttles has suggested that the present form of the name may have been derived from a village named *Swhaymalthelth* and may be translated as "vicinity of the village of (the) Whyomilth" (Duff 1969:33). An early Admiralty chart refers to Constance Cove as "Village Bay" and tiny islets outside of Lang Cove as "Village Rocks" (Duff 1969:32). These map references combined with the place name suggests that a village was likely present on Duntze Head (Duff 1969:32-33).

3.3.3 Historic Setting

Europeans began to explore the shores of Vancouver Island in the 1790s. By the mid-19th century, the British had established a permanent presence on southern Vancouver Island. In 1843, the Hudson's Bay Company (HBC) sent James Douglas to Victoria and Esquimalt Harbours to find a new site for their operations. A fort was built in Victoria Harbour, and the area adjacent to Esquimalt Harbour was acquired from the local First Nations for its promising agricultural farmland (see Duff 1969 and Harris 2002 for information regarding treaties); farms were subsequently started at Constance Cove and Plumper Bay. By 1858, HBC buildings were present along the north shore of Skinner Cover where the North Landing Wharf is located today (BC Archives).

The Royal Navy set up residence in the harbour in the 1840s, establishing a naval presence in Esquimalt that continues to this day. In 1848, Constance Cove became the operations base for the H.M.S. Constance naval ship and the Royal Navy constructed the first permanent naval base buildings on Duntze Head in 1855. The naval base included a landing and boathouse on Grant Knoll (the naval dockyard, Building 116), buildings for paint and oil, boat maintenance, ordnance, and various storage facilities. In 1860, a powder magazine was established on Cole Island, followed by the construction of two coal sheds on Thetis Island and a lighthouse on Fisgard Island. The factory building, housing an engine shop, smelter and smith shop, was constructed during the 1860s.

The Royal Navy officially declared permanent residence in Esquimalt Harbour in 1865 with the property boundary extending north, south, and east halfway to old Esquimalt village. Tension between Britain and the United States spurred further development of the base, and the naval property expanded between Skinner and Lang Coves. By 1883 there were 58 buildings present on the naval base.

Construction of a graving/dry dock in Esquimalt commenced in 1876 and was opened in 1887 on the south shore of Constance Cove to service naval and commercial ships. The graving dock was opened as a federal Public Works operation and was in use for approximately 40 years, continuing to be used even after the base was transferred from the Royal Navy to the Royal Canadian Navy in 1910 (RRMC, December 1993).

In 1911, the Songhees Indian Reserve in Victoria was surrendered to the Government of the Province of British Columbia for the sum of $10,000 among other credits and moved to its present location in Esquimalt at Songhees IR No. 1A (Section 2A, Esquimalt District) (Department of Justice Canada website).

Discussion for construction of a larger graving dock began as early as 1904 but didn't move forward until the First World War when the need to service a new class of war ships and commercial vessels arose (Golder 2010d). Land Cove was originally chosen for the location of the federal graving dock, but during survey in 1917 it was decided to move it to Skinner's Cove. Construction began in 1921 under the Dominion Public Works Department and was completed in 1926 with the first ship entering the facility on September 13. At the time it was the second largest dry dock in the world after Boston (Taylor 1986).

After the completion of the federal graving dock, the naval graving dock was put out of use until HMCS Coaticook docked there in 1945. Ownership of the dockyard was transferred to HMC Dockyard. Fill from the construction was used to connect former Thetis Island to the southern shore of Constance Cove.

In 1946/47 the precursor to the CFSA, the Royal Canadian Naval Yacht Club (West Coast) was created during a boat building project by a group of sailors near the current location of the South Jetty (CFSA website). In 1953 the name changed to the Royal Canadian Sailing Association and in 1954 it was moved to its present location north of Munroe Head. In 1968, with the integration of the three military branches, it became the Canadian Forces Sailing Association. In 1998 the CFSA became the permanent host to the Victoria Chapter of the Disabled Sailing Association of BC. Today the association provides training, recreational and competitive sailing opportunities for serving military members and their families as well as recreation for civilian members of DND, their dependants and employees of Federal Government agencies.

4.0 METHODS

4.1 Introduction

One of the objectives of this AOA was the development of a geographic information systems (GIS) based model for predicting the location of precontact archaeological sites in the Project Area. This model was developed to enable PWGSC to better understand archaeological site spatial distributions and to predict potential conflicts between proposed developments and archaeological sites in areas where little or no archaeological inventory data exist.

An archaeological predictive model involves observing patterns of where known archaeological sites are located across the landscape, and using that information to suggest where unrecorded sites are most likely to be found. Archaeological and environmental variables (*e.g.*, slope, proximity to flowing water, etc.) are scored, and areas where the variables converge (*i.e.*, where total scores are greatest), are assigned the highest site potential ratings. A variation on this form of analysis applies weighted scales to rank the variables of interest, under the assumption that some criteria are more important than others for predicting site locations.

4.2 Literature Review

A review of readily available data regarding local and regional prehistory, history, ethnography, and the environment of the Project Area was undertaken. Included in this review were archaeological site records, archaeological overview and impact assessment reports on file with the Archaeology Branch and reports provided to Golder by PWGSC. The Provincial Heritage Register was also searched using the Remote Access to Archaeological Data (RAAD) application to establish whether any previously recorded archaeological sites are found in the Project Area, and to determine the types of sites that may be located in the vicinity of the study area. Geotechnical and environmental studies, aerial photos, and historic maps specific to the study area were also reviewed.

4.3 Archaeological Modeling

The archaeological predictive model incorporates a variety of variables structured in distinct layers. Variations within these parameters are summed to arrive at graded evaluations of archaeological potential that can be accurately mapped. Variables relied upon in this study include slope, proximity to the ocean and proximity to previously recorded archaeological sites. Also factored into this model were the results from previous archaeological assessment and monitoring in the Project Area, as well as relevant information gleaned from geotechnical and geo-environmental testing in the region.

The potential model used in this analysis incorporates five sets of variables into an overall map of potential. These data sets include:

- slope;
- distance to the ocean;
- distance to known archaeological sites;
- archaeological assessment and monitoring results; and
- geotechnical and geo-environmental testing results.

Each of the variables were ranked independently of one another and mapped in ArcInfo, a GIS-based program. Rankings of high, moderate and low were determined for each variable in terms of its potential relationship with the identification of archaeological sites. These rankings were established on the basis of generally recognised principals in relation to site location parameters. In areas where the potential ratings overlap, preference was given to the higher rating.

The model is based upon the assumption that the distribution of archaeological sites is dependent upon regional terrain characteristics and availability of local resources. It is realized that human factors such as population densities, seasonal movement cycles, and other culture-based variables will also affect the distribution of archaeological sites within the Project Area. In addition, it is recognized that natural taphonomic processes have also affected what sites now exist in the archaeological record and provide a degree of bias. A large percentage of the activities carried out in the region in the past are not preserved in the present day record. Furthermore, many activities, such as the gathering of plants, often do not leave materials behind in the archaeological record.

4.3.1 Category Rankings

4.3.1.1 Slope

Slope is the angle from which the topography deviates from a flat or horizontal plane. Based on examination of the previously recorded sites and their terrain associations, slope was determined to be a factor of significant importance in predicting the location of precontact archaeological sites. For instance, most habitation activities tend to be associated with relatively level terrain.

Slope was ranked in 10 degree intervals. Slopes between 0° and 10° were provided a high potential ranking. A moderate ranking was given to slopes between 11° and 20°, while slopes above 21° were ranked low. Considering the grade of the terrain, slope should be an important factor in this predictive model.

4.3.1.2 Proximity to the Ocean

Proximity to the ocean is considered to have considerable influence on locating archaeological resources. The ocean provides a consistent source of food, and serves as an important travel route through the rugged terrain. All areas below the 1939 high water shoreline were determined to have low potential for archaeological deposits unless recent data (archaeological, geotechnical) suggested otherwise.

4.3.1.3 Previously Recorded Archaeological Sites

Actual archaeological site locations were used in the creation of the potential model. During the production of this model, existing data on archaeological sites were used for two purposes. First, site specific information provided a basis for the identification of the types of sites to be expected in the region. Second, the location of each of the sites was utilized to assign archaeological potential.

A radius was placed around the recorded boundaries of each archaeological site of 20 m (creating a circle of at least 40 m in diameter). While this range was arbitrarily chosen, it is believed that it reflects the minimum area that cultural activities can be expected to have occurred at a site.

The location of all the previously recorded archaeological sites in the Project Area was compared to the assigned potential rankings. Where a site overlapped two potential rankings, it was still given the ranking of high potential.

4.3.1.4 Archaeological Assessment Data

Areas where archaeological investigations had been previously undertaken were considered. Shovel tests, auger tests and in some cases borehole tests were entered into the archaeological potential model as they provided information on the presence or absence of archaeological deposits. Tests which were positive for archaeological deposits were given a high potential rating which was arbitrarily extended 20 m into the surrounding area to create a buffer for future development. Negative shovel, auger and borehole tests were given a low potential rating which was extended for 5 m into the surrounding area. A potential rating of moderate was given to areas where archaeological deposits were observed, but determined to have been previously disturbed. These locations were also provided with a 20 m buffer.

4.3.1.5 Geotechnical Data

Geotechnical data derived from boreholes and test pits was also used in determining archaeological potential. Boreholes containing evidence of intact shell midden deposits, as determined by a qualified archaeologist, were given a potential rating of high for archaeological deposits. All other boreholes were given a rating of moderate unless it was determined that the collected soils and sediments consisted of fill down to bedrock and did not contain any shell, in which case they were given a rating of low. A buffer of 20 m was extended to each borehole.

5.0 RESULTS

5.1 Previously Recorded Archaeological Sites within the Project Area

There are four previously recorded archaeological sites located within the Project Area (Figure 3). Each of these four archaeological sites contains precontact shell midden deposits. There are over 40 previously recorded archaeological sites located on Esquimalt Harbour, 17 of which are situated within 1 km of the development.

5.1.1 DcRu-6

DcRu-6 is located within and adjacent to the EGD Project Area. The site is situated on the shore of Pilgrim Cove and consists of a habitation feature and shell midden associated with precontact burials. Initially recorded in 1959, DcRu-6 measures approximately 190 m by 40 m. Nine archaeological investigations have been undertaken since the site was initially recorded (Golder 1999, 2009b, 2010b, 2010c, 2011b; Hall and Hutchcroft 2008; Millennia 2003c, 2005, 2010a), resulting in the recovery of intact cultural deposits, including house floors, postholes, bone, antler, and lithic artifacts (Millennia 2005, 2010a). Following the 2003 excavations by Millennia, exhumed soils containing shell midden deposits from DcRu-6 were screened for artifacts and then spread over adjacent lands to the north and northeast, including at the head (east end) of the graving dock and north of the Front Guard House. In recent years it has become common practice to redeposit exhumed soils from around the EGD containing cultural materials to these two areas (Golder 2010c, 2011a, Millennia 2011b, 2011c, 2011d). According to the Provincial Heritage Registry, the site is considered to be less than 50% intact.

5.1.2 DcRu-12

DcRu-12 is located in the north and west portions of Munroe Head and extends north through the CFSA and the New Songhees Indian Reserve No. 1A to Ashe Head. The site measures 670 m by 200 m. It was first recorded in 1959 and has since been revisited by several archaeologists conducting both research and assessment investigations. Large scale research excavations were conducted by the University of Victoria in the 1970s (McMurdo and Styles 1974; McMurdo 1975; Keddie 1976). Observed in these archaeological investigations were intact stratified shell midden deposits, artifacts, faunal remains, possible living floors, and human remains. Radiocarbon dates suggest occupation from 3000 to 250 years ago (Grant Keddie, personal communication August, 2011). Since 2002, several archaeological impact assessments and monitoring programs have been conducted at DcRu-12 (Bastion 2010; Golder 2003a, 2003b, 2008a, 2009b, 2010a, 2011a, 2011e; Millennia 2002, 2003a, 2003b, 2004a, 2004b, 2004c, 2010b, 2010c, 2011a, 2011b, 2011c). Wet site and intact archaeological deposits were observed during these assessments, including the articulated remains of a dog.

5.1.3 DcRu-789

DcRu-789 is a shell midden site that was recorded within the property boundaries of the EGD by Millennia Research Ltd. in 2004. The site is situated on sloping terrain overlooking the Esquimalt Harbour to the west. Prior to construction of the Graving Dock, DcRu-789 was likely situated immediately adjacent to the east shore of Esquimalt Harbour. Shovel tests and examination of natural exposures revealed midden deposits ranging between 25 cm and 30 cm thick directly over bedrock. Faunal remains, fire cracked rock, and a rare carved siltstone artifact shaped in the form of a phallus, have been collected from this site (Millennia 2004a).

5.1.4 DcRu-790

DcRu-790, a shell midden site, was recorded within the property boundaries of the EGD by Millennia Research Ltd. (2004a). The site measures 8 m by 5 m and is reported to be intact and unstratified. Prior to construction of the Graving Dock, DcRu-790 was likely situated immediately adjacent to the east shore of Esquimalt Harbour. It is not known if the archaeological deposits originally extended beneath a demolished building foundation located immediately adjacent to the site (Millennia 2004a).

5.2 Previous Geotechnical Studies within the Study Area

Previous environmental and geotechnical reports supplied to Golder by PWGSC were reviewed for information relating to the condition of subsurface soils and sediments. As well, borehole log summaries were examined for evidence of shell, organics, and/or intact soils, as these can be indicators of archaeological sites.

Twelve geotechnical studies and two archaeological impact assessments which utilized auger testing were reviewed for the purposes of this report. Combined, they represent data from 415 boreholes, 63 test pits and 36 shovel tests/auger tests (Figure 4). The testing results reviewed for this AOA were found in the following documents:

- Environmental Investigation of Signal Hill and Munroe Head, Esquimalt Harbour (SRK-Robinson 1993).
- Phase III Contaminated Site Investigation of DND Munroe Head Land Parcel, Esquimalt Harbour, BC. (GeoViro 1996).
- Phase 2 and 3 Environmental Site Assessments Esquimalt Graving Dock (Seacor 2002a).
- Subsurface Environmental Investigation and Remedial Options Assessment Munroe Head Property Esquimalt, BC (Seacor, 2002b).
- Supplemental Site Investigation Esquimalt Graving Dock Esquimalt, BC. (Seacor, 2003).
- Archaeological Impact Assessment Proposed Site Redevelopment Canadian Forces Sailing Association, Esquimalt, BC. (Golder, 2003b).
- Supplemental Site Investigation and Quantitative Risk Assessment at Munroe Head Esquimalt Harbour, BC. (Golder, 2003c).
- Victoria Shipyards South Jetty Redevelopment Esquimalt Graving Dock (Golder, 2007).
- Archaeological Impact Assessment of The Canadian Forces Sailing Association Site in Esquimalt, BC. (Golder, 2008a).
- Geotechnical Site Investigation North Landing Wharf Esquimalt Graving Dock, BC. (Golder, 2008b).
- Esquimalt Graving Dock Uplands Phase 1 Environmental Site Assessment Report (SLR 2009a).
- Esquimalt Graving Dock Uplands Phase 2/3 Environmental Site Assessment Report (SLR 2009b).
- Esquimalt Graving Dock Waterlot Detailed Site Investigation Update (Golder 2011d).
- Victoria Shipyards – Training Centre Maplebank Road Preliminary Geotechnical Investigation (Thurber 2011).

A review of orthophotos from 2007 (Capital Regional District Regional Community Atlas, website accessed March 19, 2009), an 1858 Admiralty Chart (RAAD 2009), maps documenting the 1924 shoreline (Golder 2008b) and photos documenting the construction of the EGD (SLR 2009a) reveal that large areas of the shoreline within the Project Area have been covered in fill. Borehole logs indicate that intact native soils have been encountered below fill from 0.25 m to 2.9 m below the present surface at EGD, and from 0.3 m to 1.5 m below the present surface in the CFSA (SLR 2009b, Seacor 2002a, Golder 2003c). If intact soils are present below fill, there is the possibility that intact archaeological deposits may be present in these same soils within the Project Area.

5.3 Archaeological Potential Model

The PWGSC property is located along the north shore of Constance Cove in the Esquimalt Harbour. Figure 5 presents the results of the archaeological potential model developed for the Project Area. The model was developed using the criteria summarized in Section 4.0, including the following variables:

- slope;
- distance to the ocean;
- distance to known archaeological sites;
- archaeological assessment and monitoring results; and
- geotechnical and geo-environmental testing results.

The archaeological potential model provides information on the location of all previously registered archaeological resources. This model also predicts the location where archaeological sites might be situated based on environmental and cultural parameters, as well as from an analysis of where buried soils and sediments may be located from previous archaeological, geotechnical and geo-environmental assessments in the Project Area. Areas of high, moderate and low potential to contain buried archaeological sites and features were identified and mapped (Figure 5).

It must be recognized that an archaeological potential model is only as accurate as the information that contributes to its formulation. Knowledge of the archaeological resource distributions in any region depends on the intensity and distribution of prior investigation. Information available in the Provincial Heritage Register also varies with respect to its quality, accuracy and detail.

Other limitations that need to be considered include the potential changes that may have taken place in the past in vegetation types and ecological zones. For example, vegetation types in early post glacial times are believed to have differed substantially from modern communities and in mid Holocene times vegetation zones are thought to have had markedly different distributions. There have also been sometimes dramatic differences in sea level across the Holocene resulting in significant differences from the current shoreline.

6.0 RECOMMENDATIONS

6.1 Introduction

An archaeological potential model has been developed for PWGSC that predicts the location of previously unidentified precontact archaeological sites within the Project Area along Esquimalt Harbour in Esquimalt, BC. Archaeological potential was defined by the presence of archaeological sites in the vicinity of the Project Area and consideration of terrain where archaeological sites have been previously identified in other localities, particularly locations near the shoreline. Information on previous archaeological, geotechnical and geo-environmental assessment in the Project Area was also incorporated into the model.

The results of the AOA indicate that the Project Area has areas of high, moderate and low potential to contain buried archaeological sites and features.

6.2 Management Concerns

PWGSC will likely be undertaking development and operational activities in the Project Area that have the potential to damage or destroy archaeological sites. While there are no specific developments proposed for the Project Area, it is anticipated that such developments will occur in the future. Anticipated impacts will vary depending on the degree of surface disturbance, as influenced by local topography, weather conditions and the types of equipment used. Information on the level of these impacts can be used in conjunction with the mapped predictions of landscape sensitivity to determine appropriate management responses to archaeological concerns. This planning would be completed in advance of proposed developments in any specific location within the Project Area.

Golder Associates has developed a matrix specifically for PWGSC that balances archaeological potential against potential impacts to significant archaeological sites (Table 1). Proposed developments have been ranked as high, moderate, and low depending upon the degree of impact to significant archaeological sites. As discussed in Section 3.2, high impact operations would include, but not limited to, excavation, grading, levelling, landscaping, dredging and demolition. Developments considered to have a moderate impact to archaeological sites include augering of boreholes for geotechnical and geo-environmental investigations and paving of roads and parking lots. Low impact activities include on-going operational activities such as vehicle use that will not disturb surface soils and sediments.

Table 1: Archaeological Management Matrix

Location	Type of Predicted Archaeological Site Impact		
	High Impact	Moderate Impact	Low Impact
Known Archaeological Site	high sensitivity	high sensitivity	low sensitivity
High Potential	high sensitivity	moderate sensitivity	low sensitivity
Moderate Potential	moderate sensitivity	moderate sensitivity	low sensitivity
Low Potential	low sensitivity	low sensitivity	low sensitivity

Table 1 compares archaeological site potential with the degree of impact. It provides for three different levels of archaeological sensitivity, high, moderate, and low. Where substantial impacts are to occur in an area of high archaeological site potential, the location would be considered to have a high sensitivity; moderate to low

impacts in a location of low archaeological site potential would be considered to be of low sensitivity. A professional archaeologist would work with PWGSC to review plans for future developments within the Project Area against this Archaeological Management Matrix.

Sensitivity evaluations are used to develop appropriate levels of program management to address archaeological concerns and the following AOA implementation is suggested:

- Where sensitivity is high, a professional archaeologist should be contacted to discuss the proposed impacts. Where archaeological resources are unknown but of high potential, an AIA would likely be recommended. Where archaeological resources have been previously assessed, it may be possible to proceed directly to an impact management measure such as site avoidance by relocating the development, site protection, or systematic data recovery (*i.e.*, archaeological excavations) by a professional archaeologist.
- For areas of moderate sensitivity, a professional archaeologist should be contacted to discuss the proposed impacts and determine if impact management actions are necessary. Suggested actions might include archaeological monitoring or avoidance. Archaeological monitoring would need to be conducted by a professional archaeologist. Monitoring would be used to identify any significant archaeological sites that might warrant further archaeological assessment and/or mitigation.
- For Areas of low sensitivity, a chance find management procedure should be developed prior to development and implemented so that the appropriate steps are taken in the unlikely event that archaeological materials are inadvertently impacted or exposed during development.

6.3 Future Investigations

An important objective of any assessment procedures undertaken in the Project Area would be to test the validity of the archaeological predictive model. The results of future investigations should be used to verify or modify the results of the model to improve its accuracy. As a test of these archaeological potential rankings, future assessment activities should also sample areas of low archaeological potential prior to development.

6.4 Conclusion

An archaeological predictive model has been developed for the Project Area. These preliminary findings provide baseline data that will serve as the basis for continued efforts to improve and refine modelling approaches in the Project Area. The model can be utilized for development and operational planning and for archaeological management purposes. For example, developments can be ranked on the basis of the anticipated impacts to archaeological sites. Using these rankings, a matrix has been proposed where planners can identify locations where particular developments have the potential to impact archaeological sites. This tool can be used to minimize high impact activities in areas of high heritage sensitivity.

It is recommended that a professional archaeologist work with PWGSC to review plans for future developments within the Project Area. Recommendations would then be formulated for the management of archaeological resources within the proposed development area. It is anticipated that the screening process can be completed well in advance of development activities allowing planners to avoid areas of archaeological concern if they wish.

It is expected that PWGSC will undertake developments that will require formal archaeological assessment before construction is allowed to proceed. Where significant archaeological deposits are identified, further measures may be required to protect the resource. Mitigative options can include the following: avoidance, further assessment, data recovery (archaeological excavation) and/or monitoring. PWGSC should be aware that serious delays have been experienced by other proponents when assessment and mitigation activities were not completed in a timely fashion. PWGSC is advised that if unanticipated archaeological materials or features (including but not limited to, culturally modified trees, rock art, stone artifacts, human remains, or unusual objects or features of a possible ceremonial nature) are encountered during any further construction or related activities, all work in the immediate area should cease, and an archaeological consultant should be contacted.

7.0 LIMITATIONS AND USE OF REPORT

This report was prepared for the use of PWGSC. Any use, reliance or decisions made by third parties on the basis of the report are the responsibility of such third parties. This study was not intended to address issues of traditional aboriginal use, rights, or title.

8.0 CLOSURE

We trust the information in this report is satisfactory for your present needs. Should you require additional information or clarification, please do not hesitate to contact the undersigned at your earliest convenience.

GOLDER ASSOCIATES LTD

ORIGINAL SIGNED

Dana Dalmer, B.A.
Archaeologist

Reviewed by:

ORIGINAL SIGNED

Ben Hjermstad, M.A.
Associate / Senior Archaeologist

DD/BH/kar

N:\FINAL\2010\1477\10-1477-0051 PWGSC AOA Update EGD Esquimalt\03-30-12 PWGSC AOA EGD Update 2012 - FINAL\rpt 03-30-12 PWGSC AOA EGD Update 2012.docx

9.0 REFERENCES

Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations.
2009 *Archaeological Overview Assessments as General Land Use Planning Tools – Provincial Standards and Guidelines*. Available at: http://www.tca.gov.bc.ca/archaeology/docs/FIA_AOA_Standards_2009.pdf

Barnett, G. H.
1955 *The Coast Salish of British Columbia.* University of Oregon, Eugene, OR.

Boas, F.
1890 The LkungEn in *The Sixth Report on the Northwestern Tribes of Canada*. Report of the 60th Meetings of the British Association for the Advancement of Science for 1890. London, pp. 563-592.

British Columbia Archives
2010 BC Archives, Victoria, BC. Map of Constance Cove surveyed by Captain G.H. Richards 1858. BCARS-CM/A1114.

Canadian Environmental Assessment Agency
1996 Strategic Environmental Assessment: The 1999 Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals: Guidelines for Implementing the Cabinet Directive. Ottawa, ON: Her Majesty the Queen in Right of Canada, 2000.

Capital Regional District Natural Areas Atlas
2009 CRD Natural Areas Atlas Map Viewer. Website, http://maps.crd.bc.ca/imf/imf.jsp?site=public_crdviewer, accessed March 19, 2009.

Department of National Defence.
1999 *Contracting Manual for Land Archaeology*. Ottawa.

Department of Justice Canada
2011 An Act respecting the Songhees Indian Reserve (S.C. 1911, c. 24). Electronic document available at: http://laws-lois.justice.gc.ca/eng/acts/S-13.5/page-2.html. Accessed March 19, 2011.

Duff, W.
n.d. Provincial Museum of Natural History and Anthropology, Wilson Duff papers. Unpublished handwritten and typed notes on various subjects pertaining to BC anthropology and archaeology (see Files 50, 51, 113, 150, 151, 152, and 154). Manuscripts on file with the Royal British Columbia Museum, Victoria.

1964 *The Indian History of British Columbia. Volume 1: The Impact of the White Man. Anthropology in British* Columbia *Memoirs 5*. Victoria.

1969 The Fort Victoria Treaties. *BC Studies* 3:3-57.

Easton, N. A.
1985a *Underwater Archaeology of Straits Salish Reefnetting*. Unpublished M.A. Thesis, Department of Anthropology, University of Victoria, Victoria, BC.

1985b The Underwater Archaeology of Straits Salish Reefnetting I. *The Midden* 17(1):9-11.

1986 The Underwater Archaeology of Straits Salish Reefnetting II. *The Midden* 18(4):3-5.

Galois, R. and C. Harris.
1994 Recalibrating Society: The Population Geography of British Columbia. *The Canadian Geographer* 38(1):37-53.

GeoViro Engineering Ltd.
1996 Phase III Contaminated Site Investigation of DND Munroe Head Land Parcel, Esquimalt Harbour, BC. Report prepared for Public Works and Government Services Canada. Report on file with author.

Golder Associates Ltd.
2003a Archaeological Assessment Proposed Site Re-development Munroe Head, Esquimalt, BC. Non-Permit report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations. Victoria, BC.

2003b Archaeological Impact Assessment Proposed Site Redevelopment Canadian Forces Sailing Association, Esquimalt, BC. Non-Permit report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations. Victoria, BC.

2003c Supplemental Site Investigation and Quantitative Risk Assessment at Munroe Head Esquimalt Harbour, BC. Report prepared for Public Works and Government Services Canada. Report on file with author.

2006 Phase I Environmental Site Assessment and Supplemental Sediment and Crab Sampling Investigation, Esquimalt Harbour, Vols. 1 – 3. Report prepared for Public Works and Government Services Canada. Report on file with author.

2007 Victoria Shipyards South Jetty Redevelopment Esquimalt Graving Dock. Report prepared for DELCAN Corporation. Report on file with PWGSC, Victoria, BC.

2008a Archaeological Impact Assessment of the Canadian Forces Sailing Association Site in Esquimalt, BC. Report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC.

2008b Geotechnical Site Investigation North Landing Wharf Esquimalt Graving Dock, BC. Report prepared for Public Works and Government Services Canada. Report on file with author, Victoria, BC.

2009a Archaeological Overview and Impact Assessment E&N Rail Trail, Victoria, BC. Report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC.

2009b Archaeological Monitoring of Geo-Environmental Testing at the Esquimalt Graving Dock, Esquimalt, BC. Report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC.

2010a Archaeological Impact Assessment within DcRu-12 Bedrock Removal at North Area Parking Lot, Esquimalt Graving Dock, Esquimalt, BC. Report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC.

2010b Archaeological Overview/Impact Assessment for the Esquimalt Graving Dock Remediation of Five AEC Locations, Esquimalt, BC. Report on file with the Archaeology Branch Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC.

2010c Archaeological Impact Assessment Esquimalt Graving Dock Front Guardhouse Security Upgrade, Esquimalt, BC. Report on file with PWGSC, Victoria, BC.

2010d Historical Archival Research Project – Esquimalt Graving Dock. On file with PWGSC, Victoria, BC.

2011a Esquimalt Graving Dock AEC 18/19 Archaeological Post Impact Assessment and North Security Gate Monitoring, Esquimalt, BC. Report on file with PWGSC, Victoria, BC.

2011b Results of Archaeological Monitoring of Slope Grading for the East End Expansion Area at the Esquimalt Graving Dock, Esquimalt, BC. Letter report submitted to PWGSC and on file with PWGSC, Victoria, BC.

2011c Esquimalt Graving Dock Waterlot Sediment Remediation Project – Archaeological Overview Assessment. Letter report prepared for Public Works and Government Services Canada. Report on file with author, Victoria, BC.

2011d Esquimalt Graving Dock Waterlot Detailed Site Investigation Update. Report prepared for Public Works and Government Services Canada. Report on file with author, Victoria, BC.

2011e Archaeological Impact Assessment for the Proposed Lease Site Lot 203 Indian Reserve No. 1A, Section 2A, Esquimalt District, BC. Report on file with the Ministry of Forests, Lands and Natural Resource Operations.

Government of Canada,
1988 Federal archaeological heritage, protection and management: a discussion paper, Published by Dept. of Communications, Ottawa.

Hall, J and D. Hutchcroft
2008 Archaeological Impact Assessment, Admirals and Colville Intersection Upgrade, Phase I, Esquimalt, BC. Report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC.

Harris, C.
2002 *Making Native Space: Colonialism, Resistance, and Reserves in British Columbia*. UBC Press, Vancouver and Toronto.

Hill-Tout, C.
1907 Report on the Ethnography of the South-eastern Tribes of Vancouver Island, BC. *Journal of the Royal* Anthropological *Institute*, XXXVII, pp. 306-74.

Historic Sites and Monuments Board of Canada.
2000 Guidelines for Evaluating Shipwrecks of National Historic Significance in Canada. On-line resource at http://www.pc.gc.ca/eng/docs/pc/guide/res/arch4_a.aspx#4a f, accessed November 28, 2010.

Keddie, G.
1976 *Preliminary Report on the 1976 Maple Bank Project Excavations at DcRu-12*. Report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC.

Kennedy, D. and R. Bouchard
1995 *An Examination of Esquimalt History and Territory: A Discussion Paper.* Unpublished report on file with the Esquimalt Nation, Victoria, BC.

Matson, R.G.

1976 *Prehistoric Adaptations at the Glenrose Cannery Site DgRr-6 Fraser Delta, BC Canada*. National Museum of Man. Mercury Series. Archaeological Survey Paper 52. Ottawa.

1992 The Evolution of Northwest Coast Subsistence in Long-term Subsistence Change in Prehistoric North America, *Research in Economic Anthropology Supplement 6,* pp. 367-428. JAI Press Inc. Greenwich, Conn.

McMurdo, A.

1975 *Excavations at the Maple Bank Site: DcRu-12*. Report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC.

McMurdo, A. and Nora Styles

1974 *Preliminary Report on Excavations at the Maple Bank Site DcRu-12 – 1974*. Non-Permit report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations. Victoria, BC.

Meidinger, D.V. and J. Pojar.

1991 *Ecosystems of British Columbia*. Victoria: Ministry of Forests. Available at: http://www.for.gov.bc.ca/hfd/pubs/Docs/Srs/Srs06.htm.

Millennia Research Ltd.

2002 Maple Bank: Results of Archaeological Monitoring. Report on file at Millennia Research.

2003a Maple Bank Phase II: Results of Archaeological Monitoring at DcRu-012. Non-Permit Report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC.

2003b Soil Excavation at Transport Canada Plumper Bay Property, Esquimalt BC: Results of Archaeological Monitoring at DcRu-12. Non-Permit report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC.

2003c Esquimalt Graving Dock: South Jetty Access Road Mitigative Data Recovery, DcRu-760. Non-Permit Report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC.

2004a *Esquimalt Graving Dock: Archaeological Inventory*. Non-permit report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC.

2004b Munroe Head Redevelopment: Archaeological Monitoring. Non-Permit report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC.

2004c Former E&N Railway Spur Line, Esquimalt Harbour, BC. Non-Permit report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC.

2005 Esquimalt Graving Dock Drainage: Results of Archaeological Monitoring at DcRu-760. Non-permit report on file with the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC.

2010a Archaeological Monitoring, PWGSC Esquimalt Graving Dock, AEC14. Letter report prepared for SLR Consulting Ltd. Report on file with PWGSC, Victoria, BC.

2010b Archaeological Monitoring of Environmental Drilling for PWGSC at Munroe Head, Esquimalt Graving Dock. Letter report submitted to SLR Consulting Ltd. Report on file with PWGSC, Victoria, BC.

2010c Archaeological Monitoring, PWGSC Esquimalt Graving Dock, AEC22. Letter report submitted to SLR Consulting Ltd. Report on file with PWGSC, Victoria, BC.

2011a Archaeological Awareness Training and Monitoring at Esquimalt Graving Dock AEC 23. Letter report submitted to SLR Consulting Ltd. Report on file with PWGSC, Victoria, BC.

2011b Esquimalt Graving Dock AEC 10: An Archaeological Impact Assessment. Report prepared for SLR Consulting Ltd. Report on file with PWGSC, Victoria, BC.

2011c Public Works and Government Services Canada Esquimalt Graving Dock AEC 10: Post Remedial Archaeological Works. Report prepared for SLR Consulting Ltd. Report on file with PWGSC, Victoria, BC.

2011d Archaeological Monitoring of Environmental Remediation at the Esquimalt Graving Dock AEC 18. Report prepared for SLR Consulting Ltd. Report on file with PWGSC, Victoria, BC.

Mitchell, M.
1968 *A Dictionary of Songish, a Dialect of Straits Salish*. Unpublished Master's Thesis in Linguistics, University of Victoria, Victoria.

Moore, C.D. and A.R. Mason
2010 Demonstration Survey of Reef Net Sites with Side Scan Sonar, near Beecher Bay, British Columbia. MS submitted to the *International Journal of Nautical Archaeology*.

Nuszdorfer, F.C., K. Klinka, and D.A. Demarchi.
1991 Chapter 5: Coastal Douglas-fir Zone in *Ecosystems of British Columbia*, edited by D.V. Meidinger and J. Pojar, Ministry of Forests, Victoria, BC. Available at: http://www.for.gov.bc.ca/hfd/pubs/Docs/Srs/Srs06.htm.

Parks Canada
1994 Cultural Resource Management Policy and Guidelines for the Management of Archaeological Resources in the Canadian Parks Service.

Petzelt, B.
2004 Preliminary Review of Archaeological Sites in the Fairview Terminal Area, West Site of Kaien Island, Prince Rupert Harbour, British Columbia. Available online: http://www.rupertport.com/pdf/envass/Archeology.pdf.

Public Works and Government Services Canada
2010 PWGSC Services – EGD website: http://www.tpsgc-pwgsc.gc.ca/pac/cse-egd/index-eng.html. Accessed February 19, 2010.

Richards, N.
2008 *Ships' Graveyards: Abandoned Watercraft and the Archaeological Site Formation Process*. University Press of Florida, Gainesville, FL.

Royal Roads Military College – Environmental Sciences Group
1993 An Environmental Study of Esquimalt Harbour: Part II Impacts Associated with Contaminants in Sediment. Prepared by Bright, D.A., & K.J. Reimer. Report on file with the author.

SEACOR Environmental Inc.
2002a Phase 2 and 3 Environmental Site Assessments Esquimalt Graving Dock. Report prepared for Public Works and Government Services Canada. Report on file with author.

2002b Subsurface Environmental Investigation and Remedial Options Assessment Munroe Head Property Esquimalt, BC. Report prepared for Public Works and Government Services Canada. Report on file with author

2003 Supplemental Site Investigation Esquimalt Graving Dock Esquimalt, BC. Report prepared for Public Works and Government Services Canada. Report on file with author.

SRK-Robinson Inc.
1993 Environmental Investigation of Signal Hill and Munroe Head, Esquimalt Harbour. Report prepared for Public Works and Government Services Canada. Report on file with author.

SLR Consulting Ltd.
2009a Esquimalt Graving Dock Uplands Phase 1 Environmental Site Assessment Report. Report prepared for Public Works and Government Services Canada. Report on file with author.

2009b Esquimalt Graving Dock Uplands Phase 2/3 Environmental Site Assessment Report. Report prepared for Public Works and Government Services Canada. Report on file with author.

Suttles, W.
1951 *Economic Life of the Coast Salish of Haro and Rosario Straits*. Ph.D. Dissertation in Anthropology, University of Washington, Seattle.

1958 Private Knowledge, Morality, and Social Classes Among the Coast Salish. American Anthropologist 60(3):497-507.

1960 Affinal Ties, Subsistence, and Prestige Among the Coast Salish. *American Anthropologist* 62(2):296-303.

1968 Coping with Abundance: Subsistence on the Northwest Coast. In Man the Hunter, edited by Richard B. Lee and Irven DeVore, pp. 56-68. Aldine, Chicago.

1987 *Coast Salish Essays*. Compiled and edited with the assistance of Ralph Maud. University of Washington Press, Seattle.

1990 Central Coast Salish. *In Handbook of North American Indians, Volume 7: Northwest Coast*, edited by Wayne Suttles. Smithsonian Institute, Washington.

Taylor, G. W.
1986 Shipyards of British Columbia: the Principal Companies. Victoria, BC: Morriss Publishing.

The Bastion Group Heritage Consultants
2010 Archaeological Monitoring for the Victoria Shipyard Co. Ltd. Submarine Repair Facility Project – Archaeological Site DcRu-12. Report prepared for Victoria Shipyards Company Ltd. and Public Works and Government Services Canada. Report on file with PWGSC, Victoria, BC.

Thurber Engineering Ltd.
2001 *B Jetty Realignment CFB Esquimalt, BC. Geotechnical Investigation Interim Report.* Report prepared for Department of National Defence.

2011 Victoria Shipyards – Training Centre Maplebank Road Preliminary Geotechnical Investigation. Letter report prepared for Stantec Consulting Ltd. report on file with PWGSC, Victoria, BC.

Turner, N.
1991 "Burning Mountain Sides for Better Crops" Aboriginal Landscape Burning in British Columbia. Archaeology in Montana 32(2):57-73.

1995 *Food Plants of Coastal First Peoples*. UBC Press, Vancouver.

Turner, N. and M. Bell.
1971 The Ethnobotany of the Coast Salish Indians of Vancouver Island. *Economic Botany* 25(1):63-104.

Williams, Judith.
2006 *Clam Gardens: Aboriginal Mariculture on Canada's West Coast*. Transmontanus 15. Vancouver, BC.

FIGURES

LEGEND

PROJECT AREA

1,500 0 1,500

SCALE 1:50,000 METRES

REFERENCE

(92-B-06) Scanned NTS maps provided by the Department of Natural Resources Canada. All rights reserved.
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 10

PROJECT: PWGSC ESQUIMALT GRAVING DOCK
ARCHAEOLOGICAL OVERVIEW ASSESSMENT
ESQUIMALT B.C.

TITLE

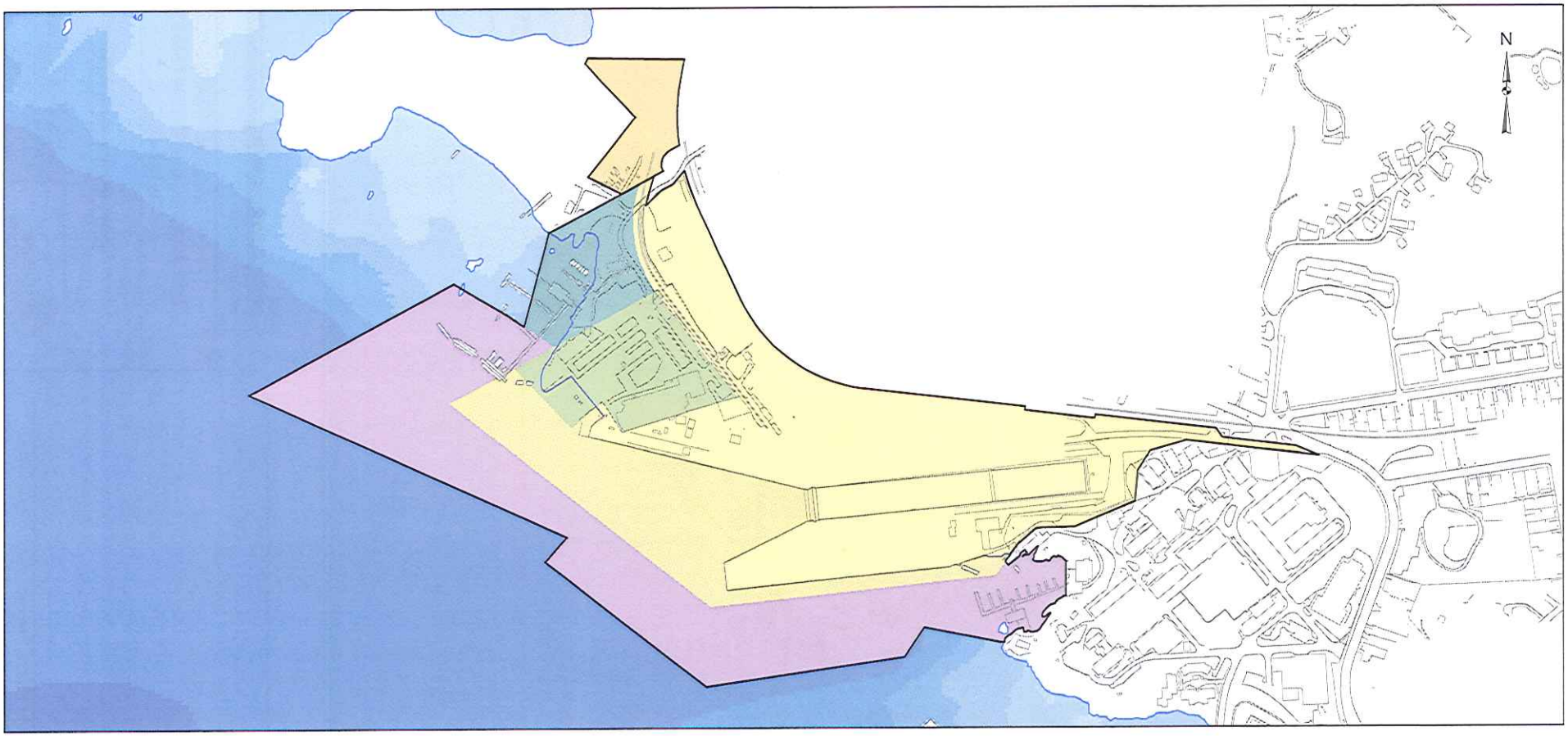
PROJECT LOCATION

Golder Associates
Victoria, BC

PROJECT No. 09-1477-0012			SCALE AS SHOWN	REV. 0
DESIGN	DD	23 Mar. 2012	FIGURE 1	
GIS	CDB	23 Mar. 2012		
CHECK	DD	28 Mar. 2012		
REVIEW	BH	28 Mar. 2012		

N:\Bus-Graphics\Projects\2009\1477-0012\GIS\mapping\mxd\2012\Figure1.mxd

N:\Cut-Graphics\Projects\2009\1477\09-1477-0012\GIS\mapping\mxd\2012\figure2.mxd



LEGEND

- PROJECT AREA

PROPERTIES

- CANADIAN FORCES SAILING ASSOCIATION (D.N.D.)
- LEASE SITE LOT 203 (IR NO. 1A, SEC. 2A)
- MUNROE HEAD (D.N.D.)
- PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
- WATERLOT (D.N.D.)

REFERENCE

Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 10
Basemap source provided by PWGSC.

125 0 125
SCALE 1:5,000 METRES

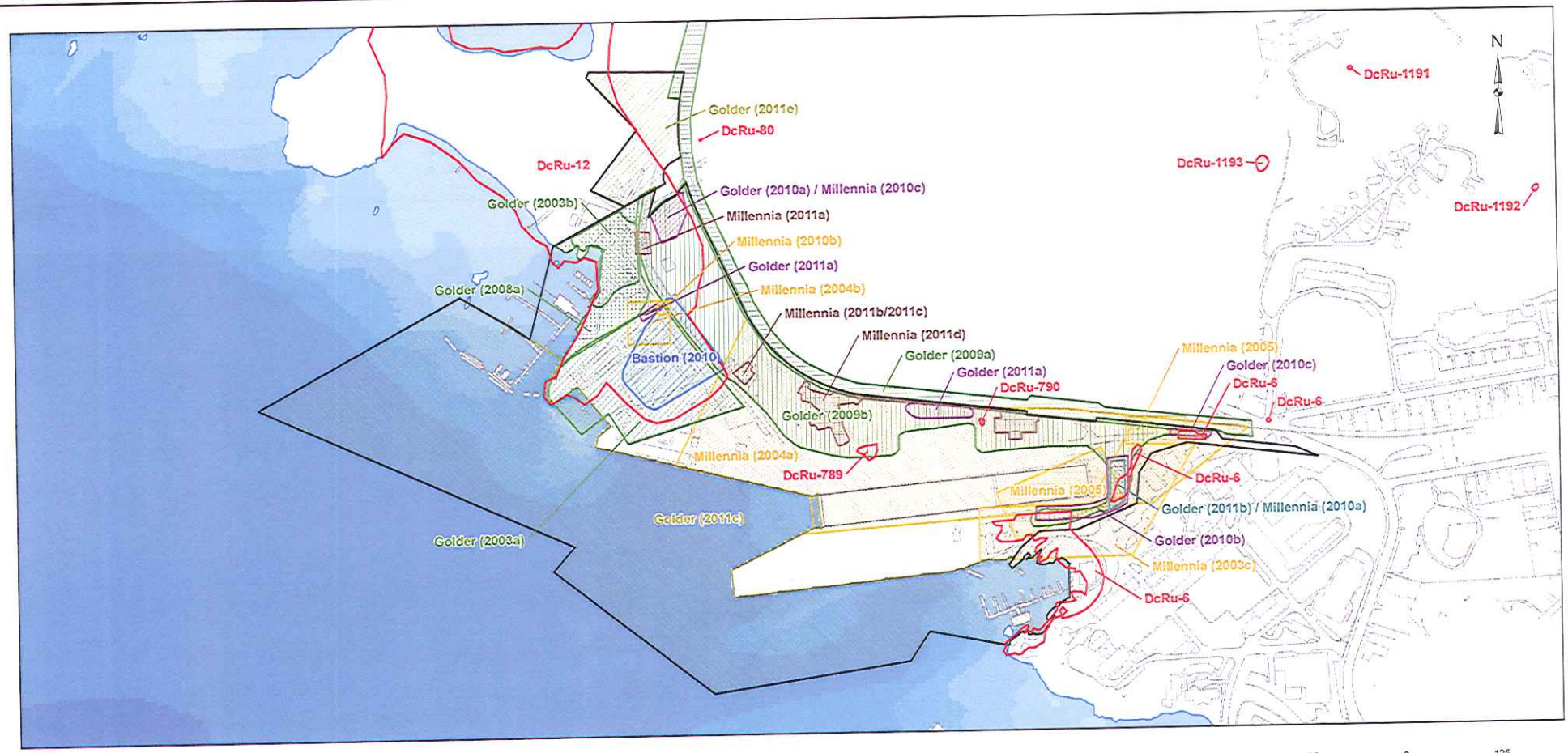
PROJECT
PWGSC ESQUIMALT GRAVING DOCK
ARCHAEOLOGICAL OVERVIEW ASSESSMENT
ESQUIMALT B.C.

TITLE
PROJECT PROPERTIES

Golder Associates
Victoria, BC

PROJECT No. 09-1477-0012		SCALE AS SHOWN	REV. 0
DESIGN	DD	23 Mar. 2012	**FIGURE 2**
GIS	CDR	23 Mar. 2012	
CHECK	DD	28 Mar. 2012	
REVIEW	RH	28 Mar. 2012	

N:\Bur-Graphics\Projects\2009\1477\09-1477-0012\GIS\mapping\mxd\2012\figure3.mxd



125 0 125
SCALE 1:5,000 METRES

LEGEND

ARCHAEOLOGICAL SITE
PROJECT AREA

PREVIOUS PROJECT AREAS

- Bastion (2010)
- Golder (2003a)
- Golder (2003b)
- Golder (2008a)
- Golder (2009a)
- Golder (2009b)
- Golder (2010a) / Millennia (2010c)
- Golder (2010b)
- Golder (2010c)
- Golder (2011a)
- Golder (2011b) / Millennia (2010a)
- Golder (2011c)
- Golder (2011e)
- Millennia (2003c)
- Millennia (2004a)
- Millennia (2004b)
- Millennia (2005)
- Millennia (2010b)
- Millennia (2011a)
- Millennia (2011b/2011c)
- Millennia (2011d)

REFERENCE

Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 10
Basemap source provided by PWGSC.

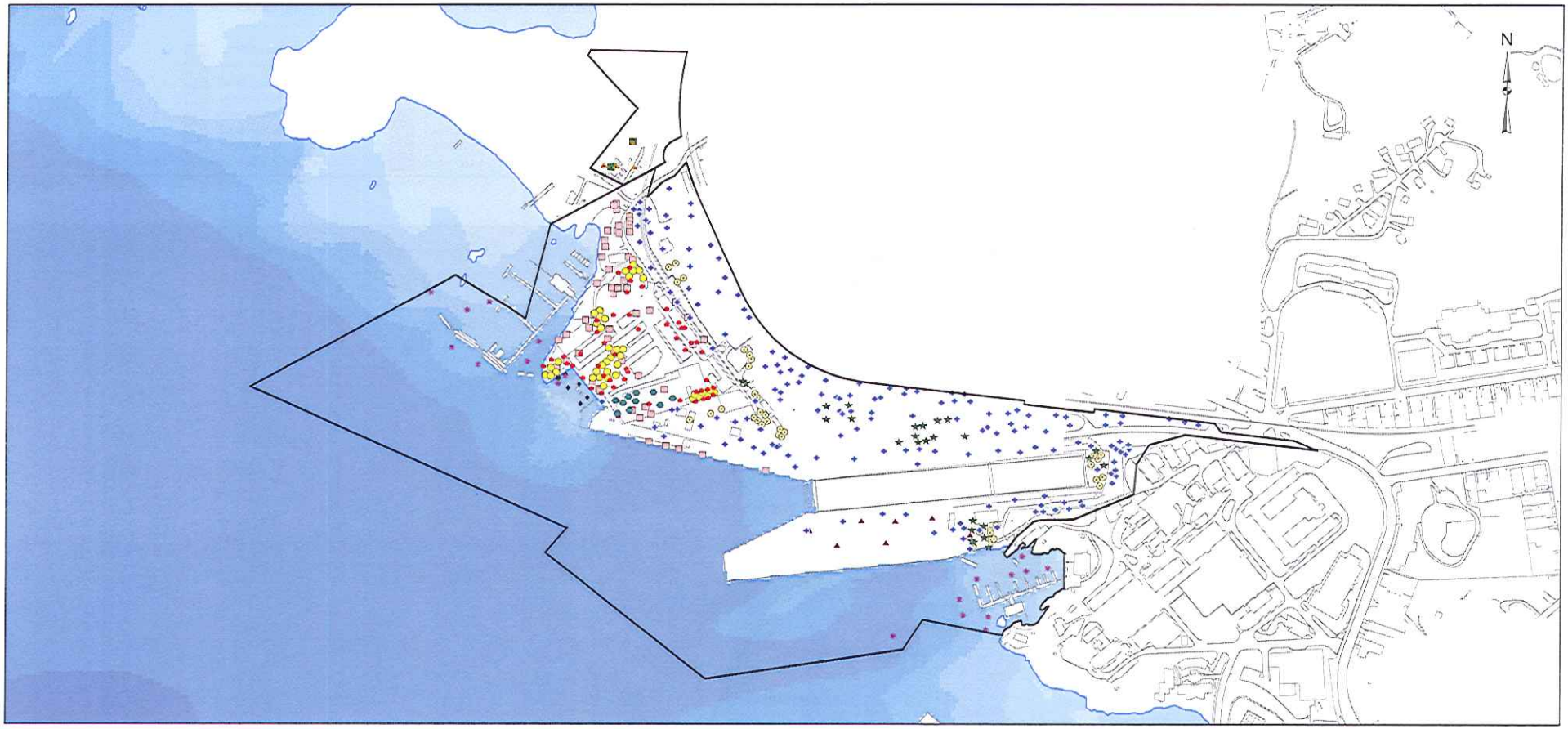
PROJECT: PWGSC ESQUIMALT GRAVING DOCK
ARCHAEOLOGICAL OVERVIEW ASSESSMENT
ESQUIMALT B.C.

TITLE: LOCATION OF KNOWN ARCHAEOLOGICAL SITES AND PREVIOUS ARCHAEOLOGICAL STUDIES

Golder Associates
Victoria, BC

PROJECT No. 09-1477-0012		SCALE AS SHOWN	REV. 0
DESIGN	DD	23 Mar. 2012	FIGURE 3
GIS	CDR	23 Mar. 2012	
CHECK	DD	28 Mar. 2012	
REVIEW	PH	28 Mar. 2012	

N:\Cur-Graphics\Projects\2009\1477\09-1477-0012\GIS\mapping\mxd\2012\figure4.mxd



LEGEND

- PROJECT AREA

PREVIOUS BOREHOLE PROJECT

- GEOVIRO, 1996
- GOLDER, (2003b, 2003c, 2008a, 2008b)
- GOLDER, 2007
- GOLDER, 2010
- GOLDER, 2011a
- GOLDER, 2011e
- Seacor, 2002a
- Seacor, 2002b
- Seacor, 2003
- SLR, 2009
- SRK, 1993
- Thurber, 2011

REFERENCE

Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 10
Basemap source provided by PWGSC.

125 0 125
SCALE 1:5,000 METRES

PROJECT
PWGSC ESQUIMALT GRAVING DOCK
ARCHAEOLOGICAL OVERVIEW ASSESSMENT
ESQUIMALT B.C.

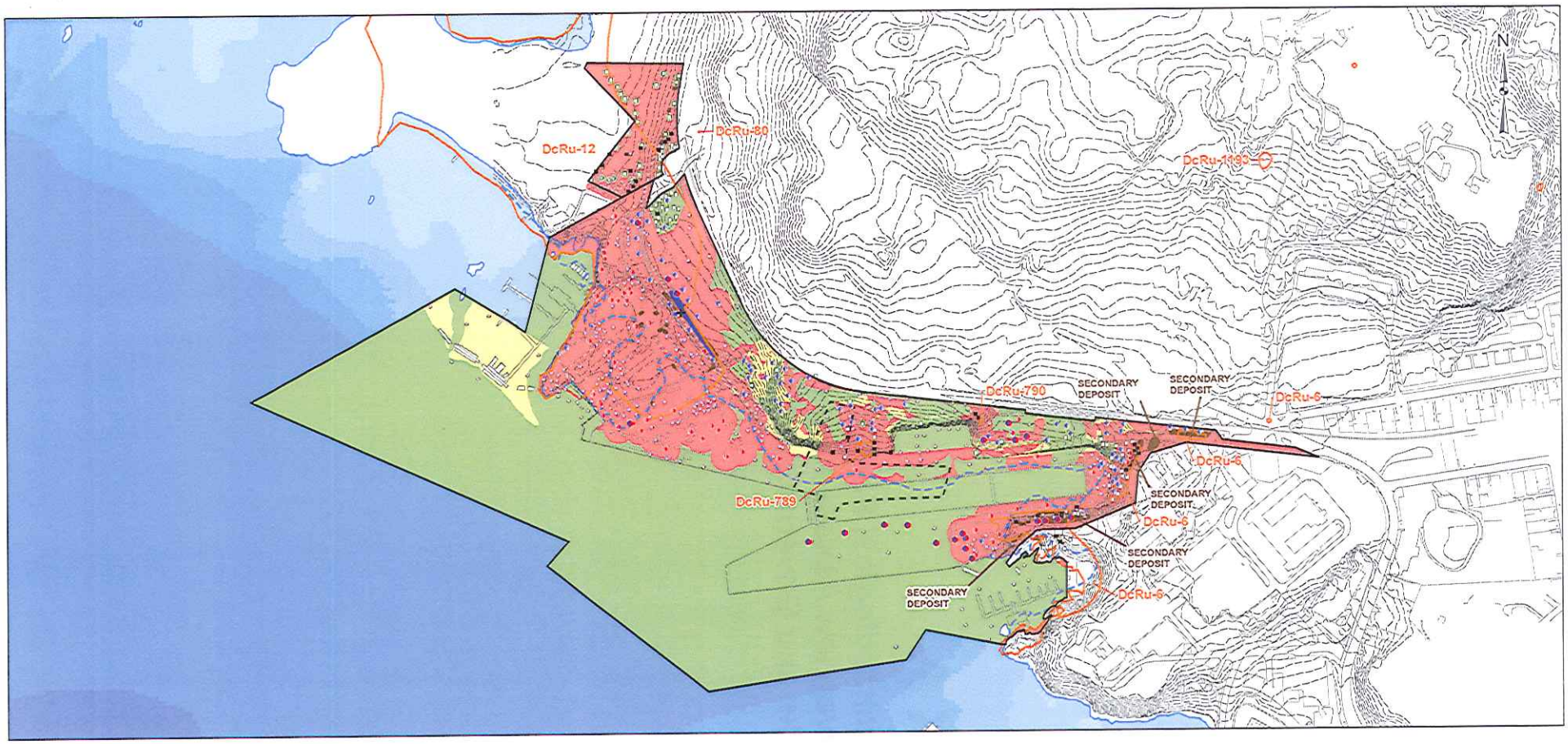
TITLE
BOREHOLE LOCATIONS

Golder Associates
Victoria, BC

PROJECT No. 09-1477-0012		SCALE AS SHOWN	REV. 0
DESIGN	DD	29 Mar. 2012	
GIS	CDB	29 Mar. 2012	
CHECK	DD	29 Mar. 2012	
REVIEW	RH	29 Mar. 2012	

FIGURE 4

N:\Cur-Graphics\Projects\2009\1477\09-1477-0012\GIS\mapping\mxd\2012\figure5.mxd



LEGEND

- EXISTING BOREHOLES
- BOREHOLES CONTAINING SHELL
- BOREHOLES CONTAINING NATIVE SOIL
- BOREHOLES CONTAINING SHELL AND NATIVE SOIL
- POSITIVE SHOVEL TEST LOCATION
- NEGATIVE SHOVEL TEST LOCATION
- REBURIED ARTIFACT (Bastion 2010)
- 1939 SHORELINE
- CONTOUR LINE

- ARCHAEOLOGICAL SITE
- ERODING SHELL
- HBC BUILDINGS FROM 1858 NAUTICAL MAP (APPROXIMATE)
- PROJECT AREA
- SHELL MIDDEN

ARCHAEOLOGICAL POTENTIAL MODEL

- HIGH
- MODERATE
- LOW

REFERENCE

Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 10
Basemap source provided by PWGSC.

125 0 125
SCALE 1:5,000 METRES

PROJECT
PWGSC ESQUIMALT GRAVING DOCK
ARCHAEOLOGICAL OVERVIEW ASSESSMENT
ESQUIMALT B.C.

TITLE
ARCHAEOLOGICAL POTENTIAL MODEL

Golder Associates
Victoria, BC

PROJECT No. 09-1477-0012		SCALE AS SHOWN	REV. 0
DESIGN	DD	23 Mar. 2012	
GIS	CDB	23 Mar. 2012	
CHECK	DD	28 Mar. 2012	
REVIEW	BH	28 Mar. 2012	

FIGURE 5

APPENDIX A

Compilation of Archaeological Reports referenced in Archaeological Overview Assessment of the Esquimalt Graving Dock, Public Works and Government Services Canada, Esquimalt, BC

Golder Associates

GOLDER ASSOCIATES LTD. REPORTS

MILLENNIA RESEARCH LTD. REPORTS

THE BASTION GROUP HERITAGE CONSULTANTS REPORT

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

Africa	+ 27 11 254 4800
Asia	+ 852 2562 3658
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
2nd floor, 3795 Carey Road
Victoria, British Columbia, V8Z 6T8
Canada
T: +1 (250) 881 7372

Golder Associates

ESQUIMALT GRAVING DOCK

ESU SSSR

ESQUIMALT, BRITISH COLUMBIA

APPENDIX F

EGD STANDARDS FOR SURVEY

Esquimalt Graving Dock (EGD)
STANDARDS FOR SURVEYS

Revised 2012-02-28

1. INTRODUCTION

This standard is written to provide the British Columbia Land Surveyor (BCLS) a guideline for producing acceptable topographic survey for all EGD projects.

2. APPLICATION OF THE STANDARD

This standard applies to surveys that are intended to show new installation of structures, utilities and underground conduits including the existing structures, utilities and underground conduits in the vicinity of the project and as requested by EGD Representative.

The Surveyor in making topographic surveys uses accepted terrestrial and/or GPS surveying methods. Topographic surveys that additionally depict the location of property lines must also be in compliance with the current standard for property surveys and show all legal boundary evidence found.

3. DEFINITIONS

1) Benchmark (control point) is a relatively permanent material object, natural or artificial, bearing a marked point whose elevation above or below an adopted datum is known and whose horizontal coordinates are known in an accepted coordinate system (UTM NAD 83 CSRS Zone 10).
2) A Contour is an imaginary line on the ground, all points of which are of the same elevation above or below a specified datum.
3) The Parcel is the area designated by an EGD Representative and is usually, but not necessarily, given by a legal description of the property.
4) Utilities are services provided by governmental and private entities that provide the following: electric power, telephone, water, sanitary and storm sewer, gas, etc.
5) Acronyms and Definitions:
    - BCLS: British Columbia Land Surveyor
    - EGD: Esquimalt Graving Dock
    - NEZ: Northing, Easting, Elevation – Coordinates
    - PBM: Permanent Benchmark (Control point)
    - TBM: Temporary Benchmark (Control point)
    - Headwall: concrete wall structure on top of or on each side of culvert.

4. RESEARCH AND INVESTIGATION

1) The Surveyor shall acquire the elevation and datum of all benchmarks to be used in the survey. The elevation used shall be based on a nationally accepted datum whenever practical or unless otherwise instructed by an EGD Representative. The EGD Representative shall specifically describe the parcel to be surveyed.
2) At least four (4) benchmarks shall be established using Global Positioning System and electronic survey total stations, in which the position of all survey works and detected objects shall relate.
3) The benchmarks shall be established on stable ground within 6 m (20 ft) adjacent to the project site or as directed by EGD Representative. The benchmarks shall have reference numbers, coordinates and heights above the established datum (geodetic and/or chart datum).

5. THE SURVEY

The survey shall be performed on the ground to obtain the information required in this standard and any additional information requested by EGD. The Surveyor shall select the equipment and procedures necessary to obtain the horizontal and vertical positional accuracy required by these standards.

6. DATA

The surveyor shall locate and show on the survey map the following information:

1) The location of permanent structures including retaining walls and culverts.
2) The location of street or road paving, entrances, driveway openings and sidewalks.
3) Elevations on the top of curbs, gutters and sidewalks.
4) EGD building numbers assigned to the parcel.
5) North arrow and scale of drawing.
6) Legend depicting the symbols and abbreviations used on the drawing.
7) Provide buildings footing corners, exterior corners, roof line corners and main floor elevations of all required building listed in Appendix A.
8) Location and elevation of existing structures, utilities, underground conduits or drainage courses on or near the surveyed parcel.

9) Schedule of all benchmarks with the reference numbers coordinates (UTM NAD83 CSRS Zone 10) and heights above the established datum (geodetic and/or chart). Description and location of the benchmarks shall also be submitted.

10) Original copy of the survey field logbooks or electronic logbook printouts data duly endorsed by the British Columbia Land Surveyor. All survey data from field logbooks or electronic notebooks shall include and clearly indicate corrections or errors done during surveying work.

11) Certificates showing that the surveying equipment used have been calibrated in the last twelve (12) months shall also be attached. These certificates shall also be submitted prior to start of work.

12) The surveyor map grid coordinate system shall be based on NAD 83 (North American Datum) UTM Zone 10.

13) Levels related to established datum (geodetic and/or chart).

14) All other items listed in **Appendix A**.

7. POSITIONAL ACCURACY

The following relative positional accuracies are provided as a guide for surveys.

	Vertical Positional Accuracy Feet	**Horizontal Positional Accuracy Feet**
Contour line 300 mm (1') interval	± 200 mm (0.65 ft)	± 300 mm (1 ft)
Contour line 600 mm (2') interval	± 400 mm (1.30 ft)	± 600 mm (2 ft)
Contour line 1.2 m (4') interval	± 800 mm (2.60 ft)	± 1.200 m (4 ft)
Contour line 1.5 m (5') interval	± 1.000 m (3.20 ft)	± 1.200 m (4 ft)
Contour line 3.0 m (10') interval	± 2.000 m (6.50 ft)	± 2.400 m (8 ft)
Floor elevations	± 10 mm (0.05 ft)	± 300 mm (1 ft)
Spot paving elevations	± 10 mm (0.05 ft)	± 300 mm (1 ft)
Spot ground elevations	± 50 mm (0.20 ft)	± 600 mm (2 ft)
Sewer invert elevations	± 10 mm (0.05ft)	± 300 mm (1 ft)
Underground utilities/conduits	± 10 mm (0.05ft)	± 300 mm (1 ft)
All underground services/structure	± 10 mm (0.05ft)	± 300 mm (1 ft)

Positional Accuracy is given at the 95 percent confidence level.

8. ELECTRONIC DATA DISTRIBUTION

Surveyor to provide the survey data in an AutoCAD 2012 or 2010 .dwg drawing file. The surveyor shall also provide a signed and sealed hard copy drawing. This drawing shall be the official map and shall be deemed to be correct and superior to the electronic data.

The electronic data file shall also contain a statement that the file is not a certified document and that the official document was issued and sealed by (*name and commission number of the BCLS*) on (*date*). Surveyor to also provide a table of the survey points data (NEZ) in electronic format (MS Excel, MS Word or PDF).

Esquimalt Graving Dock (EGD)
STANDARDS FOR SURVEYS

Appendix A - ITEMS TO BE INCLUDED IN SURVEY

Revised 2012-02-28

The following items marked with an **(X)** are to be included in the survey:

( ) Boundary survey of the parcel.

( ) Plot the location of easements and rights-of-way as shown on the recorded subdivision subdivision plan and all easements evidenced by a recorded document provided by EGD. The plan or document number of each shall be shown.

( ) Vicinity map with subject property highlighted.

( ) Observable evidence of recent earth moving work, borrow or fill.

( ) Cross-section of offsite drainage courses for engineering studies.

( ) Spot elevations covering the entire survey limits showing high points, low points, grade changes, and at sufficient intervals to represent the general character of the terrain. Existing contours shall be drawn with major contour lines at 10m (25') intervals and minor contour lines at 2m (5') intervals unless otherwise noted.

( ) Elevations at the inside of walk, top of curb, and gutter at approximately one inch 3 cm (1") intervals at the final map scale.

( ) Dimensions of curb, sidewalk, and gutter lines or ditch lines and centerline of all streets, alleys or roads adjoining the parcel. Indicate type of paving surface and condition.

( ) Location, width and elevation at both ends of all existing sidewalks. Include a description of the kind and general condition of the sidewalk.

( ) Location, diameter, and species of all trees over 10 cm diameter.

( ) Perimeter outline only of thickly wooded areas unless otherwise directed.

Esquimalt Graving Dock (EGD)
STANDARDS FOR SURVEYS

Appendix A - ITEMS TO BE INCLUDED IN SURVEY

Revised 2012-02-28

( ) Electric utilities – the location of:

- ( ) power poles – 1 point at ground elevation
- ( ) power poles – 1 point at top of pole elevation
- ( ) guy wires – 1 points
- ( ) anchors – 1 points
- ( ) Rectangular junction/pull boxes – 4 corners
- ( ) Round junction/pull boxes – cover center
- ( ) Underground conduits – all tie-ins (existing or new) and change of directions
- ( ) vaults – 4 corners

( ) Storm, sanitary or combined sewers – the location of:

- ( ) manholes – cover center
- ( ) culverts – 2 centreline measurements to show direction of flow
- ( ) headwalls – 4 corners
- ( ) catch basins – 4 corners + 1 centre measurement at gutter line
- ( ) clean-outs – center point
- ( ) Include elevations of the top and bottom of manholes, culverts, headwall and catch basins.
- ( ) Show type, size, and direction of flow and invert elevation of all pipes or culverts.

( ) Water – the location of:

- ( ) all water valves – center point
- ( ) standpipes – center point
- ( ) regulators – center point
- ( ) fire hydrants – 1 point at ground elevation
- ( ) fire hydrants – 1 point at top of hydrant elevation

( ) Gas – the location of:

- ( ) all valves – center point
- ( ) meters – center point
- ( ) gas line markers – center point
- ( ) Show elevation on top of any valves.

Esquimalt Graving Dock (EGD)
STANDARDS FOR SURVEYS

Appendix A - ITEMS TO BE INCLUDED IN SURVEY

Revised 2012-02-28

( ) Telephone – the location of:

- ( ) all poles – 1 point at ground elevation
- ( ) all poles – 1 point at top of pole elevation
- ( ) manholes – center point
- ( ) Rectangular junction/pull boxes – 2 opposite corners
- ( ) Round junction/pull boxes – cover center

( ) Street/Roads – the location of:

- ( ) all lamp poles – 1 point at ground elevation
- ( ) all lamp poles – 1 point at top of pole elevation
- ( ) Rectangular junction/pull boxes – 4 corners
- ( ) Round junction/pull boxes – cover center
- ( ) road cross-section: Survey spot levels along cross-sections at maximum 5m (15') intervals up to 30m (100') beyond the edges of the road shoulder. The interval of the spot levels shall be varied based on the condition at site. If required, closer spacing shall be surveyed where the terrain is not uniform such as deep gullies and creek areas.

( ) Heating – the location of:

- ( ) steam manholes – center point
- ( ) vaults – 4 corners

( ) Location and dimensions of:

- ( ) tanks – 2 opposite corners minimum
- ( ) fences – corners/gates + changes of direction
- ( ) fences cross-section: Survey spot levels along cross-sections at maximum 5m (15') intervals up to 30m (100') beyond the edges of the fences lines. The interval of the spot levels shall be varied based on the condition at site. If required, closer spacing shall be surveyed where the terrain is not uniform such as deep gullies and creek areas.
- ( ) obstructions – 2 opposite corners minimum

Esquimalt Graving Dock (EGD)
STANDARDS FOR SURVEYS

Appendix A - ITEMS TO BE INCLUDED IN SURVEY

Revised 2012-02-28

( ) Existing buildings – the location of:

- ( ) _____
- ( ) _____
- ( ) _____
- ( ) _____
- ( ) _____
- ( ) _____

( ) Location and description of any building or major structure on adjoining land that is not more than _____ feet outside the parcel being surveyed.

( ) Other – the location of:

- ( ) _____
- ( ) _____
- ( ) _____
- ( ) _____
- ( ) _____
- ( ) _____
- ( ) _____
- ( ) _____
- ( ) _____
- ( ) _____
- ( ) _____
- ( ) _____
- ( ) _____
- ( ) _____

ESQUIMALT GRAVING DOCK

ESU SSSR

ESQUIMALT, BRITISH COLUMBIA

APPENDIX G

SCHEDULE OF DOCK CHARGES

Annex 1 – tariff of dock charges

(Sections 2, 4, 5, 8, 17, 20, 33, 34, and 38)

▼ Table summary

This table shows the rates related to services and facilities for the Esquimalt Graving Dock

Article	Services and facilities		April 1, 2016
1	Booking		$5,307.46
2	Draining, per section		$5,307.46
3	Berthage, per metre, per day		$6.20
4	**Rail mounted crane, per hour**	**(*a*) with light hook**	$487.30
		(*b*) with main hook, up to 50 tonne lift	$703.87
		(*c*) with main hook, over 50 tonne lift	$1,082.90
5	**Mobile crane, per hour**	**(*a*) 9-tonne crane**	$135.36
		(*b*) 20-tonne crane	$173.26
		***(c)* 30-tonne crane**	$211.17
		***(d)* Forklift**	$102.88
		***(e)* Tower crane**	$173.26
6	Air compressor (first), per manifold hour		$119.12
7	Air compressor (second), per manifold hour		$113.70
8	Air compressor (wheeled), per manifold hour		$59.56
9	Motorized vessel, per hour		$196.88
10	Fresh water, per cubic metre		$1.36
11	Electric power, per kilowatt hour		$0.16
12	Tie-up or letting go		$861.39
13	Overtime labour services, dry-dock employee, per hour		$106.32
14	Security services, per vessel, per day		$487.30
15	Dockage, 1 section, per day		$3,184.47
16	Dockage, 2 sections, per day		$10,614.91
17	Dockage, 3 sections, per day		$14,860.87
18	Dockage per ton, per day: under 5,000 gross tonnage		$0.00
19	Dockage per ton, per day: 5,000-34,999 gross tonnage		$0.12
20	Dockage per ton, per day: 35,000-69,999 gross tonnage		$0.11

21	Dockage per ton, per day: 70,000-89,999 gross tonnage	$0.10
22	Dockage per ton, per day: over 89,999 gross tonnage	$0.09
23	Sewer Discharge, per litre	$0.01
24	Vacuum loader	$70.38

Date modified: 2015-09-29

Esquimalt Graving Dock

Environmental Best Management Practices

Prepared By:
Public Works and Government Services Canada
Environmental Services

Date: October 6, 2010
Version: 04

Table of Contents

Overview

The **Esquimalt Graving Dock (EGD)** is a federal-government-operated, multi-user ship repair and maintenance facility located in Esquimalt, British Columbia. The facility has been in operation since 1925, and provides service to local, Federal, and international vessels. The vessel repair and maintenance work at the EGD is carried out by privately owned shipyards that rent the required sections of the drydock and lease upland work space from the government, and pay a fee for services such as cranes, compressed air, water and power.

Industrial ship maintenance and repair operations have the potential to result in significant environmental issues and impacts. To help identify and manage these potential impacts, the EGD has implemented an **Environmental Management System (EMS)** certified under the internationally recognized standard **ISO 14001**. The EMS provides the framework for identifying potential impacts, and ensures adequate controls are in place to effectively manage them.

This manual contains a series of recommended **Environmental Best Management Practices (EBMPs)** to reduce potential environmental impacts of common activities and operations at the Esquimalt Graving Dock. The manual contains guidance for those operating at the EGD, and is intended to complement existing environmental legislation. It does not remove the responsibility of all contractors and companies operating at the facility to abide by all applicable regulatory requirements and industry standards. All users of the facility are expected to follow the EBMPs.

For further information on environmental rules and standards contact the EGD Environmental Department.

Environmental Policy

It is the goal of the Esquimalt Graving Dock, in partnership with the ship repair industry, to be the premier ship repair, construction and maintenance facility on the west coast of North America.

The Esquimalt Graving Dock and its Users realize that environmental management is an integral part of attaining that goal. Through the implementation of an ISO 14001 Environmental Management System, we are committed to managing the actual and potential environmental impacts of our operations.

To meet our commitment we will:

- *Protect the natural environment and prevent pollution.*
- *Meet or exceed applicable federal, provincial and municipal legislation and regulations; uphold departmental policies; and abide by industry standards, practices and other requirements related to our identified environmental aspects.*
- *Establish and review our programs, objectives and targets to ensure we are meeting our environmental commitments.*
- *Communicate openly with our employees, Users, tenants, contractors, suppliers, neighbours and other stakeholders regarding our Environmental Management System and the nature of our operations.*
- *Educate our employees and the Users of our facility to ensure they are aware of and understand their roles and responsibilities in protecting the environment.*
- *Meet the evolving needs and expectations of our industry and community through the continual improvement of our systems, programs and procedures.*

Bonnie MacKenzie	Jim Milne	David Latoski
Director General	Director	Operations Manager
Engineering Assets	Esquimalt Graving Dock	Esquimalt Graving Dock
Strategy Sector	Engineering Assets	Engineering Assets
	Strategy Sector	Strategy Sector

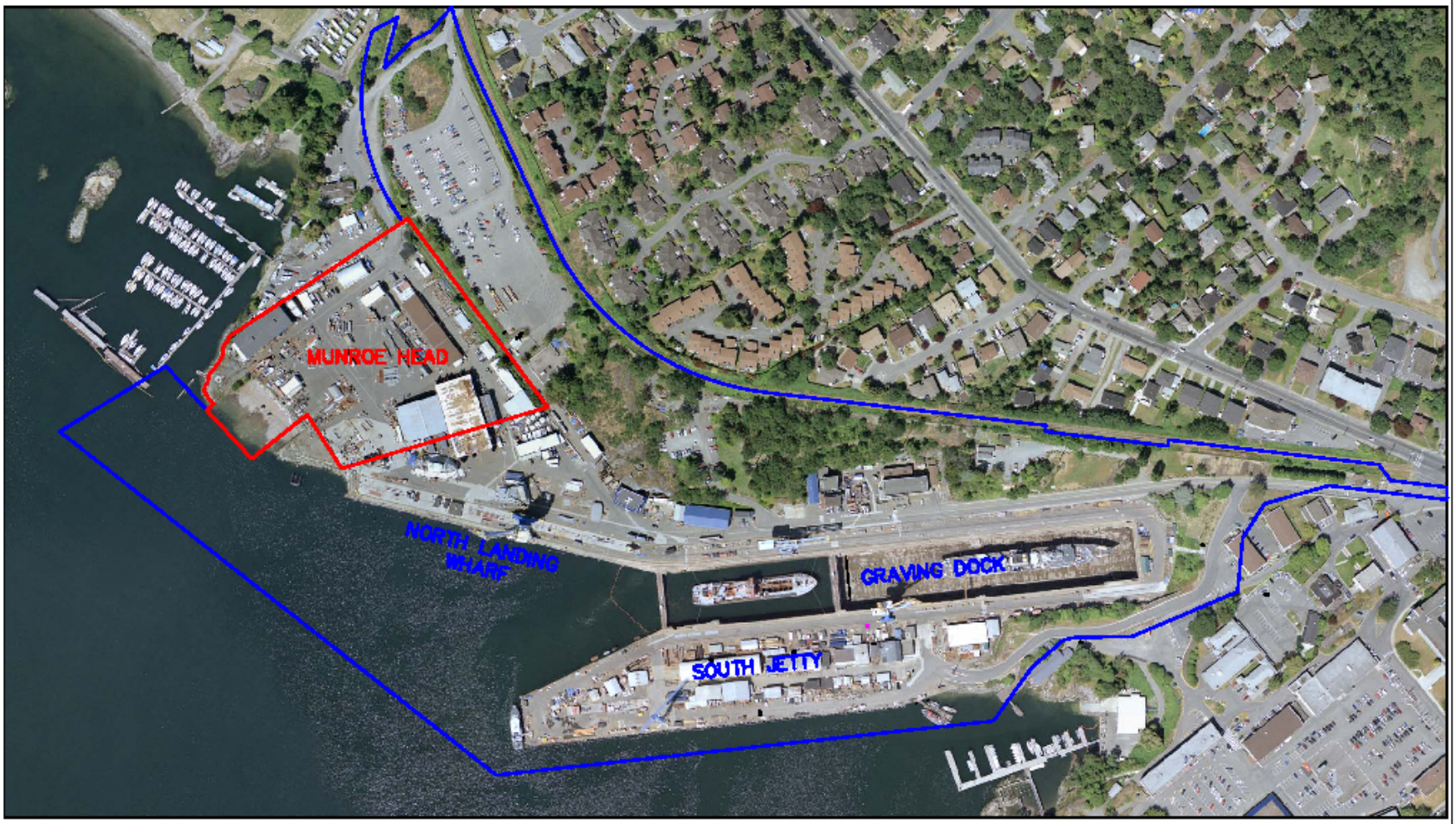
JULY 2009

Public Works and Government Services Canada | Travaux publics et Services gouvernementaux Canada

ISO 14001
EMS-011
CGSB

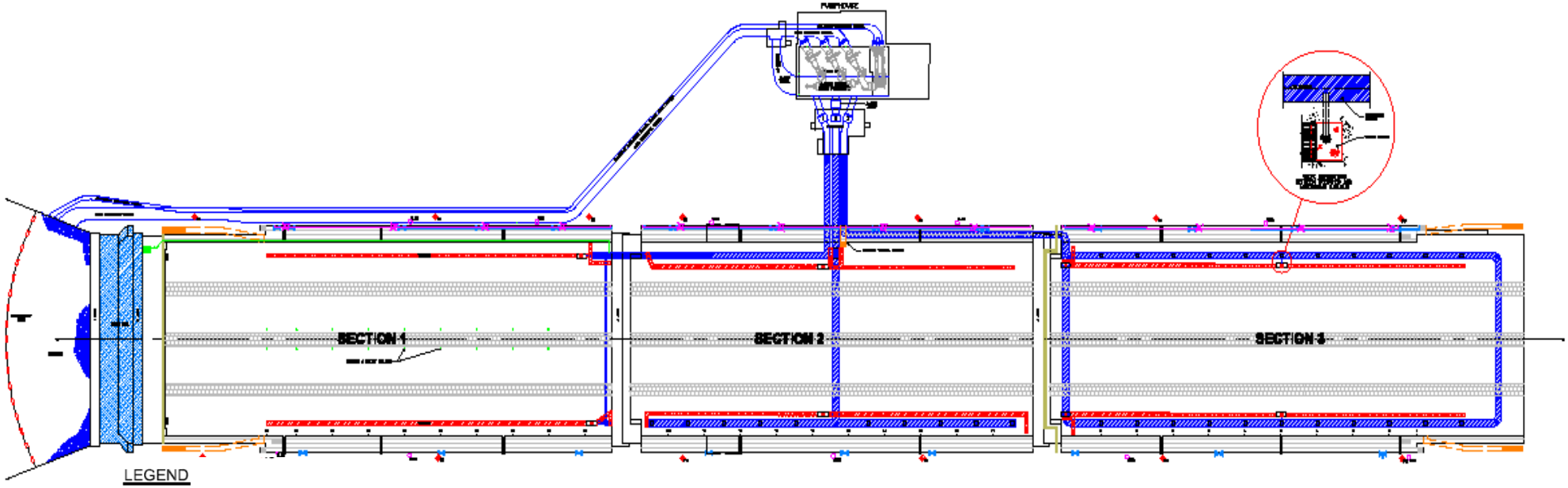
Canada

Esquimalt Graving Dock



ESQUIMALT GRAVING DOCK
DRAINAGE PLAN

Note: It is intended that this drawing be printed in colour.
If printed in black and white some detail will be lost.



LEGEND

LADDER	
STAIR	
FIRE ACCESS	
ELECTRICAL CONN.	
AIR CONNECTION	
WATER CONNECTION	
WATER PIPE	
TRENCH GRATE	
TUNNEL GRATE	
TUNNEL MANHOLE	
NET CAGE- MAIN TUNNEL ACCESS	
TRENCH DRAIN	
DE-WATERING TUNNEL	
SILL PUMP & PIPE	
MOON POOL	

ESQUIMALT GRAVING DOCK:
1178' (361.8m) LONG
128' (41.2m) WIDE
48.5' (16m) DEEP

THIS DRAWING IS NOT TO SCALE

BMP #1

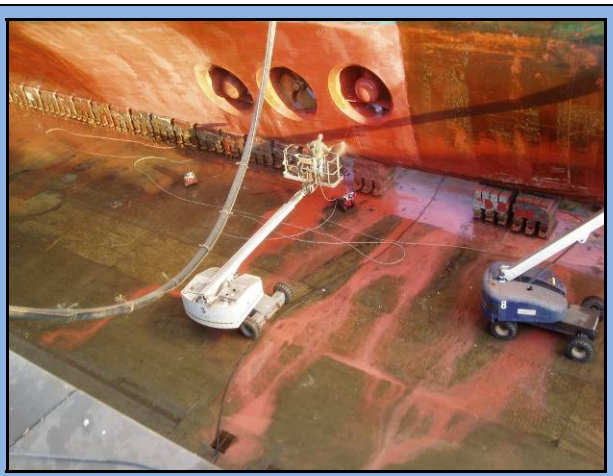
High Pressure/ Ultrahigh Pressure Washing

One of the first activities to occur on a dry-docked vessel is the high pressure washing of the vessel hull to remove salts and marine growth prior to surface preparation or painting. This typically involves pressure washing the hull and/or super structure with water at 2,000 – 3,500 psi, which may produce large volumes of paint contaminated wastewater. Shipyards may use an Ultra High Pressure (UHP) washing process (from 40,000 – 55,000 psi) to completely remove all paints, eliminating the need for further surface preparation prior to painting. This operation generates even larger volumes of wastewater and solids, which will need to be managed.

Management of Wastewater on the Graving Dock Floor

- Ensure all wastes and wastewater discharges resulting from hull washing activities are collected and disposed properly.
- Coordinate high pressure washing operations to ensure effective collection of wastewater.
- Close all sump well valves in the floor collection system prior to and during high pressure washing operations.
- Divert contaminated wastewater that falls outside of the dock floor containment area away from the tunnel drains.
- Direct non-contaminated water (i.e. ballast water, cooling water) away from contaminants on the dock floor.
- Collect and dispose of stormwater that comes into contact with contaminants.
- Do not use environmentally harmful detergents or additives in wash water.

All wastewater containing paint contaminants must be directed to the collection drains and sumps on the drydock floor, collected, and sent for treatment.



Antifoulant contaminated wash water entering the trench drain sump wells on dock bottom.

Section 1 Considerations – Caisson Leakage and Sediment

Diversion of sill water away from pressure washing areas
Water leaking into Section 1 of the graving dock from the caisson can be diverted from the work area by using a sump pump hooked to the PVC pipe installed along the north wall of the graving dock (Section 1).

Managing Entrained Sediment
Harbour sediment may become trapped in section 1, and accumulate in the corners, trenches and sumps. The users of the section will need to be aware of this. This sediment will have to be removed if it becomes contaminated with pressure washing wastewater, sandblast grit, paint chips, paint overspray, or other contaminants.

The sill diversion pump removes clean saltwater from the pool at the front of Section 1(moon pool) and discharges to the tunnel drains through a hard pipe on the dock wall.

Sediment from the harbour often settles on dock bottom after dewatering. This may become contaminated with paint, etc. and must be disposed of.

Ultra High Pressure (UHP) Washing

Ultra high pressure washing generates significant volumes of wastewater and sludge that may pose a challenge for collection and disposal.

- Prepare in advance for the management of the UHP waste.
- Remove all water, sludge and debris generated from UHP washing from the dock.
- Ensure the sludge is disposed of at an appropriately permitted facility.

The hull of a cruise ship being ultra high pressure washed. Inset: sludge produced during ultra high pressure washing.

Management of Small Vessel High Pressure Wastewater in the Upland Areas

- Perform pressure washing only in designated areas where wastewater management can be effectively achieved.
- Completely block off all drains prior to use for collecting wastewater from pressure washing.
- Ensure sufficient equipment is available for the timely collection and removal of wash water.
- Clean up work area and drains prior to removal of collection equipment. (i.e. filter cloth, plugs, tarps)

A small vessel is power washed on the North Landing Wharf (NLW).

The trench drain is blocked and a sump pump is installed to collect wash water into a tote.

Example of styrofoam blocks used as a drain blocker on the NLW.

Example of a pump set up used to collect wash water on the NLW.

BMP #2

Abrasive Blasting

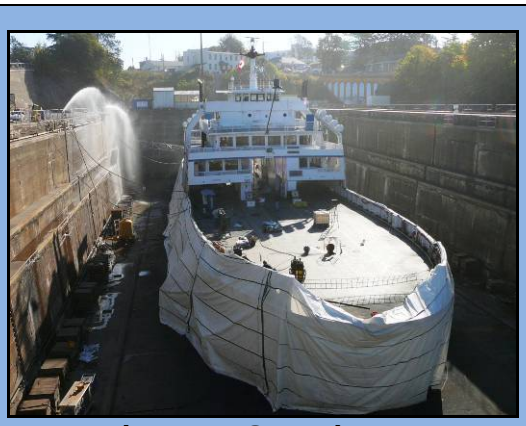
Abrasive blasting is a common operation performed at the Esquimalt Graving Dock (EGD) to prepare vessel surfaces for painting. However, this operation creates challenges with respect to controlling air emissions and the waste materials generated.

Fugitive emissions from blasting operations have the potential to negatively affect employees, facility users, neighbours, equipment and infrastructure. The dust from blasting may contain harmful environmental pollutants which may enter the harbour directly or via stormwater runoff.

Waste grit may be contaminated with antifouling paint which poses a risk to marine life if not handled properly.

Dust Control

- Cover all blast media (new and used) during transport.
- Use containment such as tarps, shrouds or portable structures to prevent airborne particles from entering the atmosphere and surface waters.
    - Containment should be large enough to adequately enclose or segregate the working area.
    - Ensure containment devices are connected so there are no gaps.
    - Ensure that containment reaches the dock floor or walls



Adequate Containment

Inadequate Containment

- Where physical containment techniques are not sufficient to prevent fugitive emissions water curtains may be used to mitigate dust emissions in problem areas.
- Do not abrasive blast during conditions that render containment ineffective (i.e. during windy conditions)
- Minimize dust emissions by ensuring blast nozzles are angled close to perpendicular and aimed slightly downward during blasting.
- No abrasive blasting of vessels shall be performed while vessels are docked at the North Landing Wharf or South Jetty

Air Quality Alarm

The Esquimalt Graving Dock has an onsite PM_{10} monitor in partnership with the Ministry of Environment.

If particulate matter levels in the air exceed 100µg/m^3 an alarm sounds in the Pumphouse, at which time corrective actions must be taken.

Waste Grit Management

- Remove waste grit from work areas as soon as possible.
- Store all waste grit in appropriate containers to prevent stormwater and wind impacts.
- Cover all skips, storage bins, tanks, and hoppers to prevent dust emissions.
- Dispose of waste grit in accordance with applicable provincial regulations.

Store all waste grit away from drains, to prevent contaminated water migrating into the marine environment.

Sweep waste grit under the vessel to prevent it from being washed down the drain.

Store waste grit in appropriate containers, protected from inclement weather.

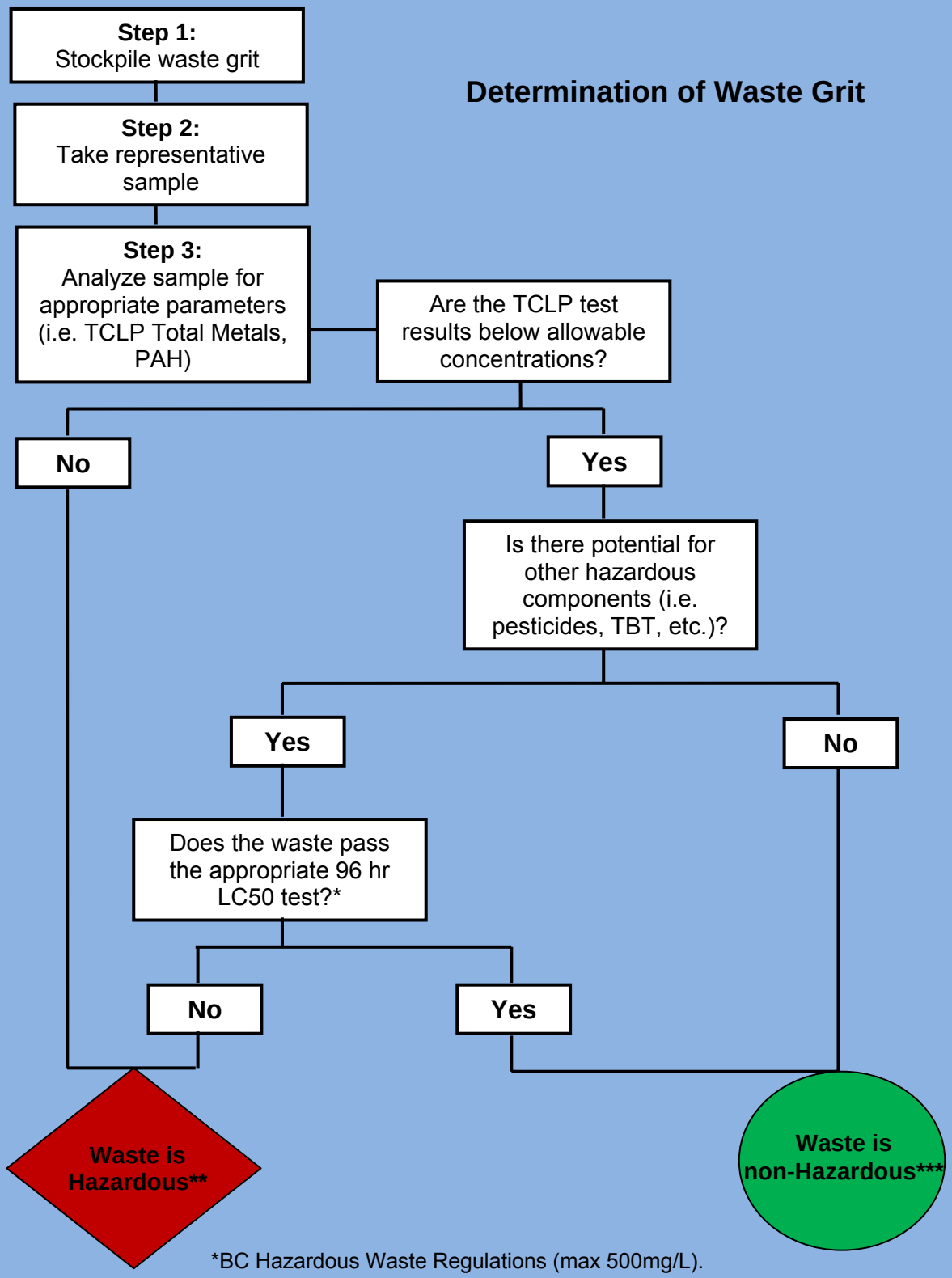
Remove waste grit from work areas as soon as possible.

Keel/Bilge Blocks

Keel and bilge blocks on dock bottom present a challenge for clean up of spent waste grit.

Excess blocks stored in dock bottom may be moved prior to sandblasting, or covered to prevent grit from collecting between the blocks.

Determination of Waste Grit



*BC Hazardous Waste Regulations (max 500mg/L).

**Waste must be disposed of at a permitted facility.

***non-Hazardous waste may be considered "Controlled" and must be disposed of at an approved facility.

BMP #3

Painting and Coating

Ship repair and maintenance often requires painting and coating of vessel surfaces to protect from corrosion or to inhibit growth of marine life. The industrial nature of marine paints, in particular antifouling paints, may result in negative impacts to the environment and surrounding infrastructure if not properly managed.

Paint Overspray

Paint overspray has the potential to impact the marine environment, soils, neighbouring residences, and nearby equipment and infrastructure.

- Use containment such as tarps, shrouds or portable structures to prevent airborne particles from entering the atmosphere and surface waters.
    - Containment should be large enough to adequately enclose or segregate the working area.
    - Ensure containment is secured so there are no gaps.
    - Ensure that containment reaches the dock floor or walls.

Adequate Containment

Inadequate Containment

- Do not spray paint during conditions that render containment ineffective (i.e. windy).
- Place containment beneath and around structures being painted on dock floor and in work areas to ensure overspray does not reach the surrounding area (i.e. during painting of anchor chains, grates, etc.).
- Manage overspray on the graving dock floor to prevent safety hazards (e.g. slippage).

For vessels docked in **Section 1** ensure that overspray does not reach the sill water. Avoid docking vessels so they extend over sill area.

Painting Dockside

- Do not spray paint vessels docked at the North Landing Wharf or South Jetty.
- Use rollers and brushes to paint vessels dockside
- Ensure tarps are in place below work areas, as well as in between the vessel and the dock to prevent spills and drips from entering the water.
- Ensure paint cans are stored securely when working alongside vessel edges.
- Ensure floor grates of manlifts are covered to prevent spills to the marine environment
- Waste generated from grinding and hand tooling must be prevented from entering the marine environment.

Ensure tarps are in place to prevent overspray impacting the surrounding work area.

While painting vessels berthed at the North Landing Wharf and the South Jetty do not spray paint, and take measures to prevent paint from entering the marine environment.

Temporary Paint Storage/Mixing Areas

- Must be under cover to protect from inclement weather
- Only in designated areas
- Must be on secondary containment (a tarp at minimum)
- Ensure empty paint cans and other associated wastes from painting are stored properly, protected from the weather, and removed from dock bottom as soon as possible.

In **rare** situations (i.e. shape of the vessel combined with ideal weather conditions) containment may not be necessary to prevent overspray from escaping the area.

In this situation, the User must notify PWGSC **prior** to beginning the work, and obtain approval, **in writing**, to paint without completely enclosing the vessel. Restrictions and monitoring requirements will be applied.

To this date this has only been allowed in three situations:

- painting underneath a flat bottom barge
- painting the underwater hull portion of the midsection of a cruise ship
- painting of a C-class ferry underwater hull area during calm wind conditions

BMP #4

Dry Dock Floor Management and Cleanup

Drain Management

- All sump well valves must be closed prior to and during power washing operations.
- Cover all tunnel drains and net cages during sandblasting, painting and power washing to prevent contaminants from entering the marine environment.
- In the case of a spill or release on dock bottom all sump well valves must be closed and all contaminated material contained and removed from dock bottom.
- Direct all contaminated water to the trench drain system, to avoid entering the tunnel drains.
- Collect and properly dispose of all contaminated water. Ensure sufficient equipment is available for contaminated water collection.
- Ensure all non-contaminated water is directed away from work areas and into the tunnel drain system. (i.e. ballast water, cooling water, caisson sill water).

Sediment Management

- Segregate any marine sediment which may enter the dock during vessel transfer from pollutants generated from vessel repair in order to reduce the amount of wastes requiring disposal.
- Collect and properly dispose of marine sediment that becomes contaminated with waste generated from vessel repair.
- Remove all contaminants and residues from the trench drains and sump wells prior to flooding at the end of work period.

Hazardous Materials Management

- Store hazardous materials (i.e. fuel, paint, waste oils) away from the drains on dock bottom.
- Store hazardous materials to the inside of the trench drains so that any spills or releases can be captured.
- Store hazardous materials in areas protected from the weather, water curtains and other water sources.
- Ensure adequate spill response equipment is in close proximity to hazardous material transfer operations. At a minimum one spill kit is required per section of the graving dock.

Housekeeping

- Remove waste sandblast grit from the work area as soon as possible to prevent migration of grit contaminants into tunnel drain system.
- Store wastes collected from the dock floor in appropriate secondary containment and removed from dock bottom as soon as possible.

Residual paint in the cans, may drip out of the skip and enter the marine environment through the drain systems.

Leaving garbage around the work site attracts wildlife such as seagulls, racoons, and rats.

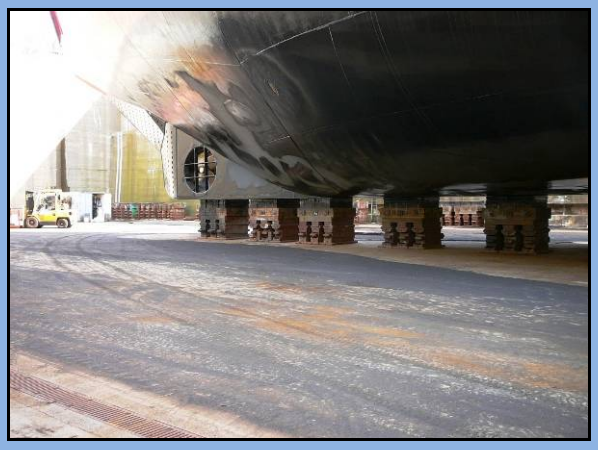
When cleaning dock bottom, skips of waste sandblast grit may leak contaminated water and should be removed as soon as possible.

All hazardous materials must be stored in appropriate containment and away from tunnel drain system.

Inspection and Cleanliness

- Prior to flooding, the drydock must be cleaned to meet the Esquimalt Graving Dock (EGD) Standard of Cleanliness, as determined by the EGD undocking supervisor.
- Users must ensure that the dock floor is free of deleterious substances prior to flooding.
- Water may be used to clean the dock floor; however, any wastewater generated must be collected and disposed of properly.
- If a vessel occupies a shared portion of a dock section each User must clean the trench drains up to and including the section sump well.

Example of a dock floor that would pass inspection.



Example of a dock floor that would not pass inspection.

EGD Standard of Cleanliness

Due to the importance of drydock cleanliness prior to flooding, and since quantitative testing is impractical due to time and cost restrictions, the following guidelines will be used to assess cleanliness of drydock surfaces.

- All drydock surfaces, including stairwells and sills must meet the standard for "**residue free**" prior to flooding of the drydock. **"Residue free"** is considered met when a person of normal visual acuity, while standing, is unable to detect visible accumulations of potential pollutants.

- This includes, but is not restricted to, the removal of abrasive grit, paint residues, cutting and grinding wastes, oil and grease, food and drink containers, ear plugs, dust masks, rope, cigarette packs, or any other refuse that may have been deposited during the work period.

- Debris of natural origin that may have been deposited during the previous flooding of the drydock, such as wood, sand, silt, seaweed, or marine life may be exempt from these requirements, as long as it will not contaminate the environment upon reintroduction.

Important Locations	Acceptable	Not Acceptable
Ramps		
Sills		
Keel Blocks		
Trench Drains		
Sump Wells		

BMP #5

Hazardous Materials Handling and Storage

A variety of materials are used, stored and transported by the Users at the Esquimalt Graving Dock (EGD). If not handled appropriately, these materials have the potential to negatively impact worker health and safety, infrastructure or the environment.

Long Term Storage

Users must have designated storage areas suitable for the materials they use on site. These areas must:

- Have appropriate secondary containment suitable to the quantity and nature of the material in that area
- Ensure materials are stored in accordance with compatibility requirements
- Be protected from the weather
- Have placards and ventilation (where applicable)
- Have controlled access

Short Term Storage and Working Areas

These areas must be:

- Clearly identified and labelled
- Located away from pathways to the marine environment
- Located on impervious surfaces (i.e. concrete, asphalt)
- Protected from the weather

Materials must be:

- Stored in containers appropriate for the nature of the material
- Labelled appropriately with product name, first aid information, and PPE requirements.
- Secured appropriately during transport

MSDS for all products stored on site must be available to all employees.

Empty containers must be labelled “Empty”.

Inspect all valves and storage containers for rust or damage before use.

Federal Regulation for Fuel Storage Tanks

As the EGD is a Federal facility, any storage tanks onsite may fall under the Petroleum and Allied Petroleum Products *Storage Tanks Regulations* (2008). Tenants may be required to register their tanks with Environment Canada.

National Fire Code

This code outlines the containment, labelling and location requirements for flammable liquid storage.

Areas to Avoid Storing Containers of Hazardous Materials

Drains: Although the trench drains provide the opportunity to collect accidentally released materials, if a tote or drum is placed directly over top or beside a drain the material will flow directly into it and the spill may not be noticed until it is too late.

Fire Holes: On the South Jetty the fire holes flow directly into the harbour. If any containers fail near the fire holes, the material will not be able to be recovered once it is in the harbour..

South Jetty and North Landing Wharf Edges: Any containers placed near the edge of the jetties have the potential to spill directly into the harbour as there are no berms or secondary containment available.

BMP #6

Waste Management and Recycling

Operations at the Esquimalt Graving Dock (EGD) generate a variety of waste streams including hazardous waste, international wastes, and general refuse and recyclables.

Hazardous Waste

Hazardous wastes generated at the EGD may include waste oil and oil filters, antifreeze, batteries, paint and solvents, oily rags and absorbent materials, spent grit, solids generated during power washing, and asbestos. Appropriate management of hazardous waste will reduce environmental liability associated with inappropriate disposal and storage as well as reduce the risk of human injury and environmental impact.

Hazardous waste storage shall be segregated from new product storage.

- Ensure designated storage areas are away from active work areas.
- Ensure areas are covered to reduce exposure to environment and wildlife.
- Ensure that waste accumulation areas are organized.

Hazardous waste should be segregated into separate containers.

- Ensure containers used are appropriate for the type of waste (i.e. separate drums for waste oil, oil filters, antifreeze, batteries, paint and solvents, oily rags and absorbent material, spent grit)
- Store batteries in a manner that prevents leakage of acid to the environment.
- Properly dispose of contaminated clean-up materials (i.e. absorbents, rags, etc.)
- Do not dilute or mix hazardous waste other hazardous or non-hazardous wastes.
- Cover waste containers to prevent exposure to weather (i.e. rain)

Clearly label all hazardous waste containers.

- Labels should Include: type of waste, generator/company name, and contact information

Asbestos

All asbestos containers and asbestos-containing materials must be identified by signage and labelling in accordance with applicable legislation.

Companies which engage in asbestos related work at the EGD must be qualified to do so.

Biological Waste

Marine life removed from vessel hulls may contain paint contaminants. This waste may be considered a controlled or hazardous waste and would need to be handled and disposed of accordingly.

Recycling

All Users of the EGD are responsible for collecting and disposing of the solid waste they generate from their activities, properties and vessels they are responsible for.

- Recycle solid waste such as plastic, glass, aluminum, mixed paper and cardboard. Recycling areas should be conveniently located and easily identifiable.
- Segregate other solid waste, such as scrap metal, wood, electronics, polystyrene foam and soft plastics for recycling at an approved facility.
- Leaf and yard waste collected on property should be composted at designated sites located on dock property.
- Construction and demolition waste should be reused or recycled wherever cost effective and technically feasible.
- Encourage the use of recyclable products to reduce the solid waste impact on the environment.

International Waste

Like hazardous waste, International Wastes may pose a threat to human health and the environment.

Dunnage from vessels has been known to carry invasive insects to local areas. Foreign dunnage must be identified, stored, and disposed of at an approved facility.

Food wastes may carry pathogenic organisms that could cause illness to those handling it. Food wastes shall be kept in separate, closed containers. The Canadian Food Inspection Agency (CFIA) will inspect foreign vessels and issue directions on disposal.

BMP #7

Fuelling and Oil Transfer

At the Esquimalt Graving Dock (EGD) the transfer of oil and fuel is a common activity. An accidental release during these operations has the potential to negatively impact the environment, and health and safety of those at the facility.

- Prior to any fuelling or oil transfer operations an emergency plan must be in place, adequate spill response equipment must be available, and employees aware of spill response procedures must be on hand.
- All transfer and storage equipment must be in good condition, tested, and properly connected.
- Do not place storage and transfer equipment near pathways to the marine environment (i.e. storm drains, edge of the dock).
- Berthed vessel fuelling operations involving trucks and barges as well as bulk oil transfers exceeding 10 tonnes (10,000 L) per day must comply with the **EGD Fuelling and Oil Transfer Policy and Checklist**.

Vessel Fuelling and Bulk Oil Transfer

Definition of Oil: as described in the Canada Shipping Act oil is considered petroleum in any form, including: crude oil, fuel oil, sludge, oil refuse, and refined products.

- All berthed vessels receiving fuel from a truck or a barge require a containment boom.
- Transfers of greater than 10 tonnes of oil per day to/from a berthed vessel require a containment boom.
- An **EGD Oil Transfer Checklist** must be filled out and signed by representatives from the truck and the vessel and submitted to EGD representatives in the pumphouse prior to fuelling or oil transfer operations.
- Transfer operations must comply with the *Canada Shipping Act*, *Regulations for the Prevention of Pollution from Ships and for Dangerous Chemicals Subdivision 5*.

Containment Boom Rental

The Esquimalt Graving Dock has a boom and deployment equipment available for rent. To arrange for booking or rental contact the EGD Operations Manager.

An orange containment boom surrounds the vessel while being fuelled

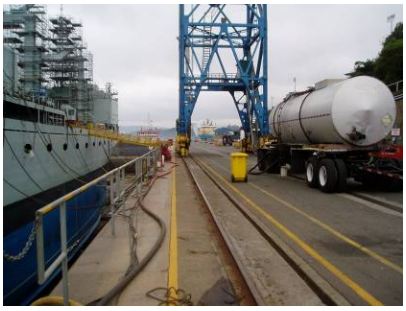
The EGD boom reel and containment boom

Example Scenario Requirements

Scenario 1: Fuelling a berthed vessel

- Completed and signed EGD Oil Transfer Checklist submitted to EGD Pumphouse
- Containment boom adequately secured at both ends.
- Emergency response plan in place.
- Adequate spill response equipment and qualified personnel available.

Scenario 2: Fuelling a vessel or bulk oil transfer (greater than 10 tonnes a day) in the drydock



- Completed and signed EGD Oil Transfer Checklist submitted to EGD Pumphouse.
- Pumphouse operator on site prepared to shut down auxiliary pumps in case of an emergency.
- Receiving containers located away from pathways to the harbour (i.e. tunnel drains).
- Adequate spill response equipment and qualified personnel available.
- Emergency response plan in place.

Scenario 3: Bulk oil transfer from berthed vessel (greater than 10 tonnes a day)

- Completed and signed EGD Oil Transfer Checklist submitted to EGD Pumphouse.
- Containment boom adequately secured at both ends.
- Receiving containers located away from pathways to the harbour (i.e. storm drains, edge of dock).
- Emergency response plan in place.
- Adequate spill response equipment and qualified personnel available.

Scenario 4: Onshore oil transfer between containers

- All containers located away from pathways to the harbour (i.e. storm drains, edge of dock).
- Emergency response plan in place.
- Adequate spill response equipment and qualified personnel available.

BMP #8

Invasive Species (Ballast Tanks and Hulls)

Invasive species are a significant threat to the marine ecosystems of British Columbia and Esquimalt Harbour. In 2000 a Fisheries and Oceans sponsored study of invasive species found that Esquimalt Harbour had a disproportionately high number of non-indigenous species. It has been widely recognized that the primary source of non-indigenous marine species in local waters are the ballast tanks and hull surfaces of transoceanic vessels.

Marine growth removed from vessel hulls must not be allowed to enter the harbour through the graving dock drainage system.

- Ballast Water
  - Vessels must follow Transport Canada Ballast Water Control and Management Regulations
- Ballast Tank Sediment
  - Shipyards must follow Transport Canada Ballast Water Control and Management Regulations
  - Sediments removed from the ballast tanks at the EGD must be contained, collected and disposed of at an authorized facility.
  - **Sediments must not be allowed to enter the harbour.**
- Anchor chain-growth
  - All biological material removed from anchor chains must be contained, collected and disposed of appropriately.
- Sea chests
  - All biological material removed from sea chests must be contained, collected and disposed of appropriately.

Sea chests such as this one from a cruise ship docked at the EGD often contain a significant amount of marine life. If not managed appropriately this marine life has the potential to negatively impact the local ecosystem of the harbour

BMP #9

Fish and Wildlife Management

The daily operations and activities of the Esquimalt Graving Dock (EGD) have the potential to negatively impact wildlife which frequents the property.

Fish

Fish and other marine life have the potential to become stranded in the graving dock during normal vessel docking/undocking operations. This may include, but is not limited to: salmon, octopus, other fish species, and seals.

- The bubble curtain must be employed during vessel transfer into and out of the graving dock.
- EGD employees must monitor the graving dock for stranded fish and/or other marine life during dewatering.
- Whenever possible, EGD employees must retrieve fish and marine life and safely return them to the Esquimalt Harbour.
- Users are prohibited from removing fish and marine life from the graving dock.

Report all instances of fish and marine life interaction with the Graving Dock to EGD Environmental Services

Authorization for the Destruction of Fish (Section 32)

The EGD has received authorization for the destruction of fish associated with normal operation of the graving dock from the Department of Fisheries and Oceans.

Conditions of the Authorization:

- Take all reasonable precautions to prevent the trapping and mortality of fish
- Monitor the success of preventative measures and retrieval success
- Report to the DFO annually

Wildlife

A variety of wildlife is known to occupy areas of the EGD property. In some cases wildlife may use the facility as a nesting/breeding ground, while others are present for short periods of time to pass to another location or to feed. Activities and operations at the EGD have the potential to impact the well being of wildlife at the facility.

Such wildlife includes: deer, raccoon, mink, river otter, great blue heron, osprey, raven, cormorants and a variety of other common nesting and song birds.

- All wildlife must be left alone
- Injured or orphaned wildlife must not be handled without proper experience and equipment.
- Dispose of dead wildlife appropriately.
- Prior approval from EGD Environmental Services is required for the relocation or removal of nesting wildlife.

In all cases, call EGD Environmental Services for wildlife related incidents

EGD Wildlife Management Plan Contact Information

Conservation Officer
T: (250) 391-2225 (daytime)
1-800-663-9453 (after hours call centre-will take messages and pass along to the Conservation Officer)

BC SPCA Wild ARC
(Animal Rehabilitation Centre)
T: (250) 478-9453

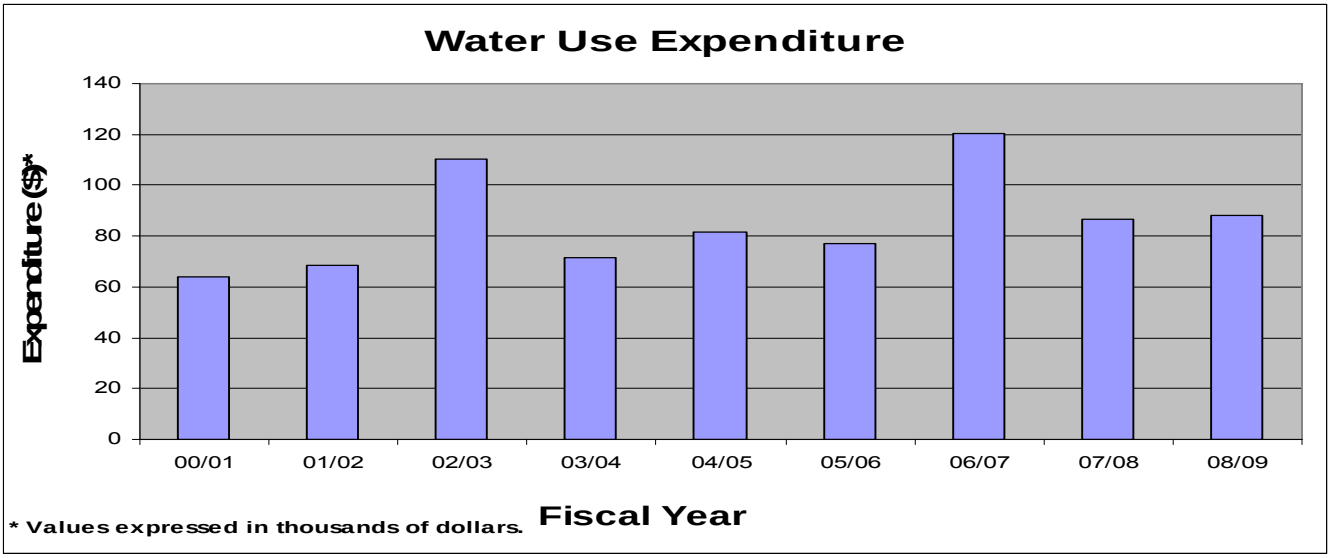
Vancouver Aquarium Rehabilitation/Rescue
T: (604) 258-7325

Water Use

Water consumption and the quality of water are considerations of the environmental management system at the Esquimalt Graving Dock (EGD).

Water Consumption

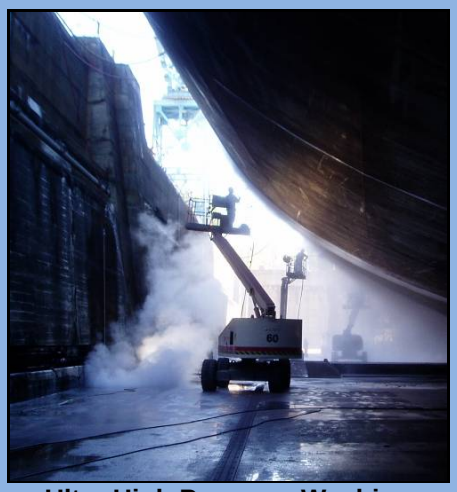
Large volumes of water are used during normal operations at the facility; because of this the EGD is considered a high volume user of fresh water in the Capital Region.



Significant Water Consuming Activities

Water Curtains

Water curtains are used to mitigate the escape of dust from sandblasting operations in dock bottom



Ultra High Pressure Washing

Ultra high pressure washing uses large amounts of water at high pressure to scour paint and biological material from the hulls of ships

In order to reduce the amount of water consumed onsite:

- Only use water curtains when all other attempts to contain particulate emissions from sandblasting have failed.
- Avoid use of freshwater to clean work areas (e.g. graving dock bottom, wharves, jetties).
- Maintain fittings in buildings and on equipment to prevent leakages.

Metered Water Use at the Esquimalt Graving Dock

- Users must ensure that water is accessed from a metered line when connecting to the water distribution system

- Portable meters are to be used where necessary.
- Pumphouse must be contacted for proper access to the water distribution system.

The EGD maintains the water distribution system.

- Flushing of the entire system is conducted on an annual basis.
- Collection and analysis of water in comparison to drinking water quality guidelines is conducted regularly.

The water distribution system at the EGD was originally designed as a firefighting system; therefore, the water in certain areas of the system may not be considered potable.

- Users are responsible for ensuring that the water they use meets guidelines for the purpose intended.

BMP #11

Energy Conservation

The Esquimalt Graving Dock (EGD), as a facility, is a major energy consumer. Inefficient energy use may result in a negative economical and environmental impact. Economical impacts are associated with inefficient electrical usage (i.e. cost). Environmental impacts include those associated with the consumption of fuel (i.e. air emissions).

Electrical Consumption

There are a number of opportunities to increase the efficiency of electrical usage at the EGD:

- Turn off lights when not in use (flood lights, office buildings)
- Turn off equipment when not in use
- Use energy efficient equipment whenever possible
- Stagger equipment start-up to decrease load on electrical system

Fuel Consumption and Emissions

The second largest source of greenhouse gas emissions from the dock is employee commuting and fuel consumption. Some opportunities to decrease the amount of fuel consumed by day to day activities are:

- Use energy efficient vehicles
- Use alternative fuels/energy sources if possible
- Avoid idling vehicles
- Use shore power whenever possible
- Encourage staff to find alternative means for commuting to work (i.e. carpool, public transit, cycling)

Idling Vehicles

Idling Vehicles produce unnecessary air emissions and noise.

- Do not idle vehicles near building doorways or air intakes
- Vehicles must be turned off if idling for more than 3 minutes in a 60 minute period

Greenhouse Gas Emissions:

Energy consumption results in the production and release of greenhouse gas emissions through the combustion of fossil fuels. Every aspect of work at the EGD results in the release of greenhouse gases whether it is running the cranes or printing a report. It is important to minimize energy consumption wherever possible to mitigate the release of harmful greenhouse gases.

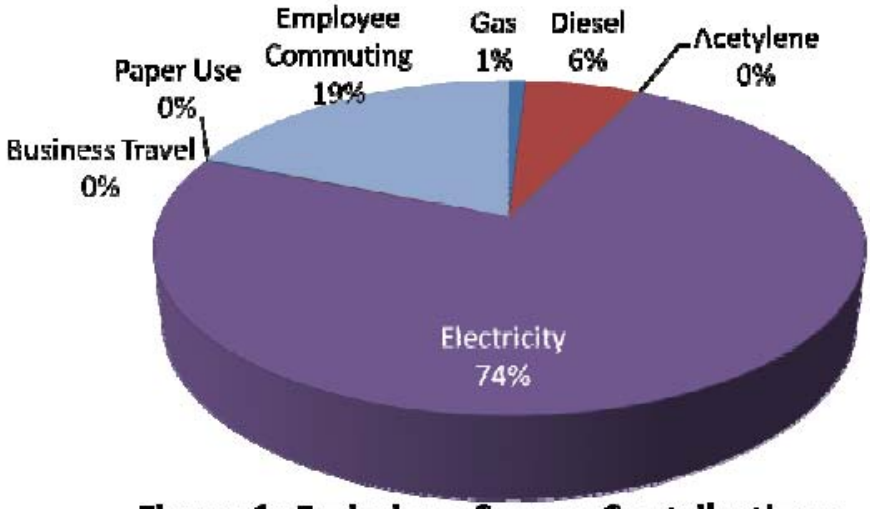


Figure 1: Emissions Source Contributions 2006/2007

The Royal Roads University (RRU) Greenhouse Gas Audit determined that the largest source of carbon emissions at the EGD was electricity use. Employee commuting was the second largest greenhouse gas producer.

Shore Power

When vessels are moored at the North Landing Wharf or the South Jetty it is important that they utilize shore power. With shore power the generator can be turned off thereby saving fuel and preventing the release of harmful air pollutants.

BMP #12

Nusiance Pollution (Noise/Odour/Light)

The daily operations of the Esquimalt Graving Dock (EGD) tenants have the potential to negatively impact the work and living environment of neighbouring businesses and homes. Nuisance pollution is often created by noise, odour and light.

Noise

- The main sources of noise at the EGD include sandblasting, drilling, hammering, compressors, generators and the crane warning bell. Even general shop repair activities generate large amounts of noise.

- Whenever possible schedule noisy activities for daytime hours 0700 hrs to 2300 hrs on weekdays, and from 0700 hrs to 1900 hrs on weekends and holidays. Through worker education and good practice the generation of high-level intermittent or non-continuous noises can be minimized.
- The EGD Environmental Policy makes a commitment to follow all applicable municipal laws and regulations, therefore it is expected that the daily operations at the EGD will meet the Esquimalt Noise Control Bylaw (2677).

The EGD is considered an “Activity Zone” and the neighbouring area is considered a “Quiet Zone”. Building and infrastructure related projects at the EGD may fall under the definition of a “Construction Zone” as per the Esquimalt Noise Control Bylaw.

Esquimalt Noise Control Bylaw		Noise Receiver Zone	
		Quiet	
		Day	Night
Noise Source Zone	Activity	60 dBA	55 dBA

Construction Zone

Building and infrastructure related projects at the EGD may fall under the definition of a “Construction Zone” as per the Esquimalt Noise Control Bylaw. The definition of a construction zone according to the Esquimalt Noise Control Bylaw is:

a) the erection, alteration, repair, relocation, dismantling, demolition and removal of a building;
b) structural maintenance, power-washing, painting, land clearing, earth moving, grading excavating, the laying of pipe and conduit, concrete placement, and the installation, or removal of construction equipment, components and materials in any form or for any purpose;
c) any work being done in connection with any of the work listed in paragraphs (a) or (b);

The noise level limit for a “Construction Zone” is **85 dBA** day and night.

Odour

- Daily dock operations often create strong and unpleasant odours whether from the release of VOCs, H_2S, organic materials, or chemicals an offensive smell can reduce the quality of the work environment for neighbouring tenants and home owners.
- In the event that odours are negatively affecting other tenants or stakeholders odour mitigating measures may be required.
- Contact EGD Environmental Services in the event of a nuisance odour from an unknown source.

H_2S Meter

The EGD utilizes an H_2S meter to ensure that any emissions released from the sanitary sewer system that create nuisance odours are not hazardous to adjacent work areas.

Light

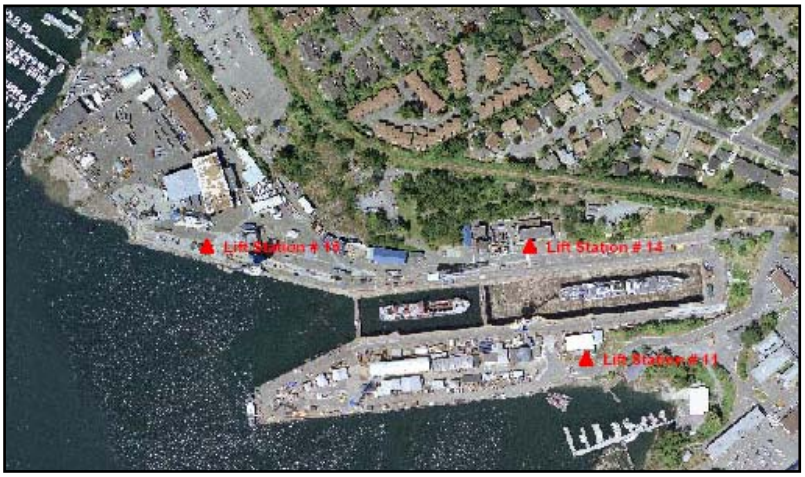
- Night time dock operations require spotlights to provide a safe work environment. However for residential neighbours strong spotlights can be a significant intrusion.
- Utilizing spotlights only when absolutely necessary will help prevent disturbing the neighbours as well as provide a more energy efficient work environment.
- Changing the direction of the lights may reduce the effect they have on the neighbours.
- Turn off or report to your supervisor any unnecessary lights left on.

BMP #13

Sanitary Waste Management and Sewer Use

The Esquimalt Graving Dock is authorized by the Capital Regional District (CRD) as a ship and boat waste disposal facility.

Discharge to the sanitary sewer at any location other than at the LS#15, LS#11 or the four vessel connections at the Graving Dock is prohibited.



The EGD is authorized to discharge to the sanitary sewer at the:

- Lift Station #15 (LS#15),
- Lift Station #11 (LS#11) and
- And the four vessel connections in the graving dock.

Permitted wastes include:

- sanitary waste
- grey water
- treated superchlorinated water*

Prohibited wastes include:

- bilge and ballast water
- wastewater sludge
- fuel and oil, paint, paint thinner, solvents, and products containing toxic chemicals

***Superchlorinated Water:** must not be discharged to the sanitary sewer unless it has been dechlorinated to less than 5 ppm chlorine.

- Users must notify the Pumphouse before conducting any discharges to the sanitary sewer. Typical methods of discharge are: large (connection to a vessel), and small (portable discharges from totes).
- Users must complete a Sanitary Sewage Discharge Form and provide it to the Pumphouse prior to discharging to the sanitary sewer.
- Pumphouse Operators will ensure that sanitary sewer discharges are in accordance with applicable regulations and authorizations.
- Pumphouse Operators will provide all completed Sanitary Sewer Discharge Forms to EGD Environmental Services, who will submit quarterly reports to the CRD.
- Users must ensure a sample collection point is accessible at the point of discharge.

BMP #14

Spill Preparedness and Response

The Esquimalt Graving Dock (EGD) is committed to the protection of human health and the environment. Safety and environmental management programs have been implemented at the EGD to reduce the potential for accidents and spills. Emphasis is placed on the prevention of spills, and although the potential for spills can be reduced through these programs, spills do happen.

All Users operating at the EGD must have the capability to effectively manage spills resulting from their activities and operations.

- User employees must have adequate training in spill response
- User employees must have access to appropriate spill response equipment and materials
- Users must have plans and procedures in place to respond to spills

For spills which are beyond the capability of the User or are not being effectively responded to by the User, the EGD will provide assistance. The EGD has additional resources available, including:

- Spill kits and response materials for land and water based spills
- Spill response boom, deployment reels and boat
- Staff trained to deal with land and water based spills

For access to the EGD spill response resources, contact EGD Management or Commissionaires.

For spills beyond the capability of the facility to manage, the DND, Port Operations and Emergency Services Branch (DND POESB) will provide support for response to land and water based spills.

ALL Spills Must Be Reported to EGD Management

Trench Drains: The EGD has installed trench drains throughout the site. These drains are easily accessible and allow for rapid containment and recovery of materials spilled on the property or in the drydock.

Environmental Emergency Contacts (24 Hours):

EGD Commissionaires	250-363-3784
Provincial Emergency Program (PEP)	1-800-663-3456
DND POESB/QHM	250-363-2160 or VHF Channel 10
Canadian Coast Guard	1- 800-889-8852 or VHF Channel 12
Environment Canada	604-666-6100

BMP #15

In-water Hull Cleaning and Maintenance

The cleaning of the underwater hull in water has the potential to release harmful contaminants into the marine environment.

In-water Hull Cleaning

- In-water hull cleaning of vessel hulls that are coated with antifouling paint is prohibited at the Esquimalt Graving Dock.
- Vessels coated in non-biocide containing paints (such as silicone based), may be considered on a case by case basis and must be approved by EGD Management prior to the commencement of hull cleaning activities.

Did you know?

Antifouling paints and their residues contain heavy metals, such as copper, that are toxic to aquatic organisms, including salmon and shellfish. Wash water and solid residues from the washing, scraping, sanding, and blasting of antifouling paints from boat hulls are considered "deleterious substances" under the *Fisheries Act*. Releasing these wastes to fish bearing waters is a violation of the Act.

Vessel berthed at the North Landing Wharf for in-water hull washing. In-water hull washing must not release antifouling paint. Discoloured water is an indication that you may be harming the environment.

In-water Hull Maintenance

- Users must receive approval from EGD Management prior to commencement of hull maintenance.
- Cleaning of the anodes, inlets, props, transducers, etc.
- Underwater maintenance required for operational and inspection purposes is permitted at the Esquimalt Graving Dock.

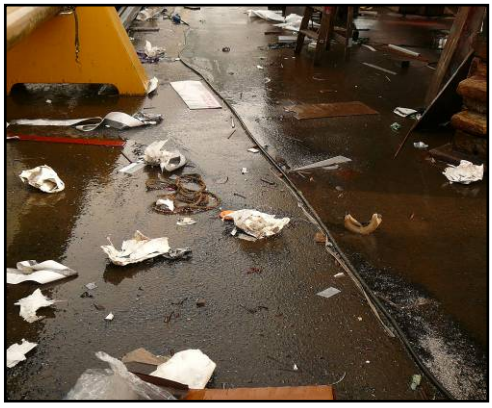
For inquiries regarding in-water hull washing please contact the Esquimalt Graving Dock Management at (250) 363-8056

BMP #16

Housekeeping

An organized, clean facility provides an environment that reduces the potential for pollutants to enter surface and ground water through spills and accidents. General cleanliness will lead to more organized and consistent handling of hazardous materials and waste products.

Clean-Up



- Clean debris from work areas immediately after any maintenance activity. Dispose of collected material appropriately.
- Ensure garbage and recycling containers are available in all leased areas and are emptied regularly.
- Do not use running water to clean the work areas where the contaminated water could enter the storm drainage system.

- Ensure trench and storm drains within designated leased areas are kept clean and free of debris.
- Sweep and/or clean the active working area of the yard on a regular basis.

Storage

- Do not store material/equipment outside of identified boundaries of leased areas.

- Regularly inspect the lease areas for unidentified or improperly stored materials.
- Place a drip pan underneath vehicles and equipment when performing maintenance. Promptly transfer the used fluids to the proper waste or recycling drums.
- Ensure all containers (i.e. drums, totes, etc.) are in good condition and have a clean exterior at all times.

BMP #17

Stormwater Management

Stormwater has been identified as one of the primary pathways of contaminant loading to the harbour from daily Esquimalt Graving Dock (EGD) operations. Common contaminants found in stormwater samples include cadmium, copper, chromium, arsenic, tributyltin (TBT), extractable petroleum hydrocarbons (LEPH/HEPH), and total suspended solids (TSS). Five stormwater catchment areas terminate into the harbour from the EGD property.

A stormwater monitoring program has been implemented at the EGD. The stormwater outfalls will be sampled semi-annually in the spring and fall. Waste grit separators have been installed upstream of the five stormwater outfalls. These help to remove contaminants or debris that enter the storm drain system from daily operations at the EGD, in particular they remove: fuel or oil, paint, sandblast grit, general debris.

Materials Storage:

- Store hazardous materials away from storm drains and trenches.
- Store hazardous materials away from the South Jetty fire holes. These holes lead directly to the marine environment.
- Ensure totes, drums and pails containing hazardous materials are protected from the weather.

Storm Drains:

- Ensure storm drains are kept clear of debris to prevent flooding during heavy stormwater events.
- When using trench drains for secondary containment, ensure the containment system is monitored and removed in a stormwater event. A blocked trench drain may cause flooding of the area.
- Conduct regular inspections of trench drains in lease areas to ensure they are kept clear of debris.

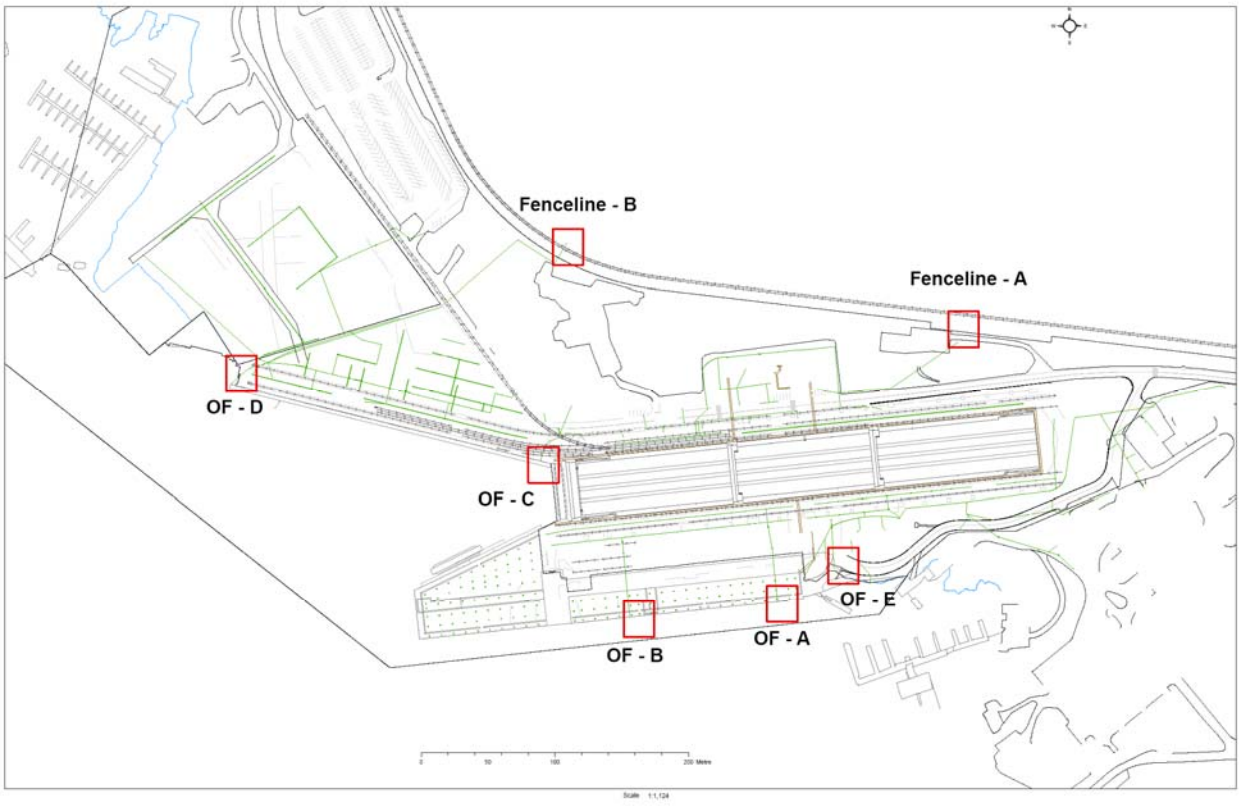
During heavy rain events in dock bottom:
Stormwater has the potential to mix with wash water during power washing operations in dock bottom. To reduce the amount of wash water requiring treatment it is good practice to stop power washing operations until storm water can be controlled.

- Sump well valves may be opened to allow storm water to drain in to the tunnel drains if the area is clear of contaminants and debris.
- Sump wells containing visibly contaminated material must be pumped out and cleaned prior to opening the valves.
- Ensure there is capacity in the trench drain/sump well system to manage the expected stormwater volume to prevent flooding of the dock floor.

Stormwater Monitoring Program

- Stormwater sampling is conducted semi-annually in the spring and fall by EGD Environmental Services.
- Stormwater samples are tested for: total metals, total suspended solids, tributytin, LEPH/HEPH and microbiological parameters.

EGD Stormwater Monitoring Program Sample Sites



BMP #18

Property and Infrastructure Maintenance, Modifications and Construction

There are significant environmental issues and potential impacts related to the management of Esquimalt Graving Dock properties and infrastructure. Any new construction or modifications to the infrastructure at the EGD must consider environmental issues in the project planning.

Infrastructure Maintenance

Maintenance and repair of the aging EGD infrastructure often results in waste generation and other environmental issues which need to be addressed.

Minor Concrete Work

- Contain dust from cutting and drilling.
- Prevent runoff to the storm drains.

Use of Preserved Wood

- Avoid use of creosote preserved timbers where possible.
- Follow applicable guideline for use of preserved wood products.
- Creosote wood waste may be considered a hazardous, restricted or controlled waste.

Demolition/Renovation

- Ensure structures are assessed for the presence of hazardous materials (i.e. lead paint, asbestos) prior demolition or renovation.

Infrastructure Modification and Construction

All construction projects taking place at the EGD need to be assessed for environmental impacts, and plans put in place to mitigate these impacts.

Environmental Impact Assessment

- Any significant changes to infrastructure, changes to an existing lease or application for a new lease, must be approved by EGD Management.
- Prior to the approval of an infrastructure project, a CEAA Environmental Impact Assessment may be required.
- An Environmental Approval Form must be filled out for new lease applications and changes to existing leases.

*****The Environmental Impact Assessment and Environmental Approval Form outlines specific environmental protection and mitigation measures required*****

Common project related aspects that require management include: noise, dust, hazardous materials, storm water runoff, and prevention and management of accidental releases and spills. Requirements for the operational aspects are identified in previous sections of these EBMPs.

Significant non-operational aspects related to construction projects may include:

- Loss of Green Space and Vegetation
- Management of Archaeological Impacts
- Soil Management

Loss of Green Space and Vegetation

The EGD property includes an area of vegetation that provides many benefits. It is home to a number of sensitive native plant species, provides habitat for wildlife, and acts as a buffer between the industrial operations of the drydock and ship repair operations and the neighbouring residential area.

All projects which have the potential to impact vegetation must be reviewed and approved by EGD Management.




Archaeological Considerations

The EGD property and surrounding area has a rich First Nations history. There are four Provincially Registered Archaeological Sites listed within the property boundaries of the EGD.

- All excavation projects must be reviewed and approved by EGD management prior to work beginning
- Depending on the scale of the project a detailed Archaeological Impact Assessment may be required.

Esquimalt Graving Dock Archaeological Overview Assessment

An Archaeological Overview Assessment was carried out in 2010 which outlines the archaeologically sensitive areas on the EGD property and identifies areas of high archaeological potential. Archaeological significant materials found during excavation projects at the facility include artefacts, shell midden, faunal and human remains.

Soil Management

The EGD has undergone significant capital and operation and maintenance projects in recent years. Extensive investigations into the soil conditions (chemical contamination and structure), utility mapping and identification of archaeological conditions have taken place. The industrial history of the facility has resulted in the contamination of the soil and in-fill material used on site. The primary contaminants commonly found at levels exceeding industrial soil standards include: arsenic, cadmium, copper, lead, mercury, zinc, and polycyclic aromatic hydrocarbons (PAH).

Requirements for Excavations at the EGD

Planning Excavation

1. Consult with EGD Facility Management to identify:
   - Project area and excavation boundaries.
   - Known utilities, structures, and historical information regarding the proposed excavation area.
   - Known contaminated soil locations, the nature and level of contaminants potentially in the soils to be excavated.
   - Archaeologically significant areas, requirements for mitigation archaeological impacts, and dealing with unanticipated archaeological finds.

2. Prepare a plan for management, stockpiling, and sampling of soils to be excavated. Key issues to be identified include:
   - Turnaround times for samples may be up to 2 weeks.
   - Parameters to be sampled may vary depending area of excavation. Common parameters include total metals, leachable metals, PAHS, and hydrocarbons (LEPH, HEPH).
   - Stockpile areas must be approved by EGD Management.
   - Soils which exceed the CCME Industrial Levels or BC CSR Industrial levels must be disposed of off site at an approved location.
   - Soils which are below industrial standards may remain on site if geotechnically suitable, approved by EGD Management, and there is an identified use for the soil.

3. Ensure contractors and employees are aware of the health and environmental risks associated with the suspected contaminated soils and have procedures in place to mitigate these risks. This includes adequate Personal Protective Equipment (PPE) and hygiene practices (i.e. no smoking, wear gloves)

Conducting Excavation

1. Ensure appropriate PPE and hygienic precautions are in place to prevent exposure to contaminants in the soils.
2. Monitor all excavations for visible soil contamination or archaeologically significant material.
3. Ensure soil is stockpiled, sampled and analysed in accordance with the BC MOE Technical Guidance on Contaminated Sites (January 2009).
4. Ensure soils suspected of contamination are stockpiled on an impervious surface and covered with a minimum 6 mil PVC or plastic liner to prevent exposure to wind, storm water runoff or people.
5. Imported fill material must be certified clean by the supplier.

After Excavation

1. Ensure all soil is disposed of at approved facilities.
2. Obtain disposal certificates from the receivers of contaminated soils.
3. Report to EGD Management on the volume, analysis of results, excavation details and dimensions.
4. Provide all as-builts and project drawings to EGD management in the format compatible with the EGD drawing standards.

Requirements for Small Excavations (less than $10m^3$)

In areas of suspect contamination: soil must be removed, stockpiled and sampled. Soil cannot go back into the excavation or used elsewhere on site until it is determined through analysis to contain contaminants less than industrial soil standards. The EGD management must give approval for any reuse of excavated soil on site.

In areas of non-suspect contamination: soil may go back into the excavation if geotechnical suitable. The EGD management must give approval for any reuse of excavated soil on site.

ESQUIMALT GRAVING DOCK

ESU SSSR

ESQUIMALT, BRITISH COLUMBIA

APPENDIX H

ESQUIMALT GRAVING DOCK

ENVIRONMENTAL BMP

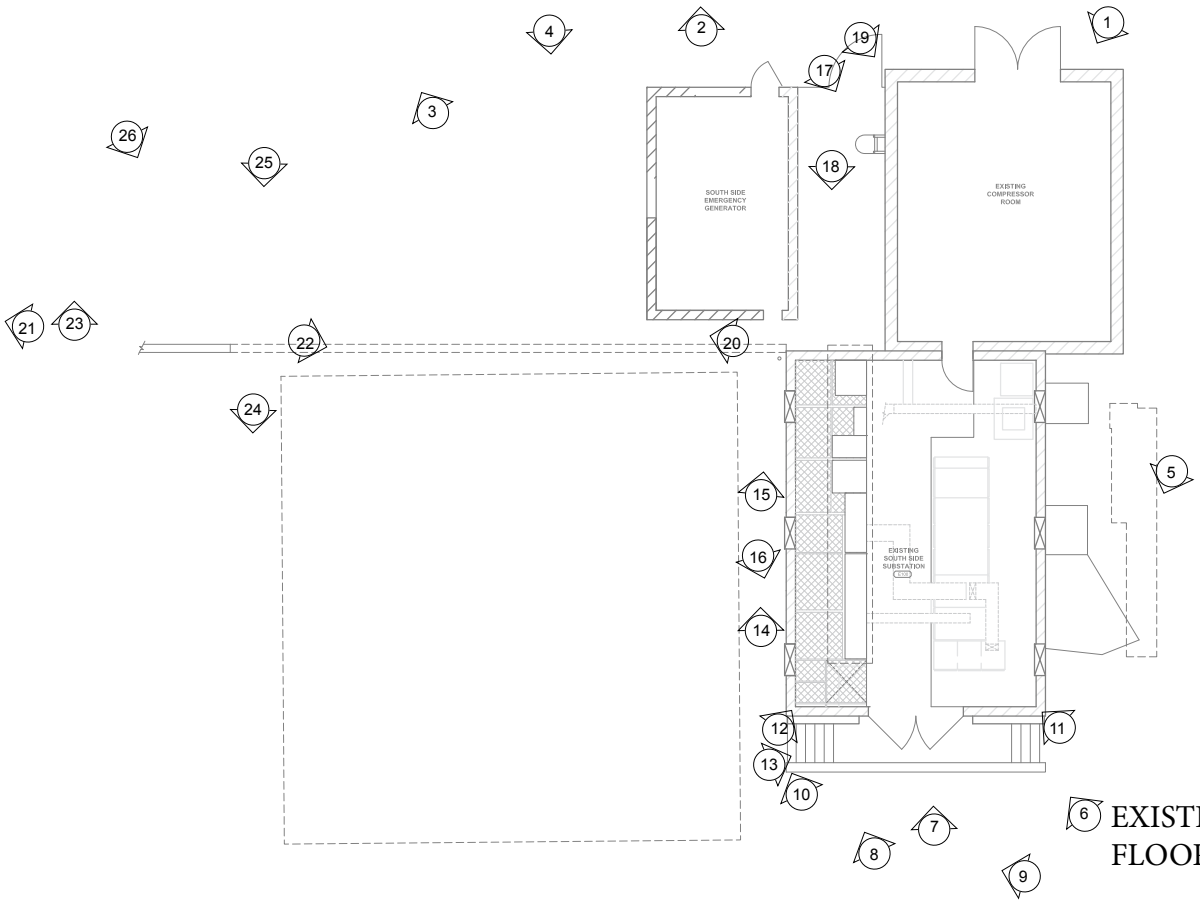
ESQUIMALT GRAVING

DOCK ESU SSSR

ESQUIMALT, BRITISH COLUMBIA

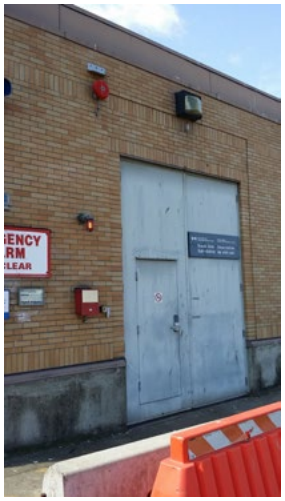
APPENDIX J

SITE PHOTOS



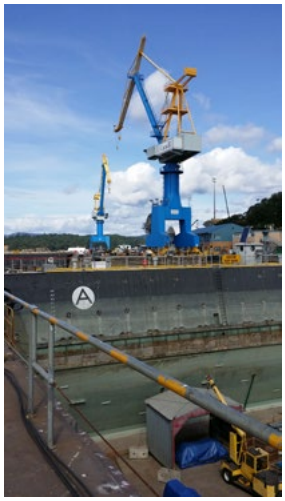
EXISTING MAIN FLOOR PLAN

1. JPG



2. JPG

3. JPG



4. JPG

5. JPG

6. JPG

7. JPG

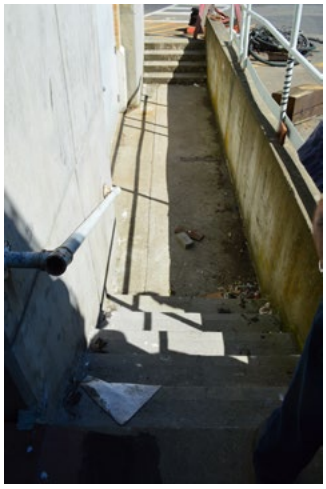
8. JPG

9. JPG

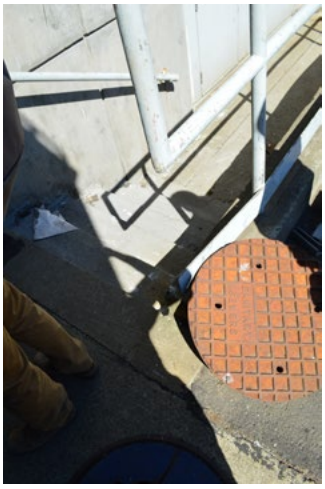
10. JPG

11. JPG

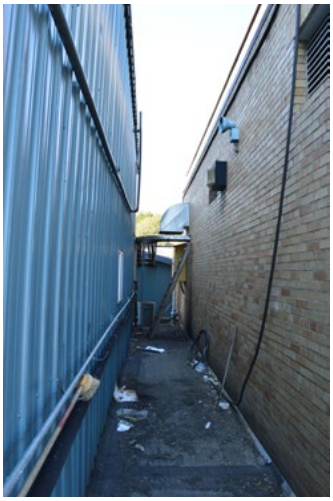
12. JPG



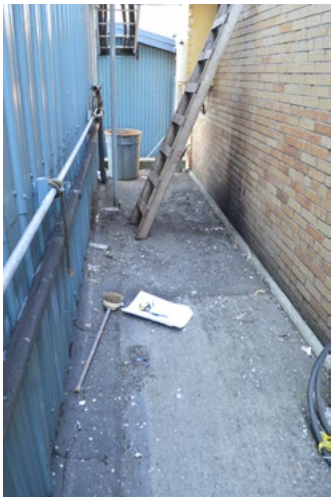
13. JPG



14. JPG



15. JPG



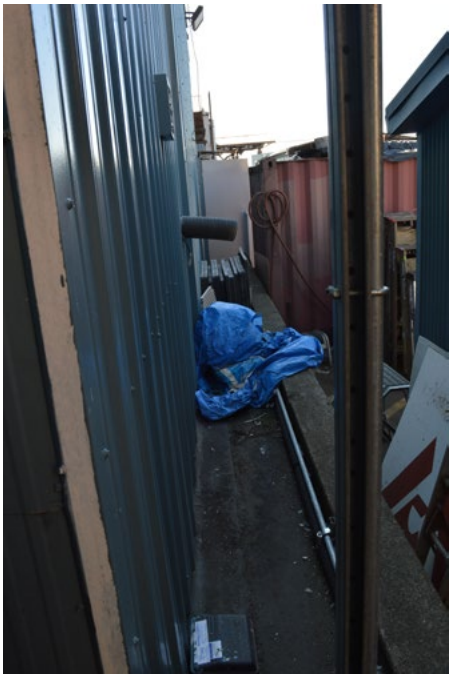
16. JPG

17. JPG

18. JPG

19. JPG

20. JPG



21. JPG

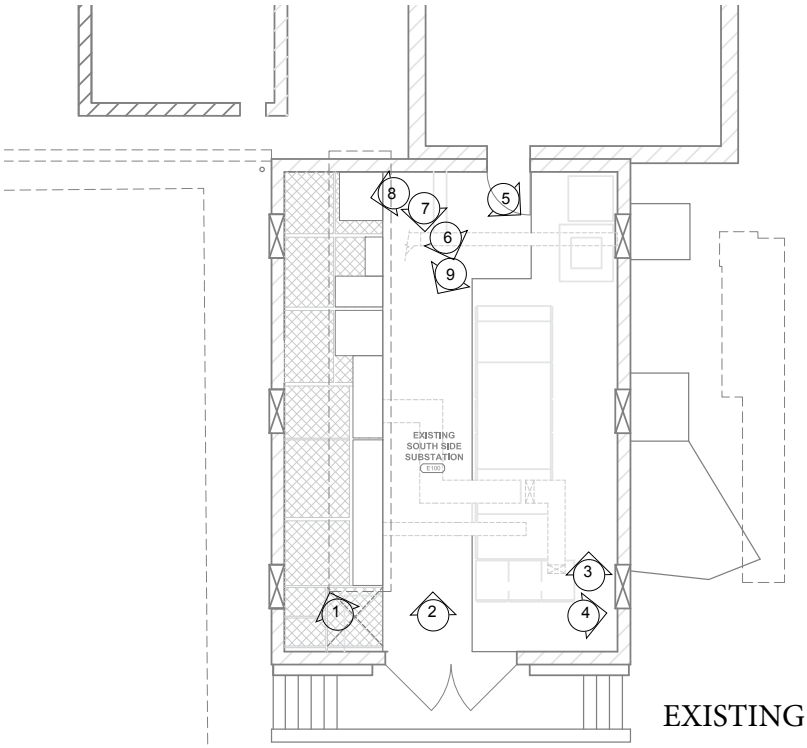
22. JPG

23. JPG

24. JPG

25. JPG

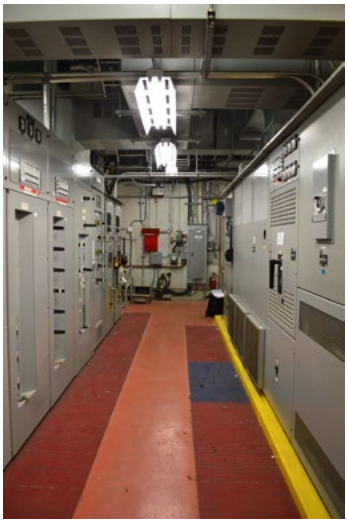
26. JPG



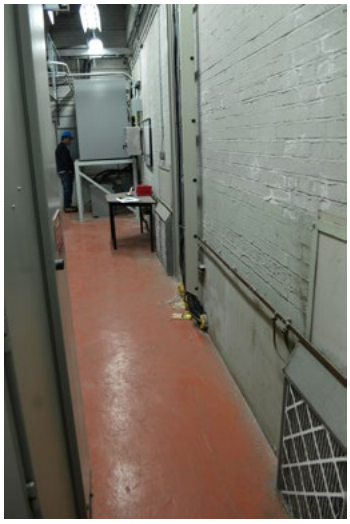
EXISTING MAIN FLOOR PLAN

1. JPG

2. JPG



3. JPG

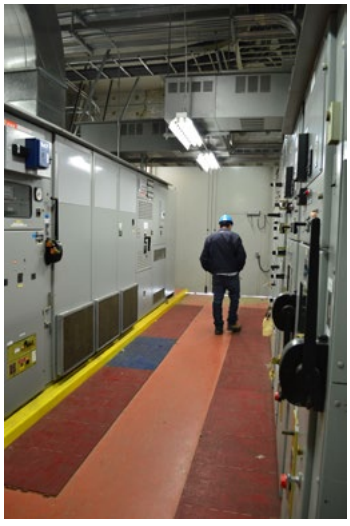


4. JPG

5. JPG

6. JPG

7. JPG



8. JPG

8. JPG

9. JPG

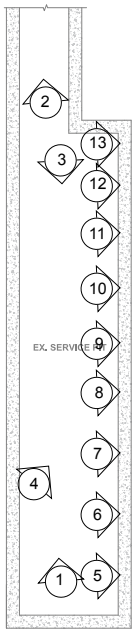
9. JPG

SITE PLAN

1. JPG

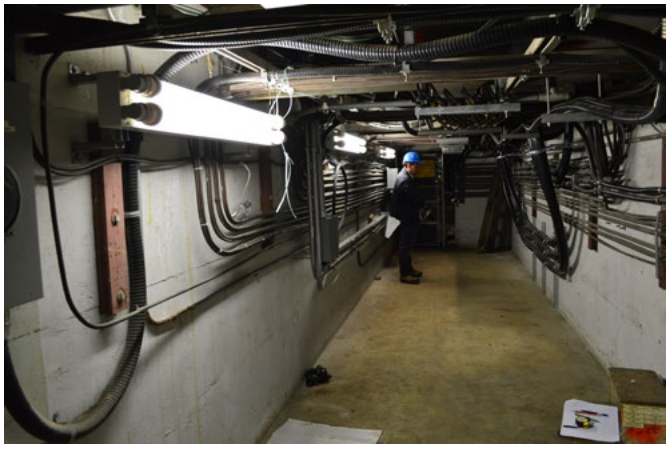
2. JPG

3. JPG

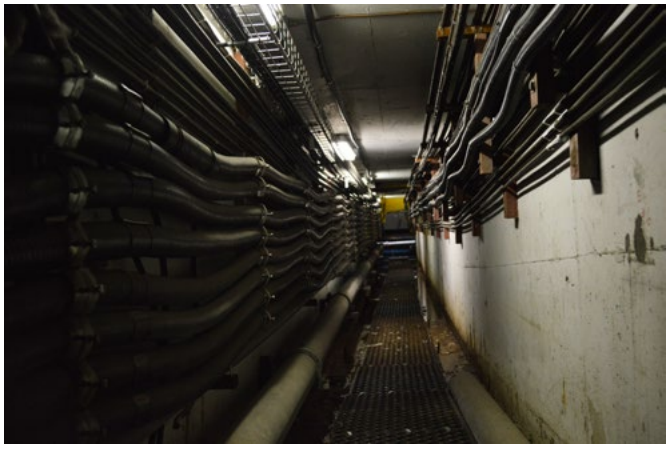


EXISTING SERVICE PIT PLAN

1. JPG



2. JPG



3. JPG

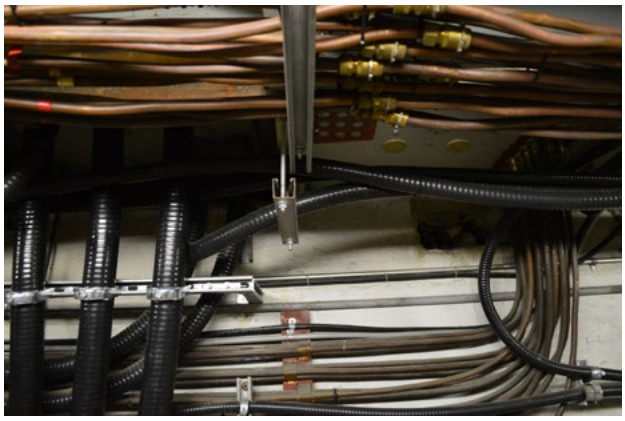
4. JPG

5. JPG

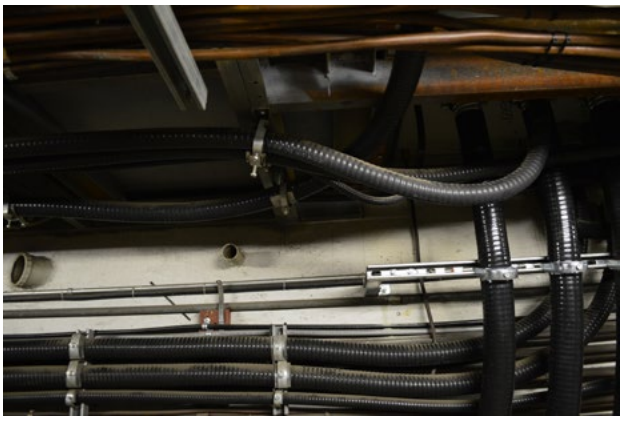
6. JPG

7. JPG

8. JPG



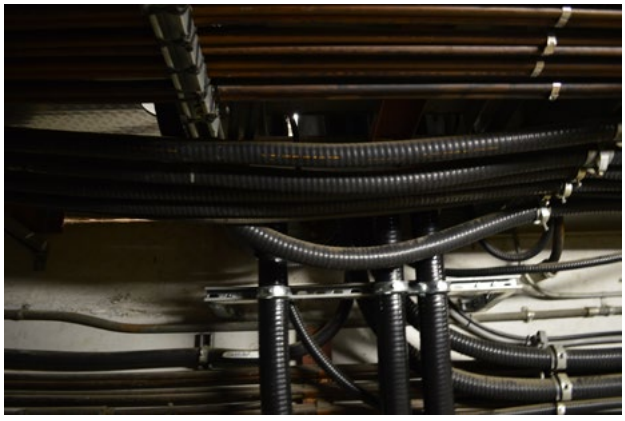
9. JPG



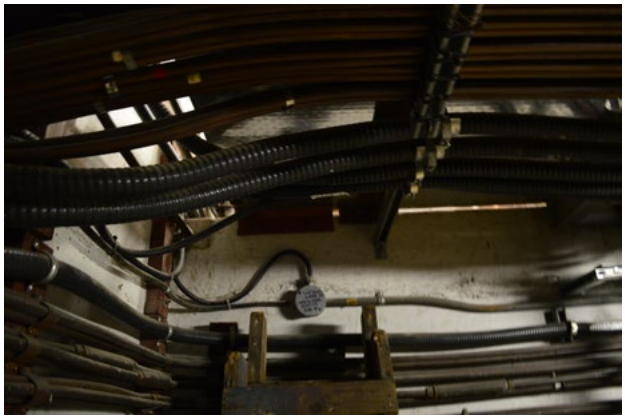
10. JPG

11. JPG

12. JPG



13. JPG



ESQUIMALT GRAVING DOCK

ESU SSSR

ESQUIMALT, BRITISH COLUMBIA

APPENDIX K

ESQUIMALT GRAVING DOCK

CONTAMINATED SOIL

N

NOTES

1. DRAWING COMPILED FROM PWGSC BASE PLAN DATED MAY 29, 2009
2. ALL EXCEEDING RESULTS ARE FOR SURFACE COMPOSITE SAMPLES COLLECTED BY HEMMERA IN 2003.
3. AEC 1B (PARKING LOTS & PATHWAY) INCLUDES CONTAMINATED FILL FROM EXCAVATIONS ACROSS THE SITE
4. AEC 19 CONSISTS OF NATURAL AND/OR LANDSCAPED AREAS WITH SURFACE CONTAMINATION
5. SAMPLE ID/LOCATION UNKNOWN

LEGEND

- PROPERTY BOUNDARY
- PREVIOUS COMPOSITE SAMPLE LOCATIONS (HEMMERA)
- HAND AUGER
- BOREHOLE LOCATION
- BOREHOLE LOCATION COMPLETED AS A MONITORING WELL
- BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (DECOMMISSIONED)
- BOREHOLE LOCATION COMPLETED AS A VAPOUR SAMPLING POINT
- SOIL SAMPLE, WALL
- SOIL SAMPLE, BASE
- SOIL SAMPLE ANALYZED
- SURFICIAL SOIL SAMPLE LOCATION
- TEST PIT (GOLDER, FEBRUARY 2010)
- CONTAMINANT CONCENTRATIONS MEET CSR IL STANDARDS & CCME IL CRITERIA
- CONTAMINANT CONCENTRATIONS EXCEED CCME GUIDELINES, CWS PHC STANDARDS AND/OR CSR IL STANDARDS

AEC 23
FORMER RAIL SPUR

AEC 19

DND
MUNROE HEAD

DND
NADEN BASE

DRY DOCK

STEEP ROCKY OUTCROP

BASE OF STEEP ROCKY OUTCROP

ROCK OUTCROP

RAIL LINE

WATER LOT BOUNDARY

PARKING LOT NORTH

SCALE 1:750
WHEN PLOTTED AT 48 x 36 PAGE SIZE
0 7.5 15 30 45 m

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

PWGSC
ESQUIMALT GRAVING DOCK UPLANDS
825 ADMIRALS ROAD
ESQUIMALT, BC

Report: REMEDIAL ACTION PLAN / RISK MANAGEMENT ACTION PLAN

Drawing: OVERVIEW OF SITE-WIDE SOIL CONTAMINATION

Date:	February 9, 2012	Scale:	AS SHOWN
File Name:	s_205c03514x00c04	Project No.:	205.03514.00000
		Drawing No.:	3A

SLR

ESQUIMALT GRAVING DOCK

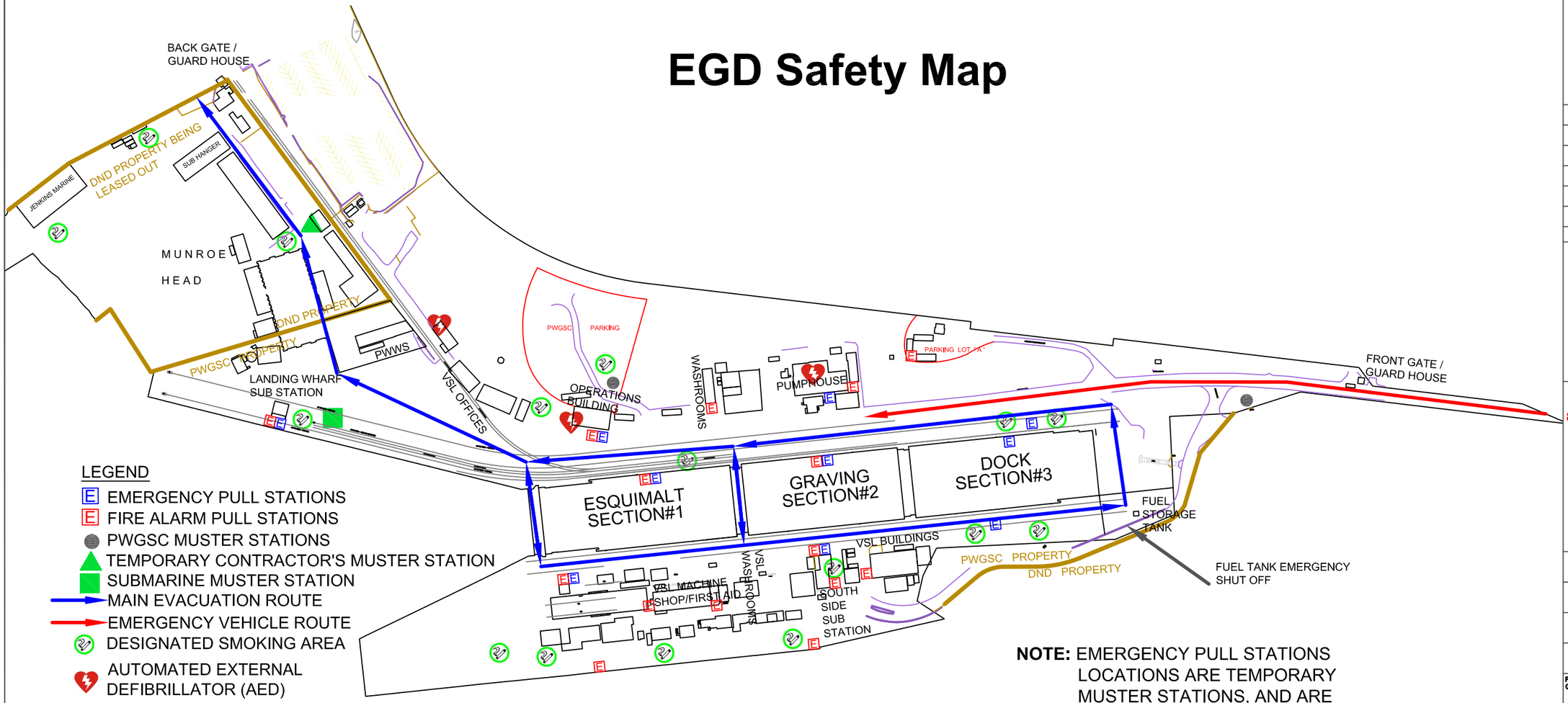
ESU SSSR

ESQUIMALT, BRITISH COLUMBIA

APPENDIX L

FIRE SAFETY MAP

EGD Safety Map



LEGEND

- EMERGENCY PULL STATIONS
- FIRE ALARM PULL STATIONS
- PWGSC MUSTER STATIONS
- TEMPORARY CONTRACTOR'S MUSTER STATION
- SUBMARINE MUSTER STATION
- MAIN EVACUATION ROUTE
- EMERGENCY VEHICLE ROUTE
- DESIGNATED SMOKING AREA
- AUTOMATED EXTERNAL DEFIBRILLATOR (AED)

NOTE: EMERGENCY PULL STATIONS LOCATIONS ARE TEMPORARY MUSTER STATIONS, AND ARE SUBJECT TO CHANGE.

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Pacific Region
SERVICES IMMOBILIERS
Région de Pacifique

Revision/ Revision	Description/Description	Date/Date
2	Revisions by J.W. Brown	2013/05
1	Revisions by D. Ferrier	2005/11
0	Design Completion	2005/10

Client/client

ESQUIMALT GRAVING DOCK

825 ADMIRALS ROAD
ESQUIMALT, B.C. V9A 2P1

Project title/Titre du projet
ESQUIMALT GRAVING DOCK
825 ADMIRALS ROAD, ESQUIMALT, B.C
BLDG_NAME

Consultant Signature Only

Designed by/Concept par

Drawn by/Dessine par
D Ferrier 2005/05

PWGSC Project Manager/Administrateur de Projets TPSGC

PWGSC, Regional Manager, Architectural and Engineering Services/ Gestionnaire régionale, Services d'architectural et de génie, TPSGC

Drawing title/Titre du dessin
Esquimalt, BC.
Graving Dock
Site Plan

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
	1 OF 1	2

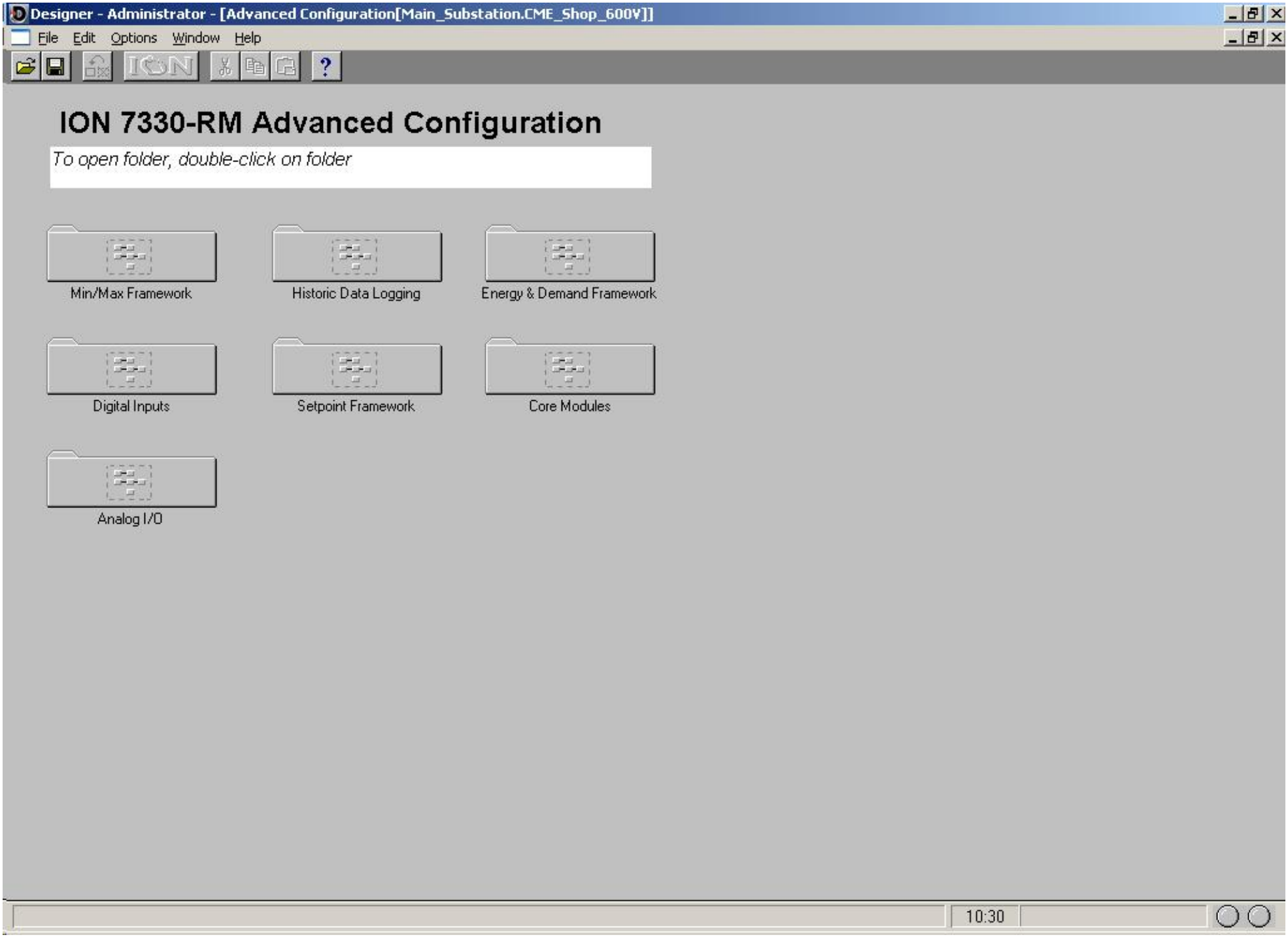
ESQUIMALT GRAVING DOCK

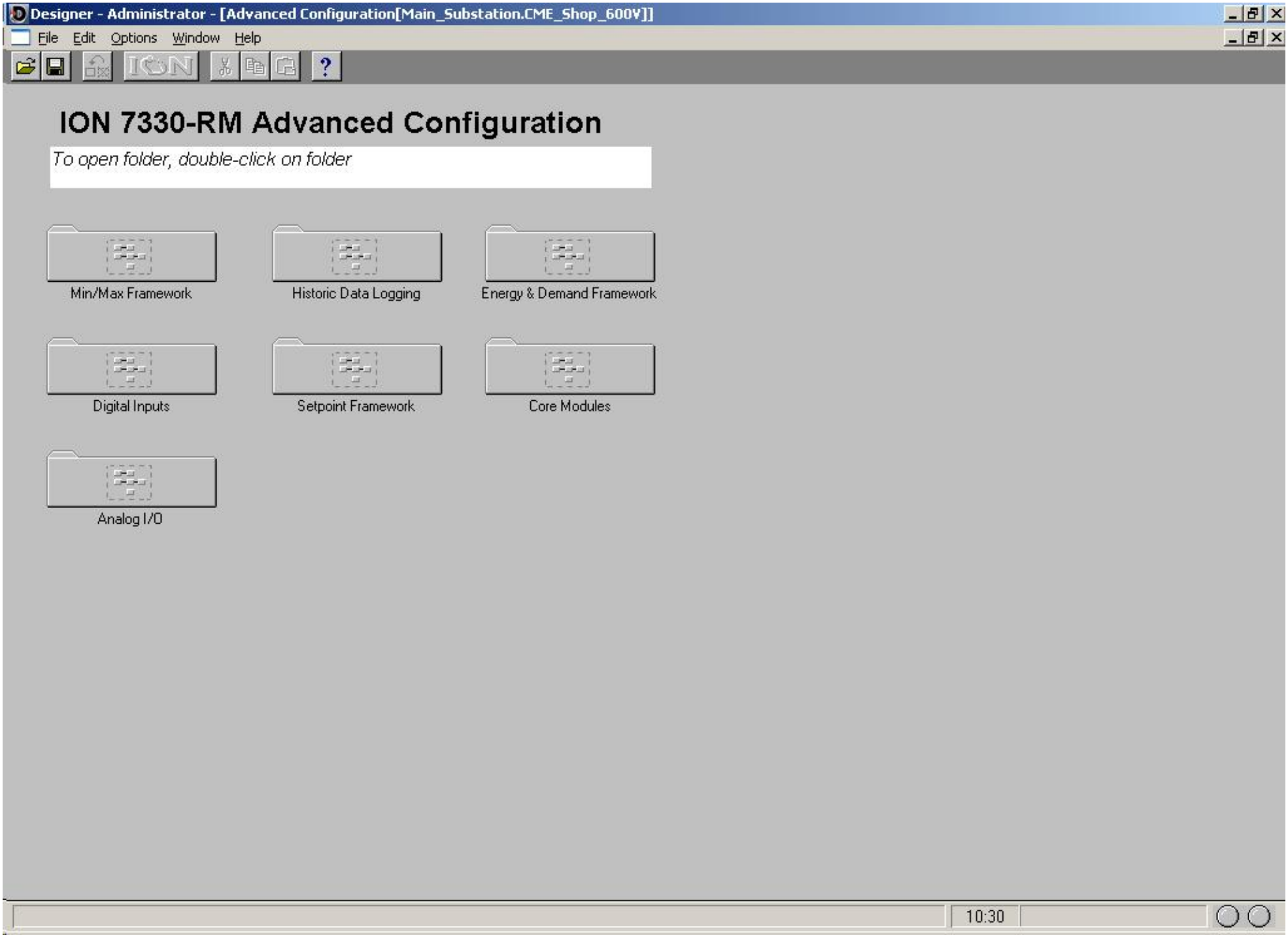
ESU SSSR

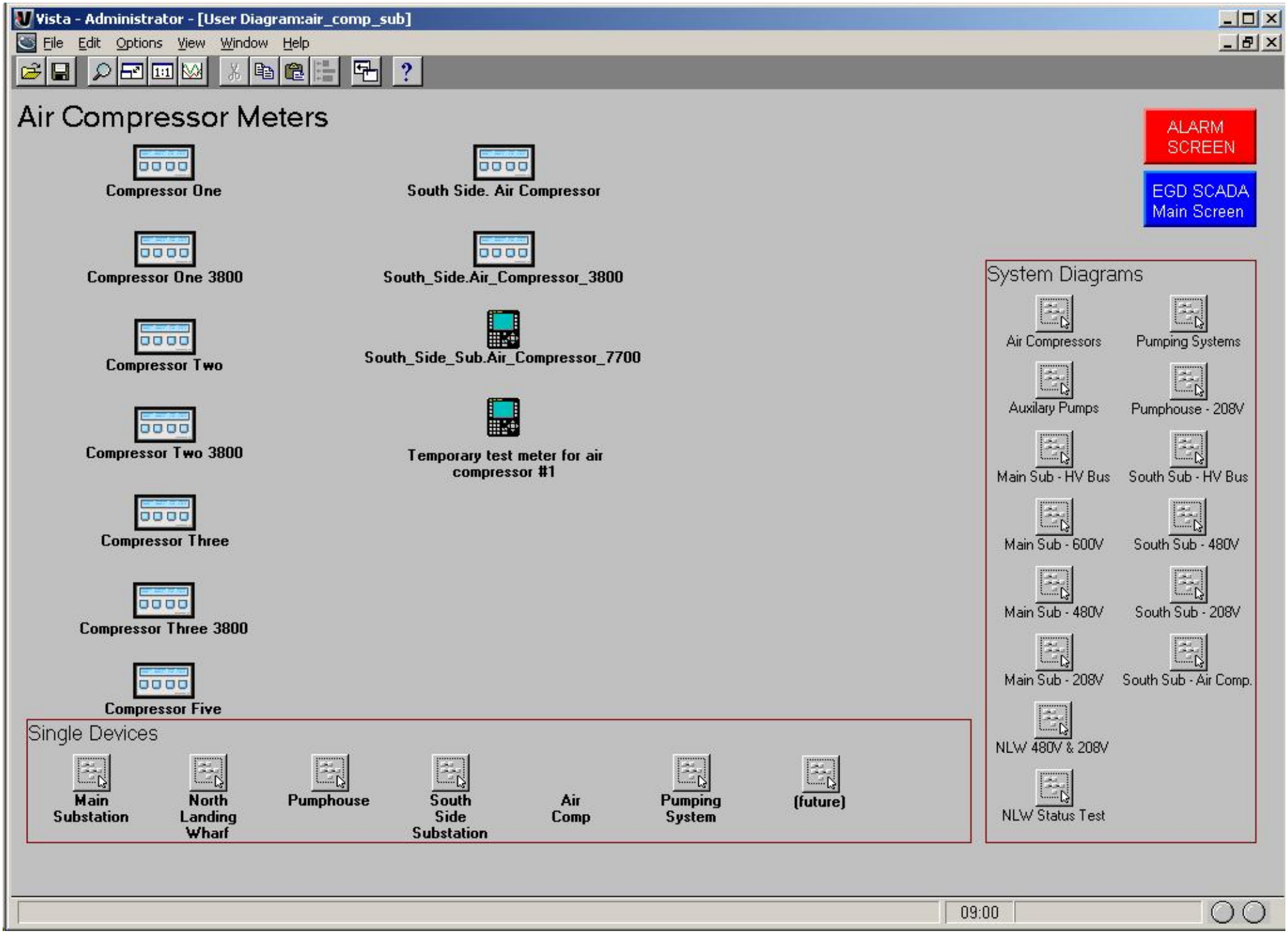
ESQUIMALT, BRITISH COLUMBIA

APPENDIX M

EXISTING DIGITAL METERING INFORMATION


Designer - Administrator - [Advanced Configuration[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Advanced Configuration
To open folder, double-click on folder
Min/Max Framework
Historic Data Logging
Energy & Demand Framework
Digital Inputs
Setpoint Framework
Core Modules
Analog I/O
10:30


Designer - Administrator - [Advanced Configuration[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Advanced Configuration
To open folder, double-click on folder
Min/Max Framework
Historic Data Logging
Energy & Demand Framework
Digital Inputs
Setpoint Framework
Core Modules
Analog I/O
10:30


Vista - Administrator - [User Diagram:air_comp_sub]
File Edit Options View Window Help
Air Compressor Meters
ALARM SCREEN
EGD SCADA Main Screen
Compressor One
South Side. Air Compressor
Compressor One 3800
South_Side.Air_Compressor_3800
Compressor Two
South_Side_Sub.Air_Compressor_7700
Compressor Two 3800
Temporary test meter for air compressor #1
Compressor Three
Compressor Three 3800
Compressor Five
System Diagrams
Air Compressors
Pumping Systems
Auxilary Pumps
Pumphouse - 208V
Main Sub - HV Bus
South Sub - HV Bus
Main Sub - 600V
South Sub - 480V
Main Sub - 480V
South Sub - 208V
Main Sub - 208V
South Sub - Air Comp.
NLW 480V & 208V
NLW Status Test
Single Devices
Main Substation
North Landing Wharf
Pumphouse
South Side Substation
Air Comp
Pumping System
(future)
09:00

Vista - Administrator - [User Diagram:air_compressors]

File Edit Options View Window Help

Air Compressors

12.5 kV
2.4 kV
600 V
480 V
208 V

ALARM SCREEN

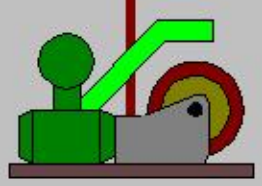
EGD SCADA Main Screen

Pumphouse

Compressor #1

VII avg : 2,347.0
I avg : 0.0
kW tot : 229.0
PF sign tot : -86.0

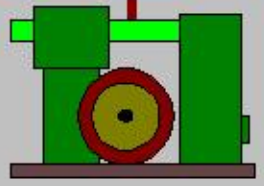
Stopped



Compressor #2

VII avg : 2,349.0
I avg : 1.0
kW tot : 0.0
PF sign tot : 0.0

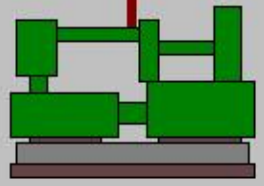
Stopped



Compressor #3

VII avg : 2,364.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0

Stopped

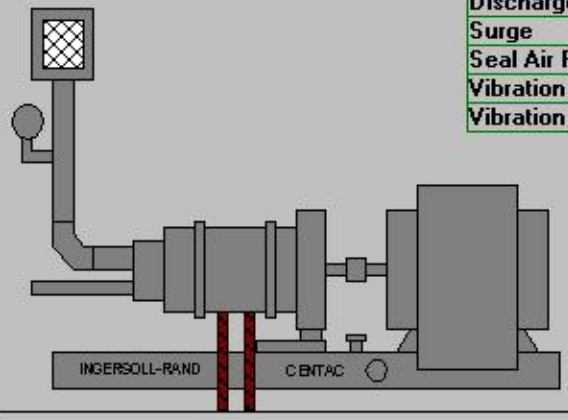


South Air Compressor Room

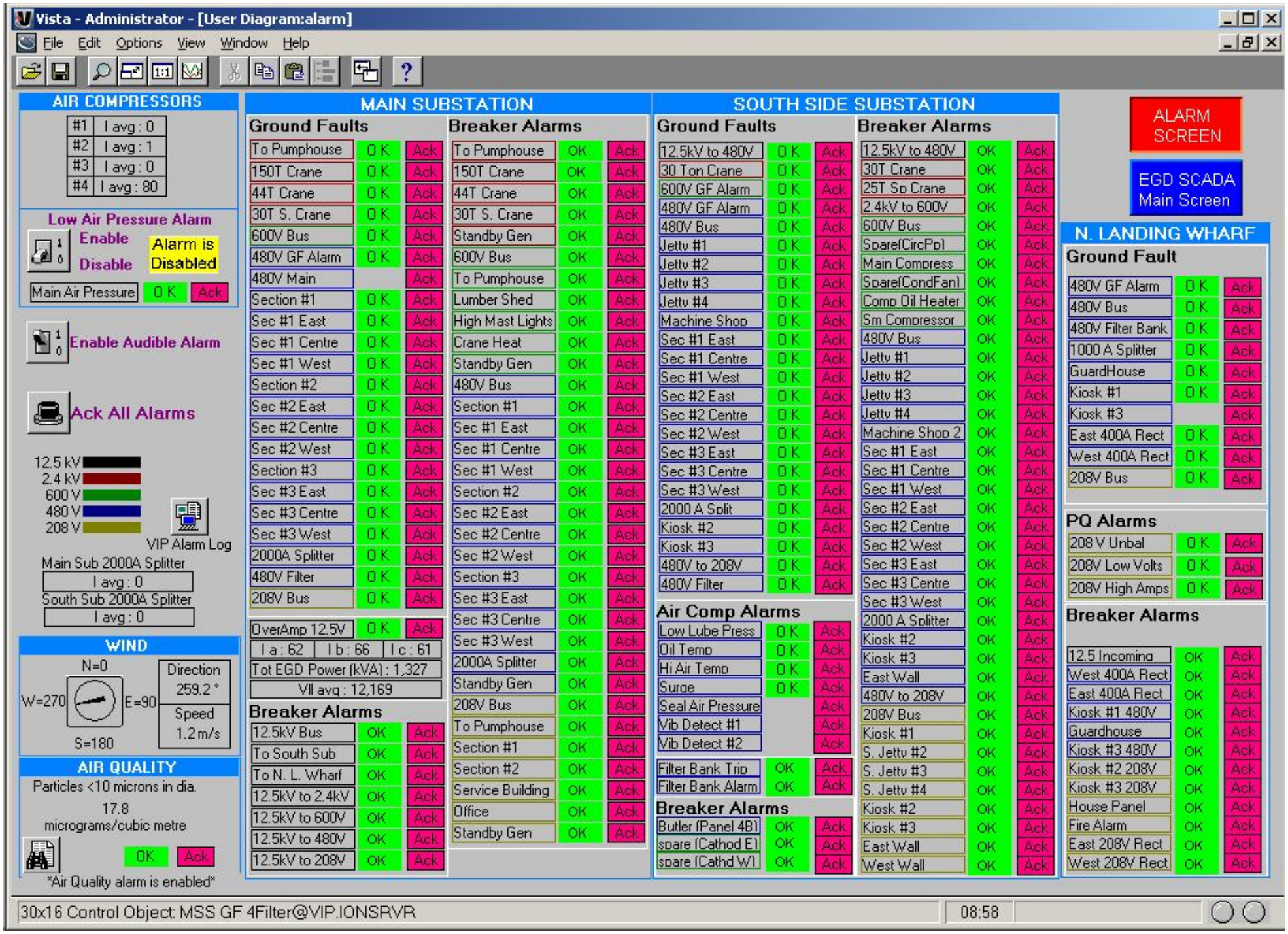
Compressor #4

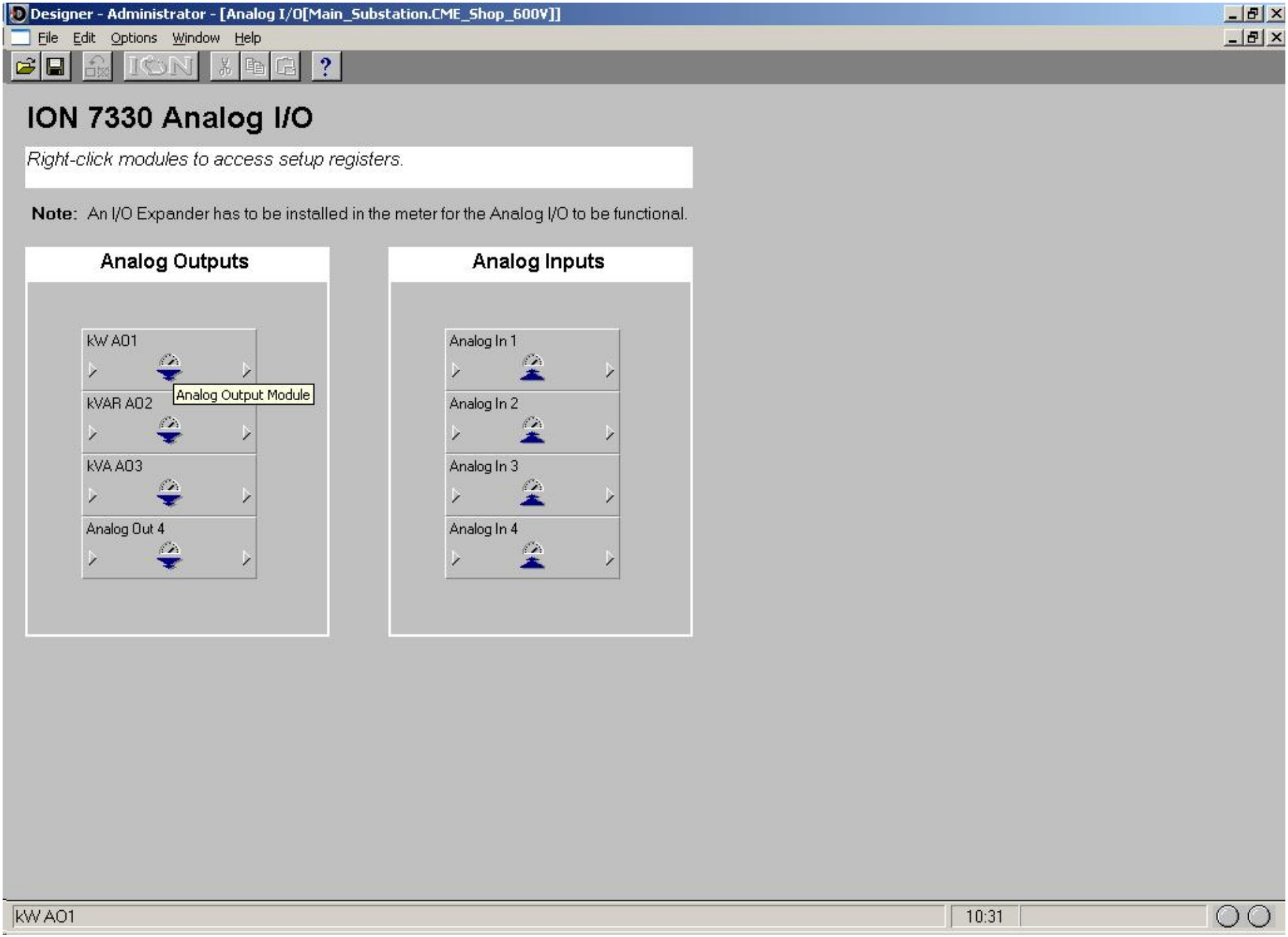
VII avg : 0.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0

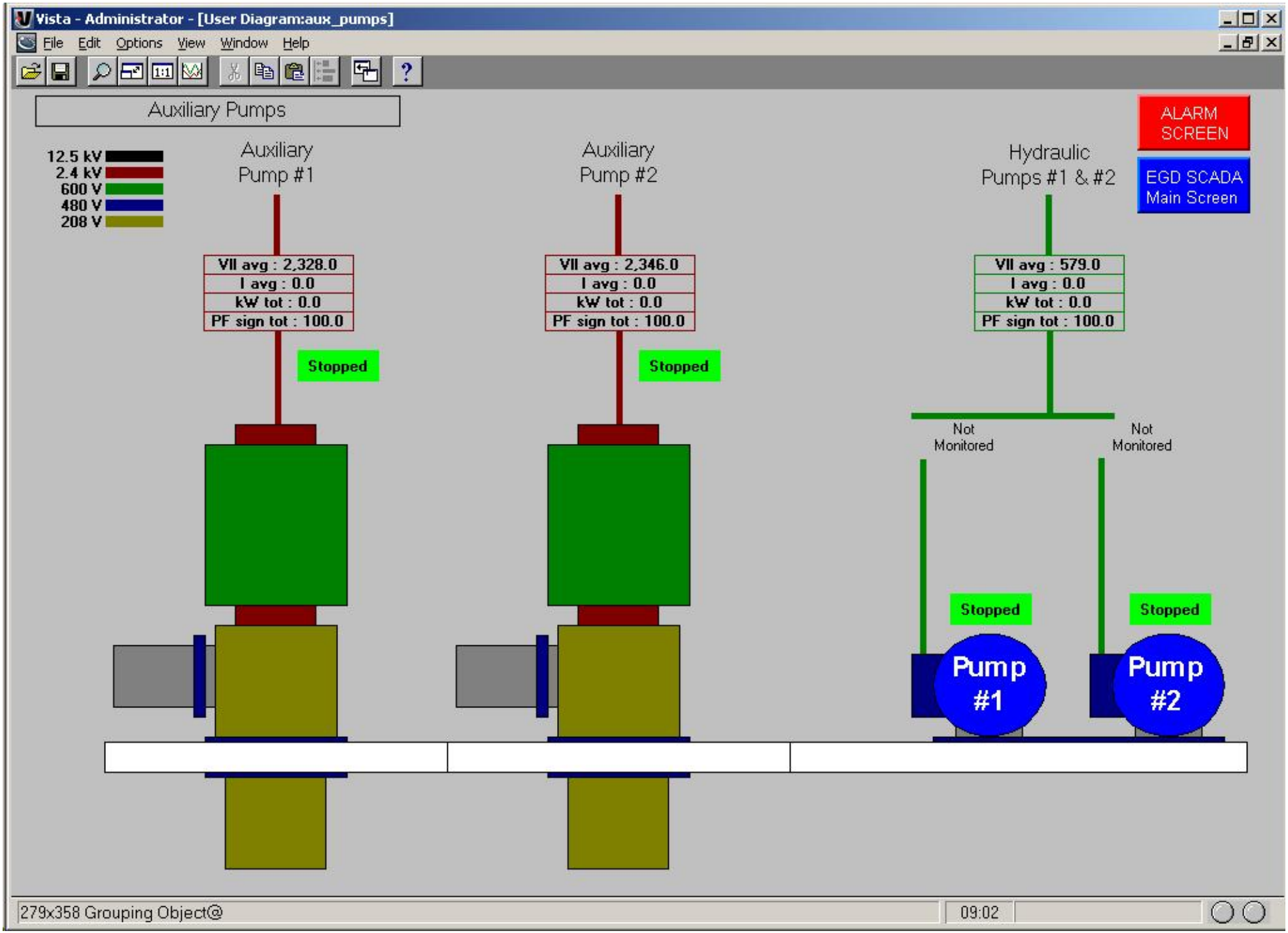
Compressor Status	
Lub. Oil Pressure	
Lub. Oil Temperature	F
Discharge Air Temp.	F
Surge	O K
Seal Air Pressure	
Vibration Detector	
Vibration Detector	

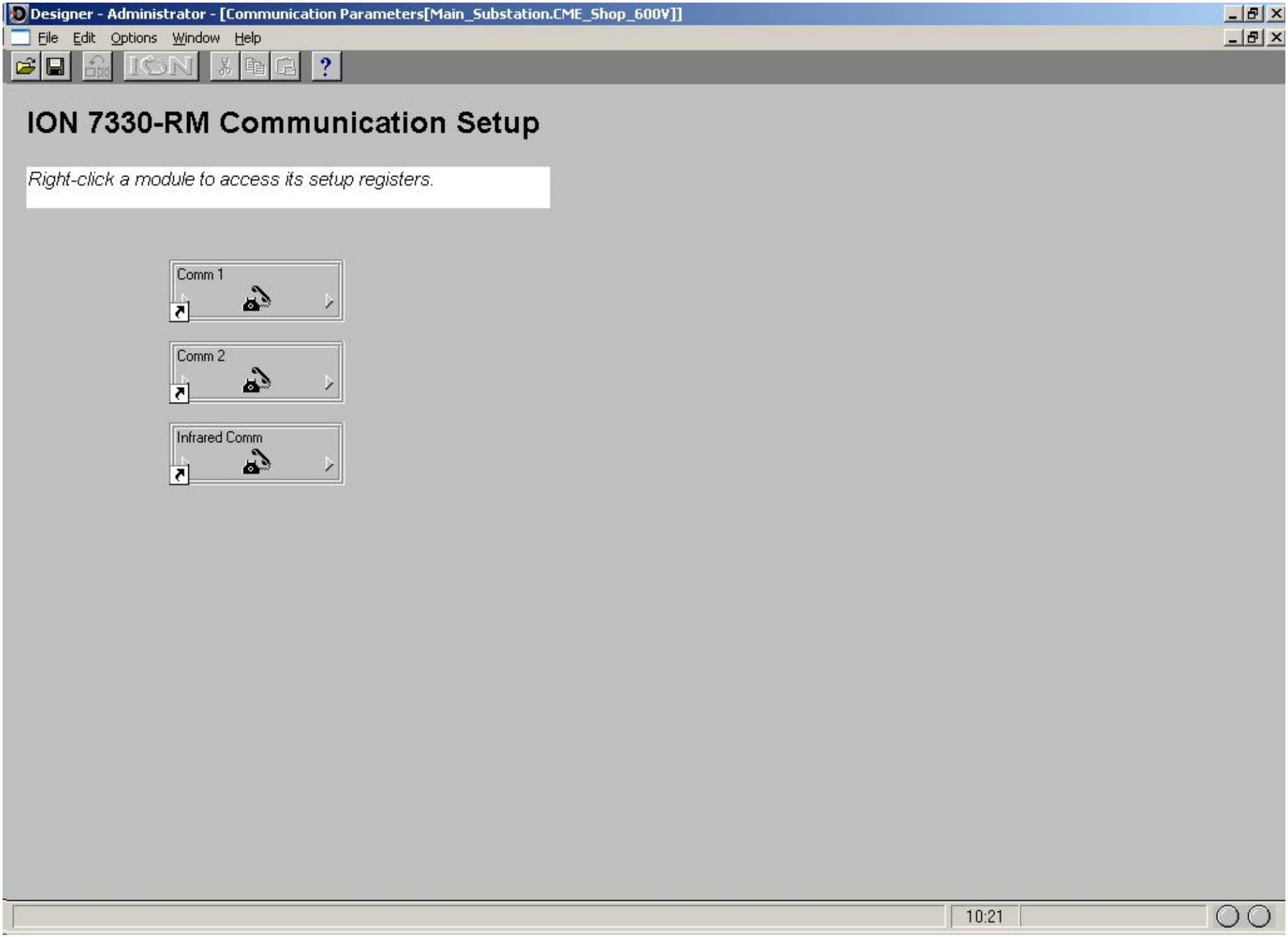


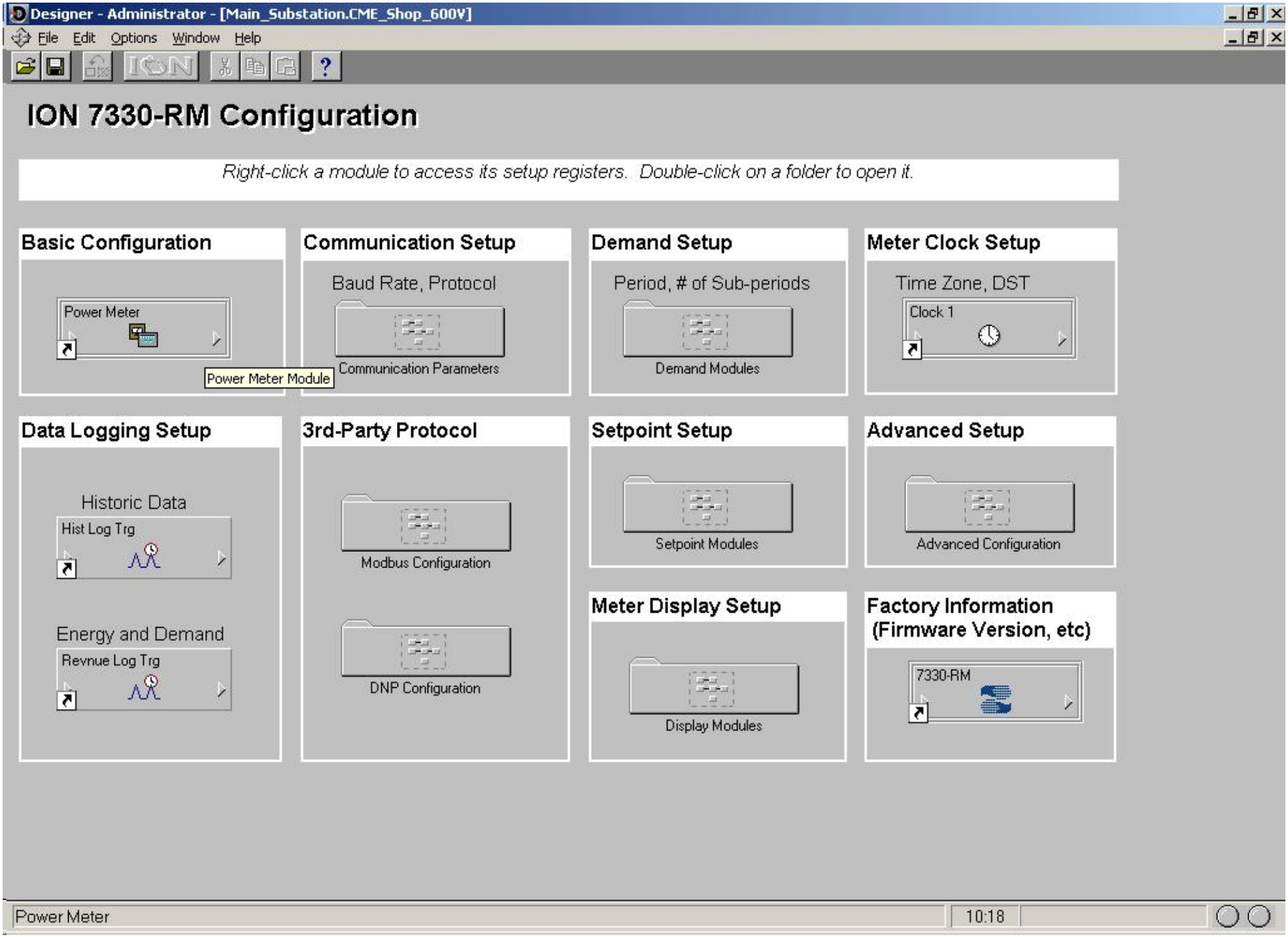
Text Box 09:01

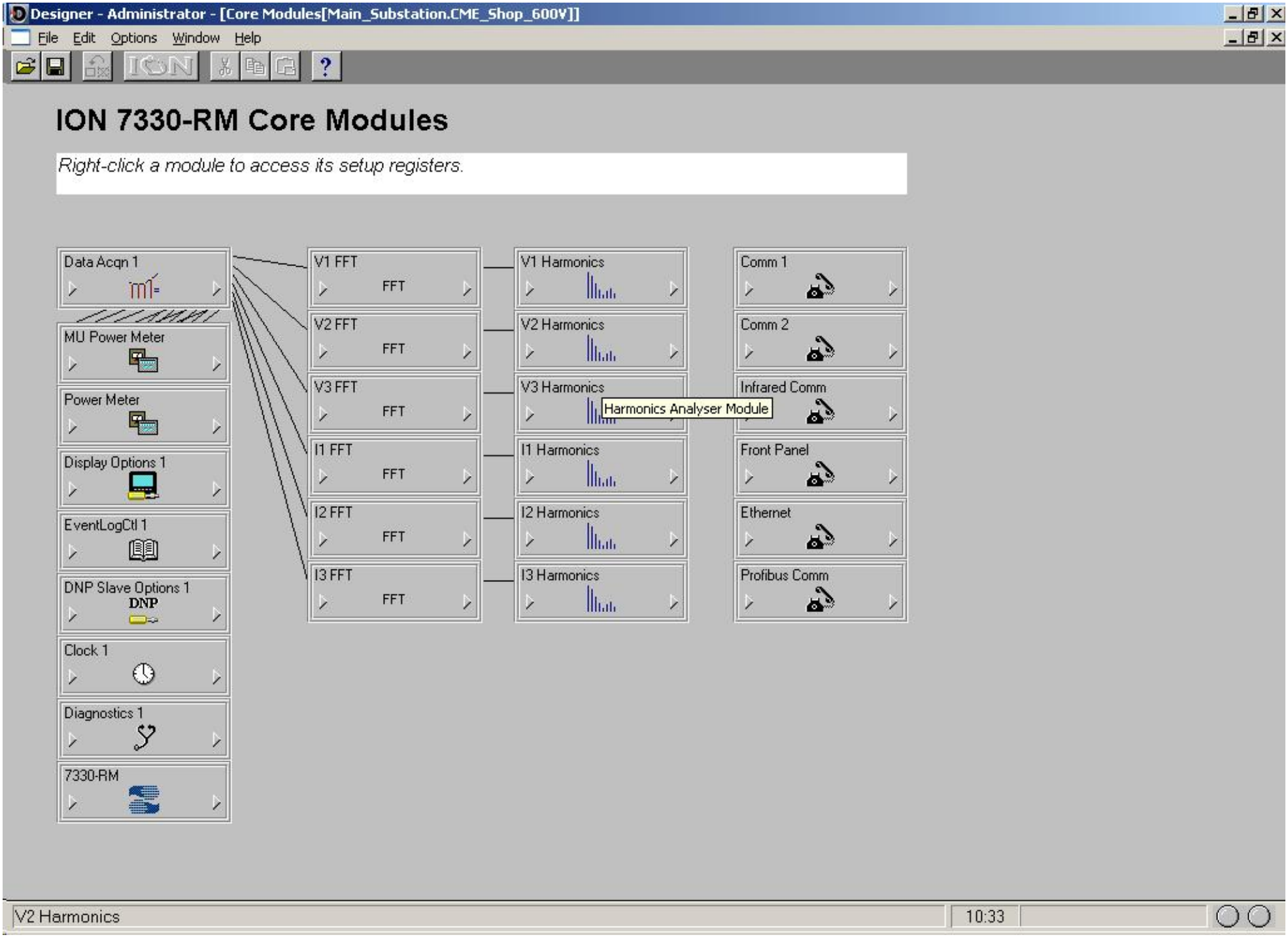

Vista - Administrator - [User Diagram:alarm]
File Edit Options View Window Help
AIR COMPRESSORS
#1 I avg : 0
#2 I avg : 1
#3 I avg : 0
#4 I avg : 80
Low Air Pressure Alarm
Enable
Disable
Alarm is Disabled
Main Air Pressure 0 K Ack
Enable Audible Alarm
Ack All Alarms
12.5 kV
2.4 kV
600 V
480 V
208 V
VIP Alarm Log
Main Sub 2000A Splitter
I avg : 0
South Sub 2000A Splitter
I avg : 0
WIND
N=0
W=270
E=90
S=180
Direction 259.2 °
Speed 1.2 m/s
AIR QUALITY
Particles <10 microns in dia.
17.8
micrograms/cubic metre
OK Ack
Air Quality alarm is enabled
MAIN SUBSTATION
Ground Faults
To Pumphouse 0 K Ack
150T Crane 0 K Ack
44T Crane 0 K Ack
30T S. Crane 0 K Ack
600V Bus 0 K Ack
480V GF Alarm 0 K Ack
480V Main Ack
Section #1 0 K Ack
Sec #1 East 0 K Ack
Sec #1 Centre 0 K Ack
Sec #1 West 0 K Ack
Section #2 0 K Ack
Sec #2 East 0 K Ack
Sec #2 Centre 0 K Ack
Sec #2 West 0 K Ack
Section #3 0 K Ack
Sec #3 East 0 K Ack
Sec #3 Centre 0 K Ack
Sec #3 West 0 K Ack
2000A Splitter 0 K Ack
480V Filter 0 K Ack
208V Bus 0 K Ack
OverAmp 12.5V 0 K Ack
I a : 62 I b : 66 I c : 61
Tot EGD Power (kVA) : 1,327
Vll avg : 12,169
Breaker Alarms
12.5kV Bus OK Ack
To South Sub OK Ack
To N. L. Wharf OK Ack
12.5kV to 2.4kV OK Ack
12.5kV to 600V OK Ack
12.5kV to 480V OK Ack
12.5kV to 208V OK Ack
Breaker Alarms
To Pumphouse OK Ack
150T Crane OK Ack
44T Crane OK Ack
30T S. Crane OK Ack
Standby Gen OK Ack
600V Bus OK Ack
To Pumphouse OK Ack
Lumber Shed OK Ack
High Mast Lights OK Ack
Crane Heat OK Ack
Standby Gen OK Ack
480V Bus OK Ack
Section #1 OK Ack
Sec #1 East OK Ack
Sec #1 Centre OK Ack
Sec #1 West OK Ack
Section #2 OK Ack
Sec #2 East OK Ack
Sec #2 Centre OK Ack
Sec #2 West OK Ack
Section #3 OK Ack
Sec #3 East OK Ack
Sec #3 Centre OK Ack
Sec #3 West OK Ack
2000A Splitter OK Ack
Standby Gen OK Ack
208V Bus OK Ack
To Pumphouse OK Ack
Section #1 OK Ack
Section #2 OK Ack
Service Building OK Ack
Office OK Ack
Standby Gen OK Ack
SOUTH SIDE SUBSTATION
Ground Faults
12.5kV to 480V 0 K Ack
30 Ton Crane 0 K Ack
600V GF Alarm 0 K Ack
480V GF Alarm 0 K Ack
480V Bus 0 K Ack
Jetty #1 0 K Ack
Jetty #2 0 K Ack
Jetty #3 0 K Ack
Jetty #4 0 K Ack
Machine Shop 0 K Ack
Sec #1 East 0 K Ack
Sec #1 Centre 0 K Ack
Sec #1 West 0 K Ack
Sec #2 East 0 K Ack
Sec #2 Centre 0 K Ack
Sec #2 West 0 K Ack
Sec #3 East 0 K Ack
Sec #3 Centre 0 K Ack
Sec #3 West 0 K Ack
2000 A Split 0 K Ack
Kiosk #2 0 K Ack
Kiosk #3 0 K Ack
480V to 208V 0 K Ack
480V Filter 0 K Ack
Air Comp Alarms
Low Lube Press 0 K Ack
Oil Temp 0 K Ack
Hi Air Temp 0 K Ack
Surge 0 K Ack
Seal Air Pressure Ack
Vib Detect #1 Ack
Vib Detect #2 Ack
Filter Bank Trip OK Ack
Filter Bank Alarm OK Ack
Breaker Alarms
Butler (Panel 4B) OK Ack
spare (Cathod E) OK Ack
spare (Cathd W) OK Ack
Breaker Alarms
12.5kV to 480V OK Ack
30T Crane OK Ack
25T Sp Crane OK Ack
2.4kV to 600V OK Ack
600V Bus OK Ack
Spare(CircPp) OK Ack
Main Compress OK Ack
Spare(CondFan) OK Ack
Comp Oil Heater OK Ack
Sm Compressor OK Ack
480V Bus OK Ack
Jetty #1 OK Ack
Jetty #2 OK Ack
Jetty #3 OK Ack
Jetty #4 OK Ack
Machine Shop 2 OK Ack
Sec #1 East OK Ack
Sec #1 Centre OK Ack
Sec #1 West OK Ack
Sec #2 East OK Ack
Sec #2 Centre OK Ack
Sec #2 West OK Ack
Sec #3 East OK Ack
Sec #3 Centre OK Ack
Sec #3 West OK Ack
2000 A Splitter OK Ack
Kiosk #2 OK Ack
Kiosk #3 OK Ack
East Wall OK Ack
480V to 208V OK Ack
208V Bus OK Ack
Kiosk #1 OK Ack
S. Jetty #2 OK Ack
S. Jetty #3 OK Ack
S. Jetty #4 OK Ack
Kiosk #2 OK Ack
Kiosk #3 OK Ack
East Wall OK Ack
West Wall OK Ack
ALARM SCREEN
EGD SCADA Main Screen
N. LANDING WHARF
Ground Fault
480V GF Alarm 0 K Ack
480V Bus 0 K Ack
480V Filter Bank 0 K Ack
1000 A Splitter 0 K Ack
GuardHouse 0 K Ack
Kiosk #1 0 K Ack
Kiosk #3 Ack
East 400A Rect 0 K Ack
West 400A Rect 0 K Ack
208V Bus 0 K Ack
PQ Alarms
208 V Unbal 0 K Ack
208V Low Volts 0 K Ack
208V High Amps 0 K Ack
Breaker Alarms
12.5 Incoming OK Ack
West 400A Rect OK Ack
East 400A Rect OK Ack
Kiosk #1 480V OK Ack
Guardhouse OK Ack
Kiosk #3 480V OK Ack
Kiosk #2 208V OK Ack
Kiosk #3 208V OK Ack
House Panel OK Ack
Fire Alarm OK Ack
East 208V Rect OK Ack
West 208V Rect OK Ack
30x16 Control Object: MSS GF 4Filter@VIP.IONSRVR
08:58


Designer - Administrator - [Analog I/O[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330 Analog I/O
Right-click modules to access setup registers.
Note: An I/O Expander has to be installed in the meter for the Analog I/O to be functional.
Analog Outputs
kW AO1
Analog Output Module
kVAR AO2
kVA AO3
Analog Out 4
Analog Inputs
Analog In 1
Analog In 2
Analog In 3
Analog In 4
kW AO1
10:31


Vista - Administrator - [User Diagram:aux_pumps]
File Edit Options View Window Help
Auxiliary Pumps
ALARM SCREEN
EGD SCADA Main Screen
12.5 kV
2.4 kV
600 V
480 V
208 V
Auxiliary Pump #1
Vll avg : 2,328.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
Stopped
Auxiliary Pump #2
Vll avg : 2,346.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
Stopped
Hydraulic Pumps #1 & #2
Vll avg : 579.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
Not Monitored
Not Monitored
Stopped
Stopped
Pump #1
Pump #2
279x358 Grouping Object@
09:02


Designer - Administrator - [Communication Parameters[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Communication Setup
Right-click a module to access its setup registers.
Comm 1
Comm 2
Infrared Comm
10:21


Designer - Administrator - [Main_Substation.CME_Shop_600V]
File Edit Options Window Help
ION 7330-RM Configuration
Right-click a module to access its setup registers. Double-click on a folder to open it.
Basic Configuration
Power Meter
Power Meter Module
Communication Setup
Baud Rate, Protocol
Communication Parameters
Demand Setup
Period, # of Sub-periods
Demand Modules
Meter Clock Setup
Time Zone, DST
Clock 1
Data Logging Setup
Historic Data
Hist Log Trg
Energy and Demand
Revnue Log Trg
3rd-Party Protocol
Modbus Configuration
DNP Configuration
Setpoint Setup
Setpoint Modules
Advanced Setup
Advanced Configuration
Meter Display Setup
Display Modules
Factory Information (Firmware Version, etc)
7330-RM
Power Meter
10:18


Designer - Administrator - [Core Modules[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Core Modules
Right-click a module to access its setup registers.
Data Acqn 1
MU Power Meter
Power Meter
Display Options 1
EventLogCtl 1
DNP Slave Options 1
DNP
Clock 1
Diagnostics 1
7330-RM
V1 FFT
FFT
V2 FFT
FFT
V3 FFT
FFT
I1 FFT
FFT
I2 FFT
FFT
I3 FFT
FFT
V1 Harmonics
V2 Harmonics
V3 Harmonics
Harmonics Analyser Module
I1 Harmonics
I2 Harmonics
I3 Harmonics
Comm 1
Comm 2
Infrared Comm
Front Panel
Ethernet
Profibus Comm
V2 Harmonics
10:33

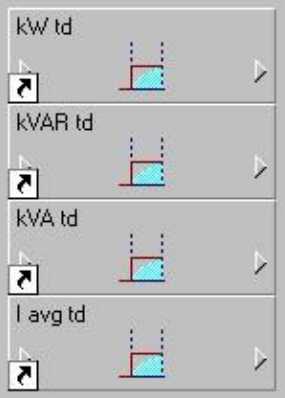
Designer - Administrator - [Demand Modules[Main_Substation.CME_Shop_600V]]

File Edit Options Window Help

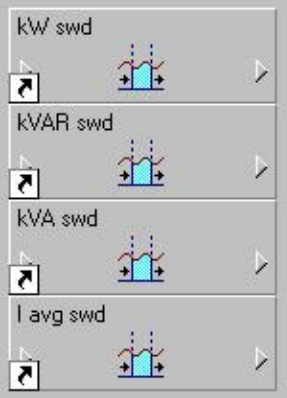
ION 7330-RM Demand Setup

Right-click a module to access its setup registers.

Thermal Demand



Sliding Window Demand



10:23

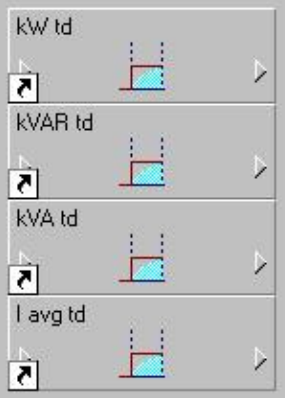
Designer - Administrator - [Demand Modules[Main_Substation.CME_Shop_600V]]

File Edit Options Window Help

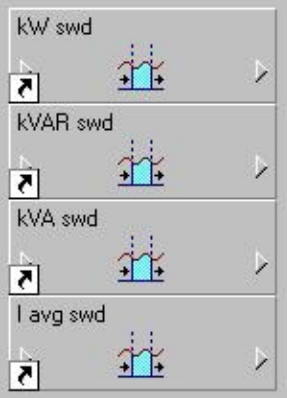
ION 7330-RM Demand Setup

Right-click a module to access its setup registers.

Thermal Demand



Sliding Window Demand



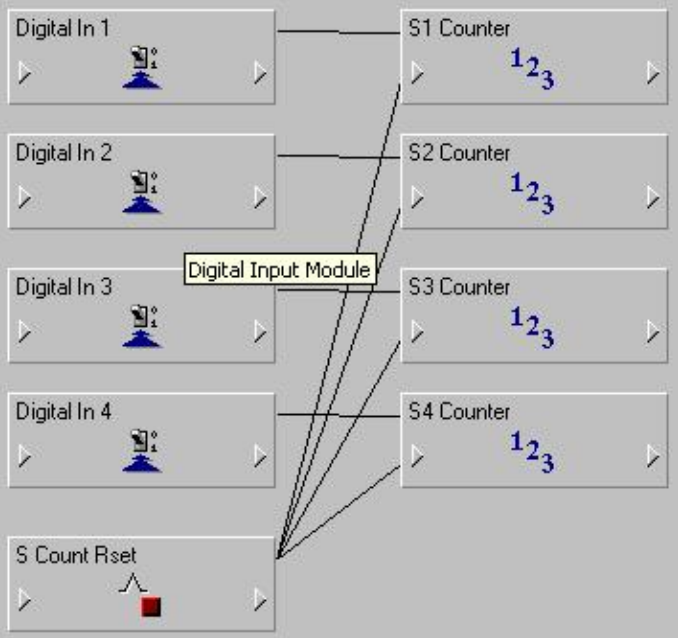
10:23

Designer - Administrator - [Digital Inputs[Main_Substation.CME_Shop_600V]]

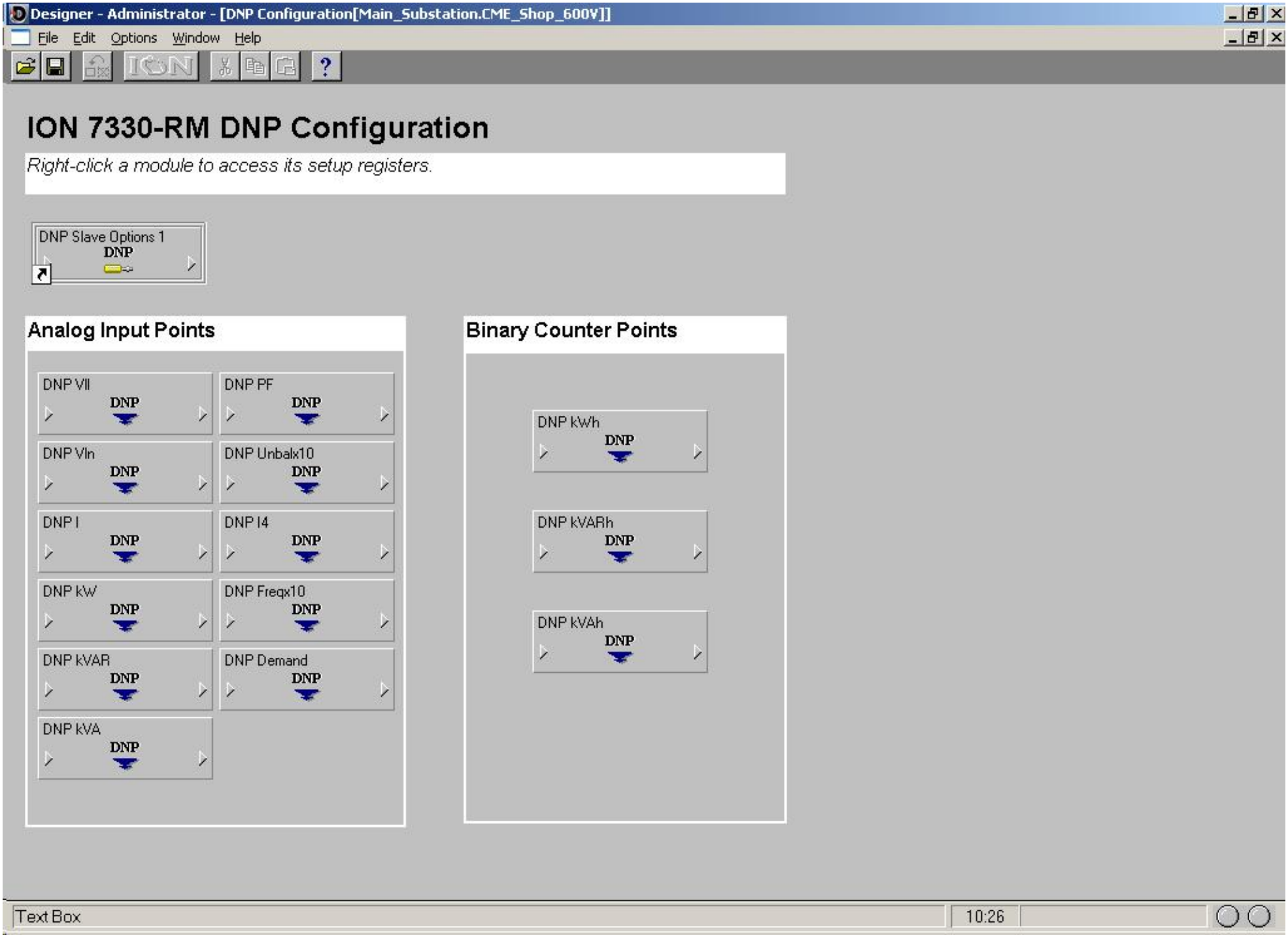
File Edit Options Window Help

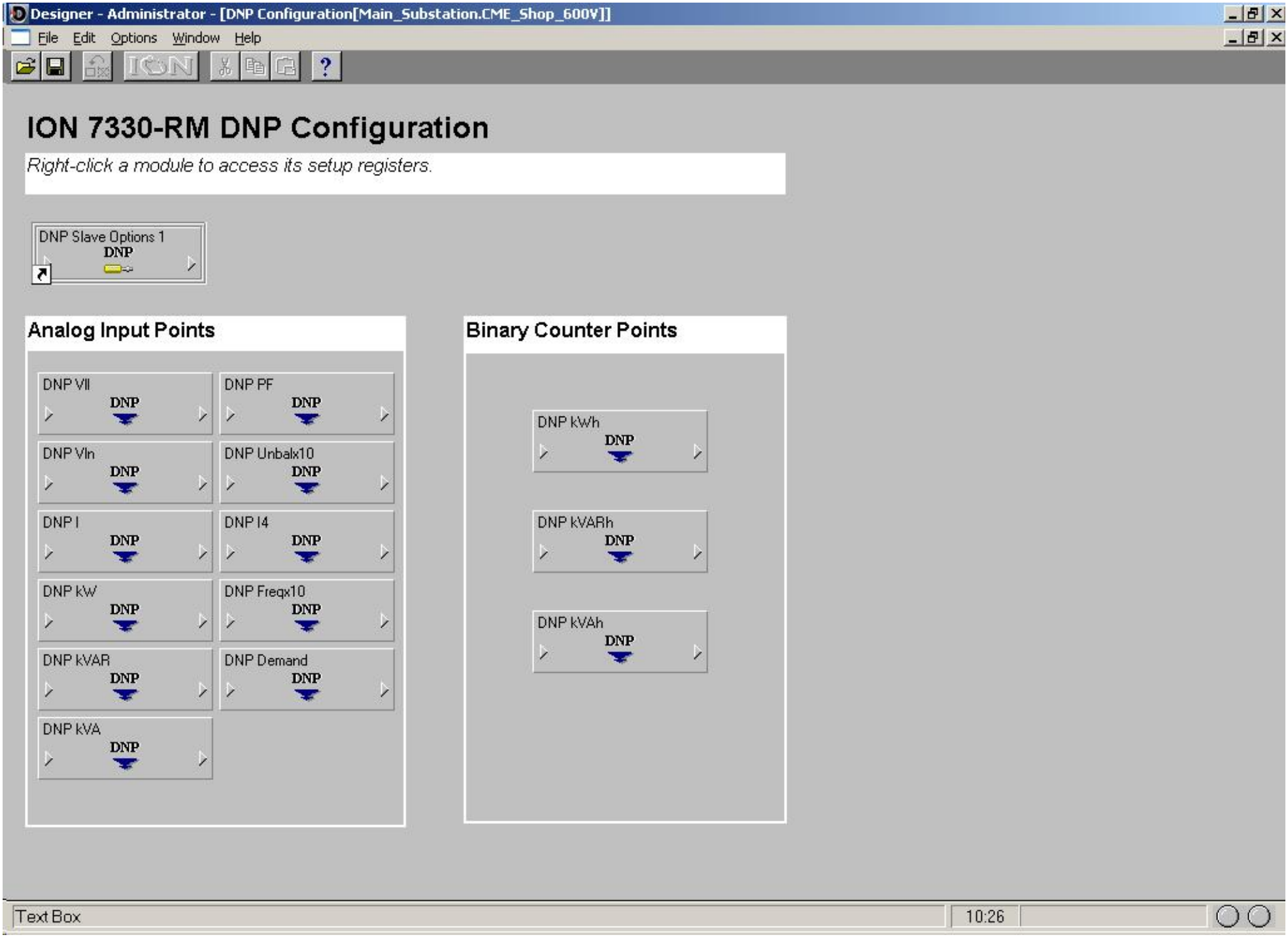
ION 7330-RM Digital Inputs

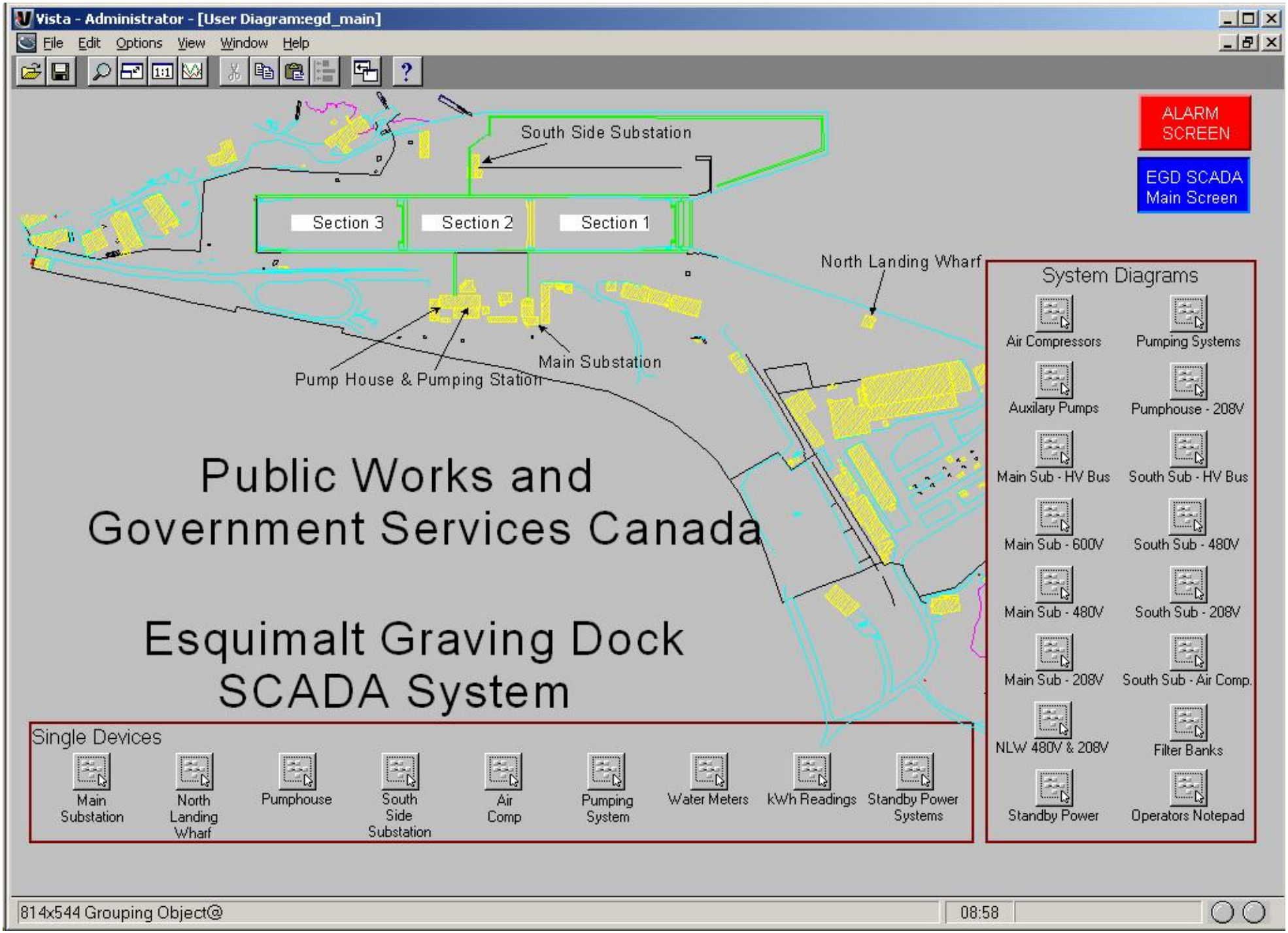
Right-click a module to access its setup registers.

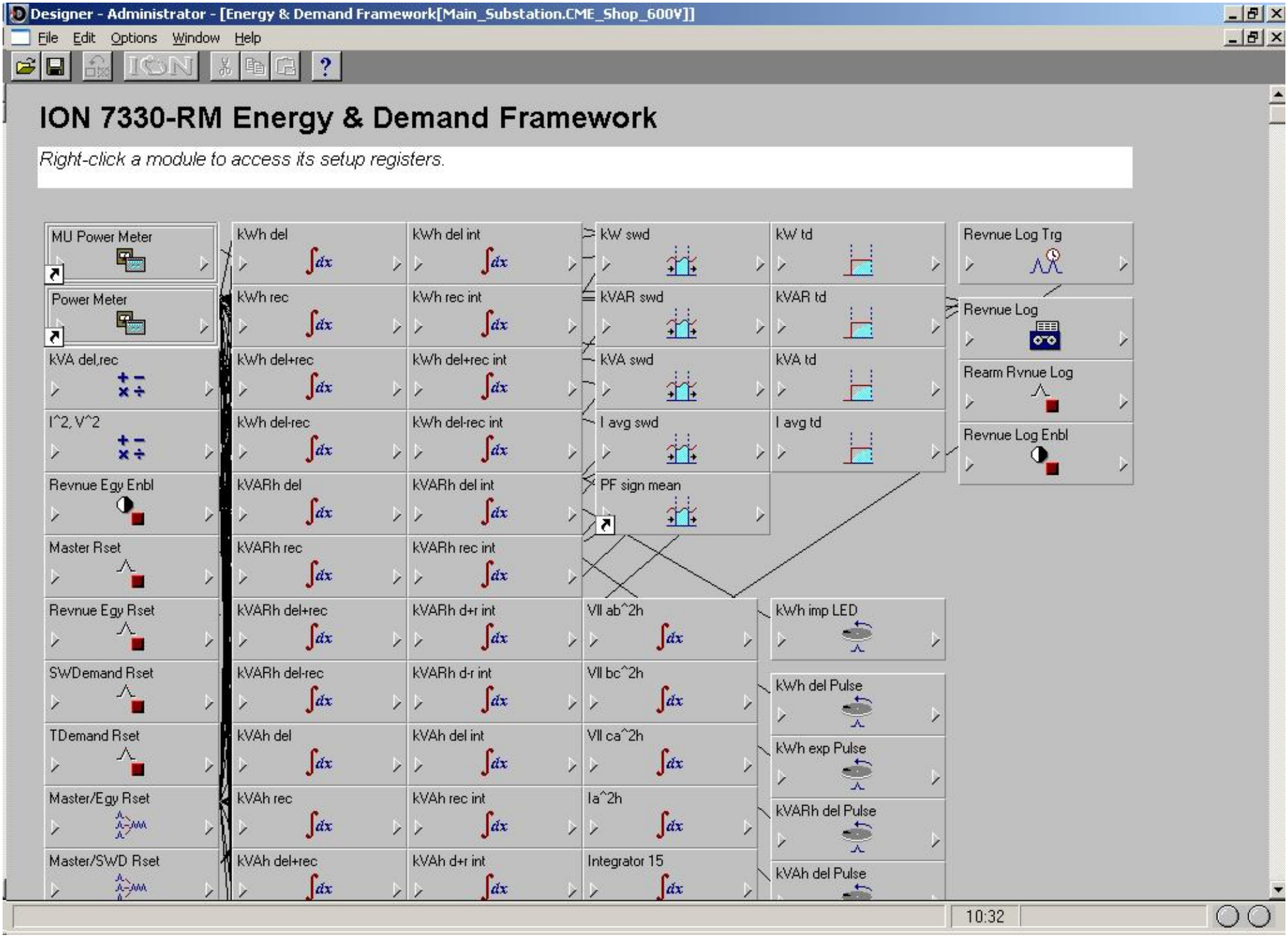


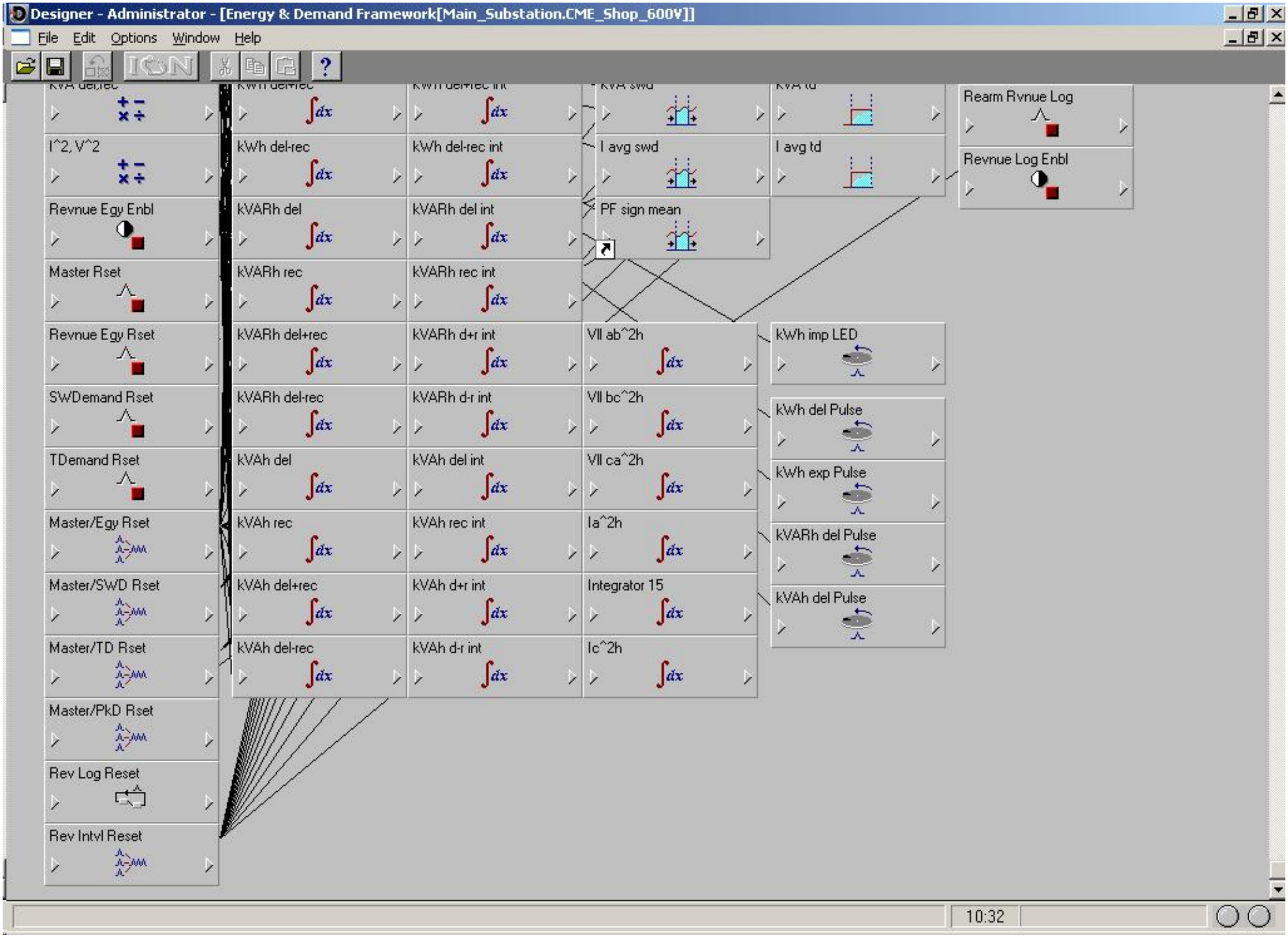
Digital In 2 10:31

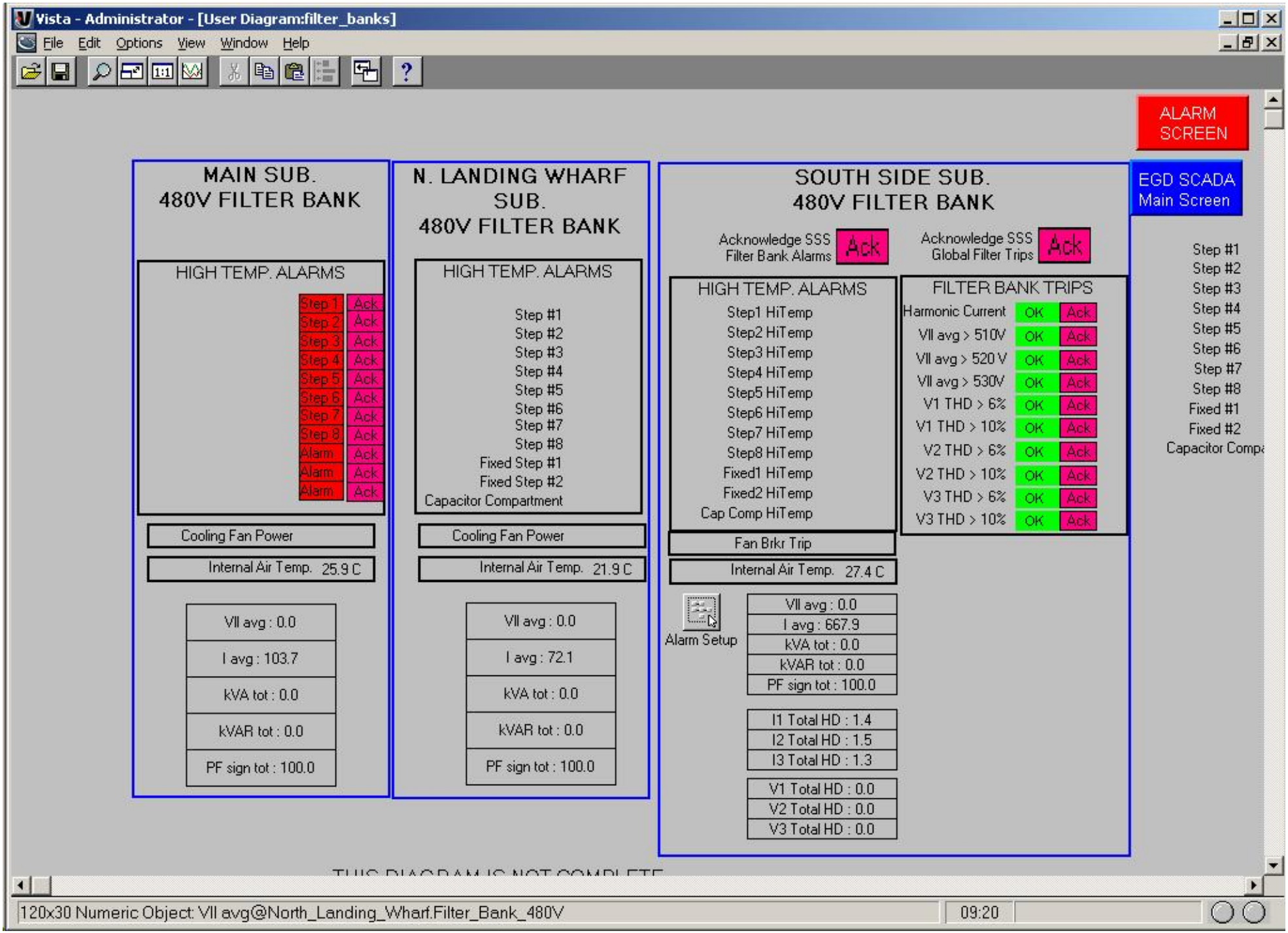

Designer - Administrator - [DNP Configuration[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM DNP Configuration
Right-click a module to access its setup registers.
DNP Slave Options 1
DNP
Analog Input Points
DNP VII
DNP
DNP PF
DNP
DNP Vln
DNP
DNP Unbalx10
DNP
DNP I
DNP
DNP I4
DNP
DNP kW
DNP
DNP Freqx10
DNP
DNP kVAR
DNP
DNP Demand
DNP
DNP kVA
DNP
Binary Counter Points
DNP kWh
DNP
DNP kVARh
DNP
DNP kVAh
DNP
Text Box
10:26

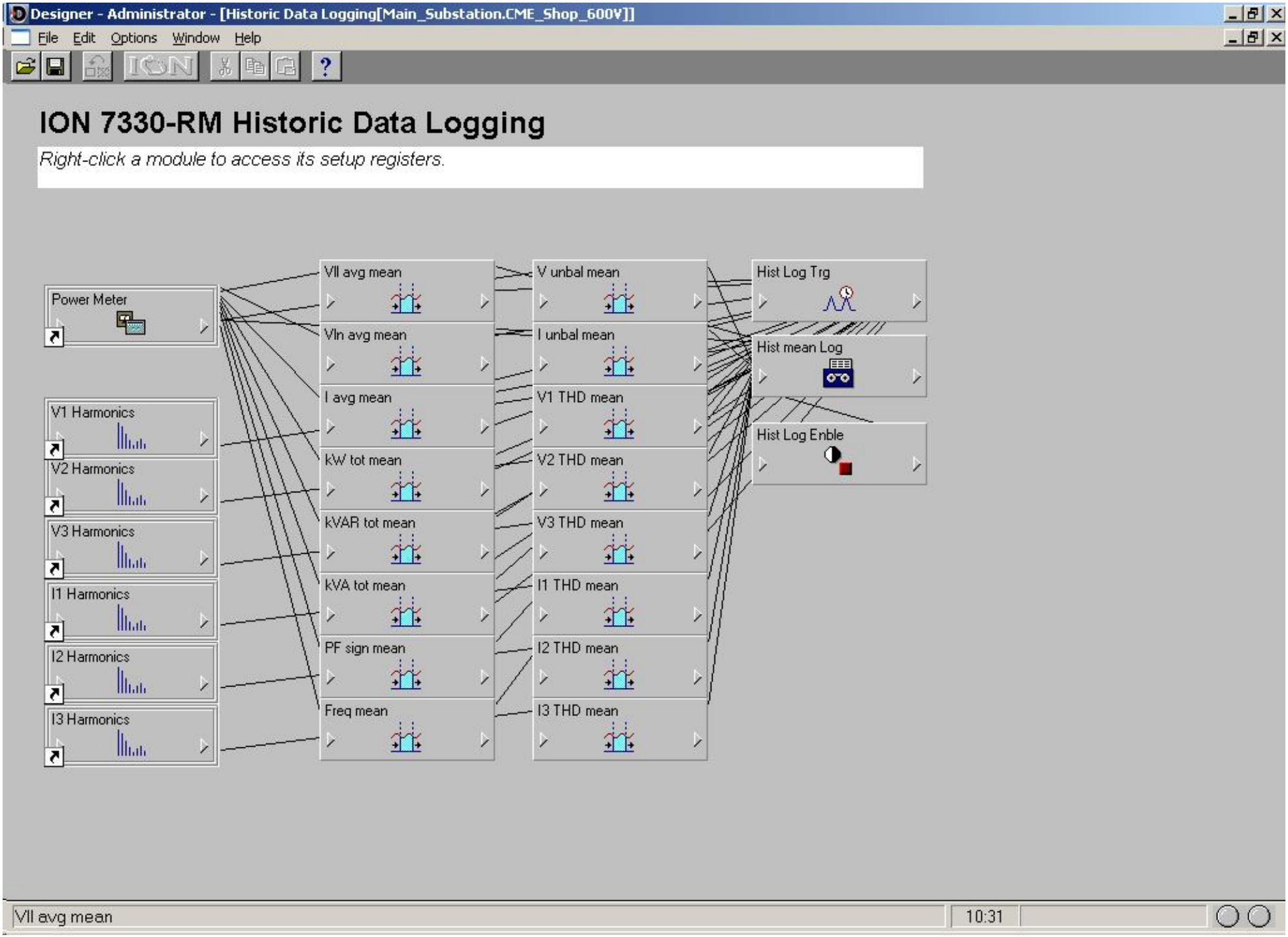

Designer - Administrator - [DNP Configuration[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM DNP Configuration
Right-click a module to access its setup registers.
DNP Slave Options 1
DNP
Analog Input Points
DNP VII
DNP
DNP PF
DNP
DNP Vln
DNP
DNP Unbalx10
DNP
DNP I
DNP
DNP I4
DNP
DNP kW
DNP
DNP Freqx10
DNP
DNP kVAR
DNP
DNP Demand
DNP
DNP kVA
DNP
Binary Counter Points
DNP kWh
DNP
DNP kVARh
DNP
DNP kVAh
DNP
Text Box
10:26

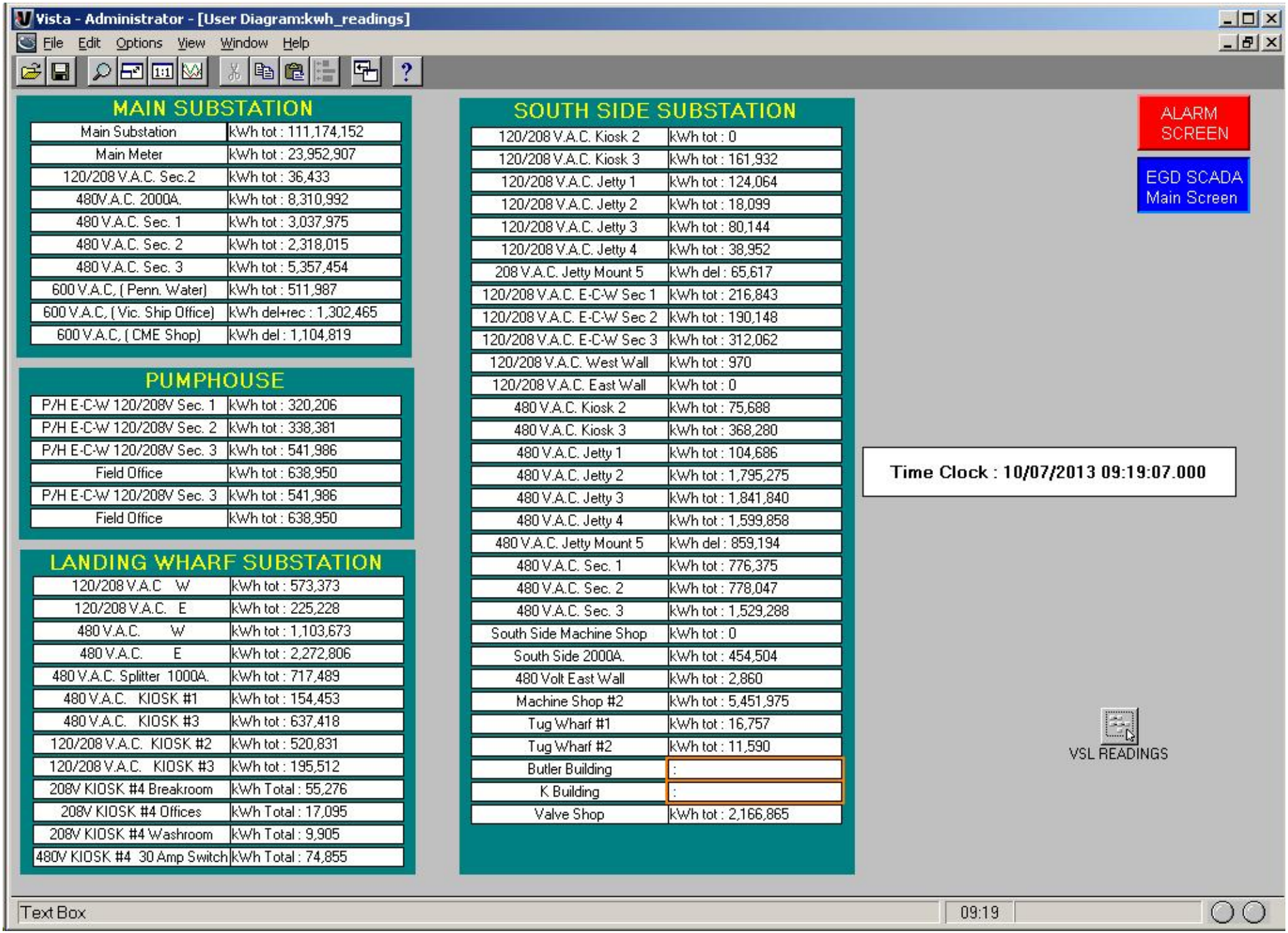

Vista - Administrator - [User Diagram:egd_main]
File Edit Options View Window Help
ALARM SCREEN
EGD SCADA Main Screen
South Side Substation
Section 3
Section 2
Section 1
North Landing Wharf
Main Substation
Pump House & Pumping Station
Public Works and Government Services Canada
Esquimalt Graving Dock SCADA System
System Diagrams
Air Compressors
Pumping Systems
Auxilary Pumps
Pumphouse - 208V
Main Sub - HV Bus
South Sub - HV Bus
Main Sub - 600V
South Sub - 480V
Main Sub - 480V
South Sub - 208V
Main Sub - 208V
South Sub - Air Comp.
NLW 480V & 208V
Filter Banks
Standby Power
Operators Notepad
Single Devices
Main Substation
North Landing Wharf
Pumphouse
South Side Substation
Air Comp
Pumping System
Water Meters
kWh Readings
Standby Power Systems
814x544 Grouping Object@
08:58

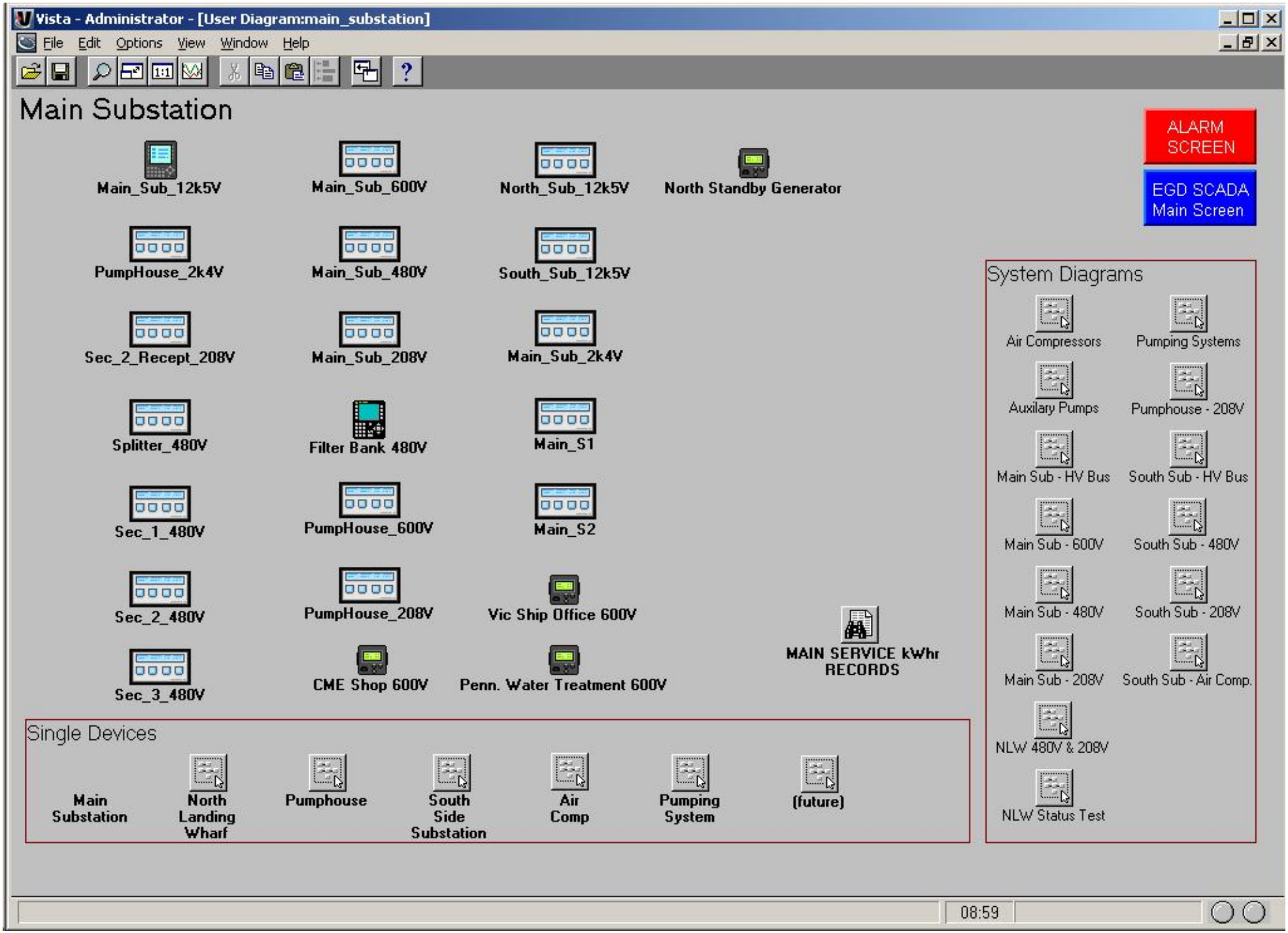

Designer - Administrator - [Energy & Demand Framework[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Energy & Demand Framework
Right-click a module to access its setup registers.
MU Power Meter
Power Meter
kVA del,rec
I^2, V^2
Revnue Egy Enbl
Master Rset
Revnue Egy Rset
SWDemand Rset
TDemand Rset
Master/Egy Rset
Master/SWD Rset
kWh del
kWh rec
kWh del+rec
kWh del-rec
kVARh del
kVARh rec
kVARh del+rec
kVARh del-rec
kVAh del
kVAh rec
kVAh del+rec
kWh del int
kWh rec int
kWh del+rec int
kWh del-rec int
kVARh del int
kVARh rec int
kVARh d+r int
kVARh d-r int
kVAh del int
kVAh rec int
kVAh d+r int
kW swd
kVAR swd
kVA swd
I avg swd
PF sign mean
Vll ab^2h
Vll bc^2h
Vll ca^2h
Ia^2h
Integrator 15
kW td
kVAR td
kVA td
I avg td
Revnue Log Trg
Revnue Log
Rearm Rvnue Log
Revnue Log Enbl
kWh imp LED
kWh del Pulse
kWh exp Pulse
kVARh del Pulse
kVAh del Pulse
10:32

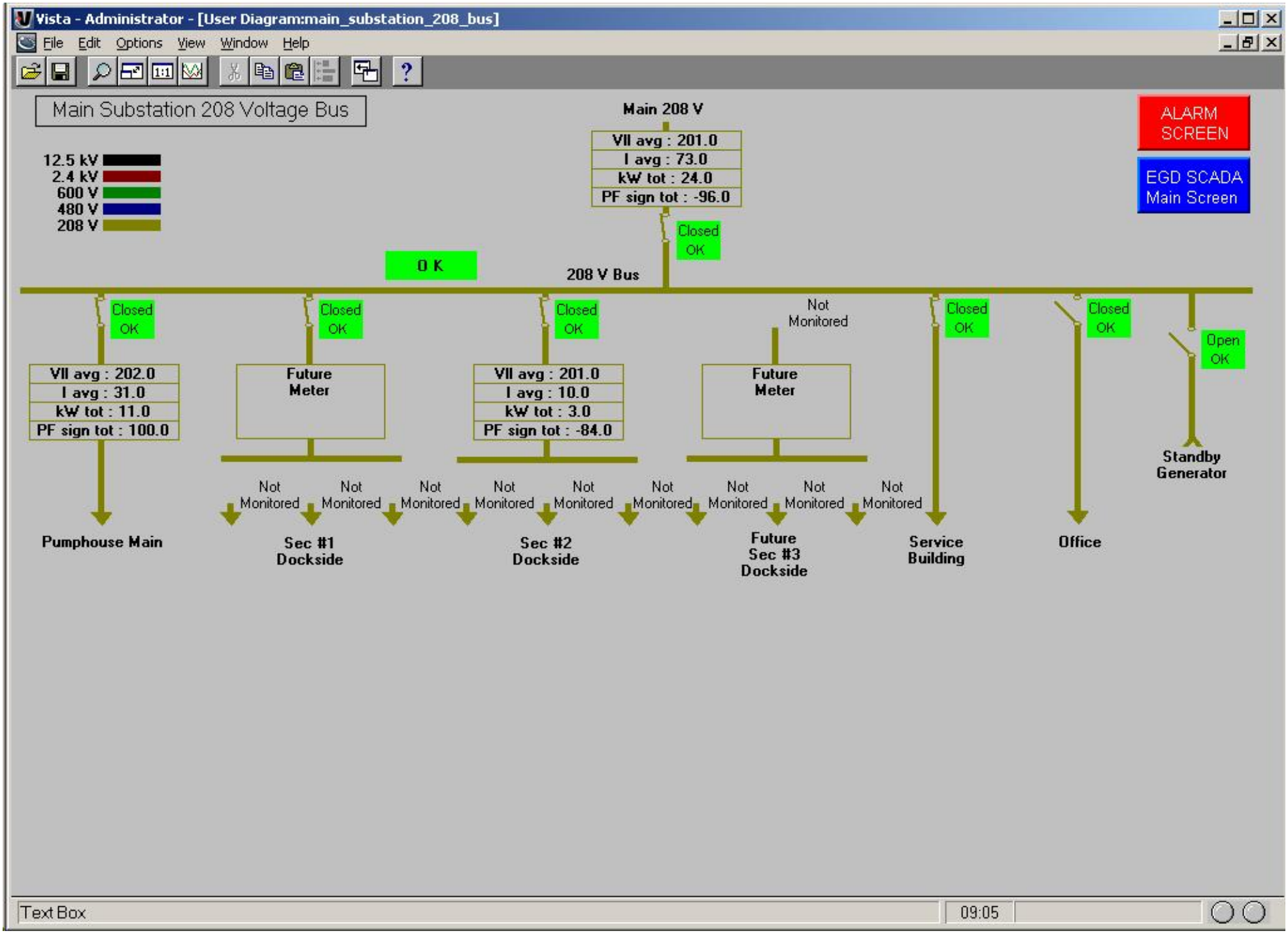

Designer - Administrator - [Energy & Demand Framework[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
I^2, V^2
Revnue Egy Enbl
Master Rset
Revnue Egy Rset
SW/Demand Rset
TDemand Rset
Master/Egy Rset
Master/SWD Rset
Master/TD Rset
Master/PkD Rset
Rev Log Reset
Rev Intvl Reset
kWh del-rec
kWh del-rec int
kVARh del
kVARh del int
kVARh rec
kVARh rec int
kVARh del+rec
kVARh d+r int
kVARh del-rec
kVARh d-r int
kVAh del
kVAh del int
kVAh rec
kVAh rec int
kVAh del+rec
kVAh d+r int
kVAh del-rec
kVAh d-r int
I avg swd
I avg td
PF sign mean
Vll ab^2h
Vll bc^2h
Vll ca^2h
Ia^2h
Integrator 15
Ic^2h
Rearm Rvnue Log
Revnue Log Enbl
kWh imp LED
kWh del Pulse
kWh exp Pulse
kVARh del Pulse
kVAh del Pulse
10:32

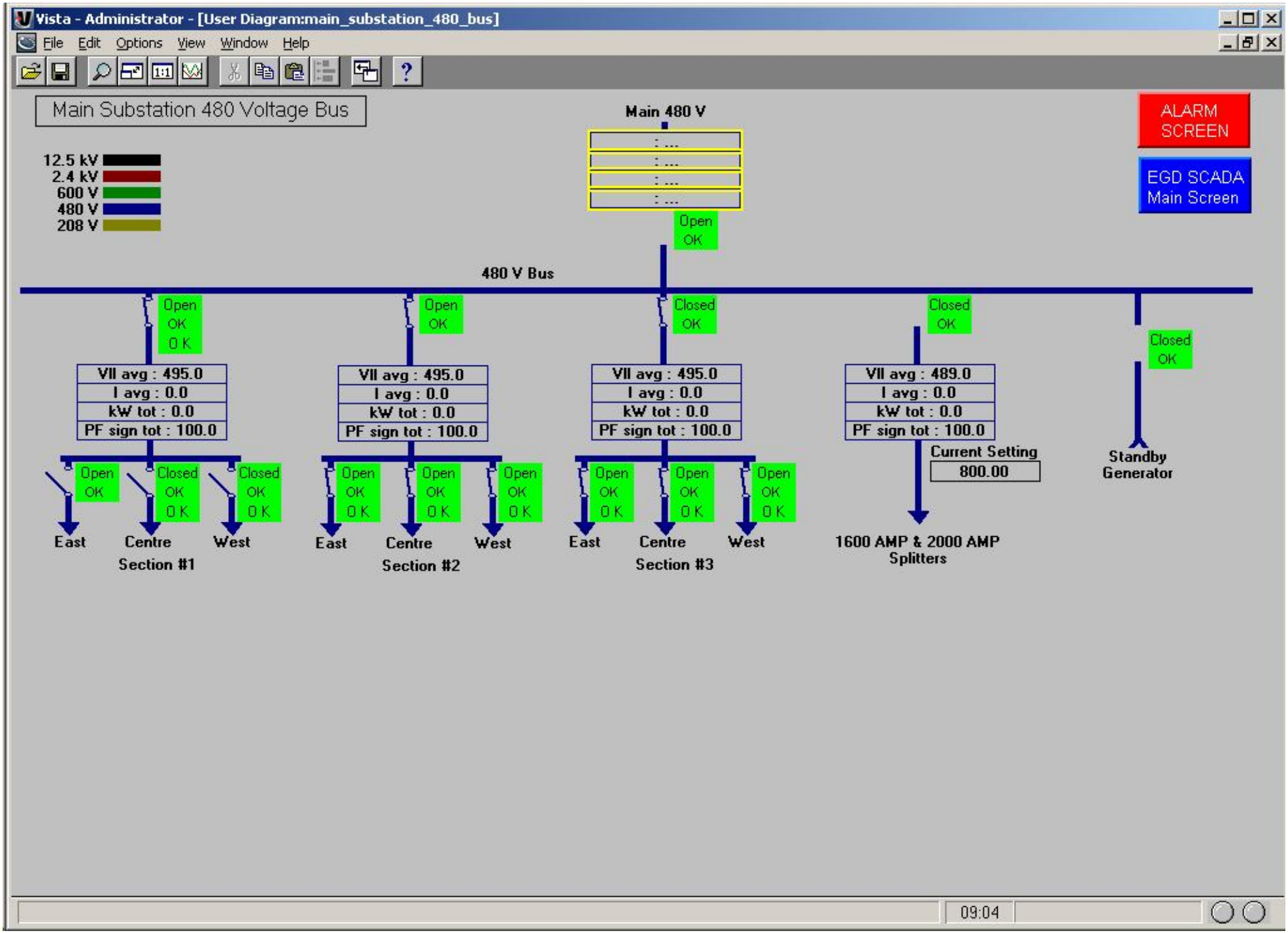

Vista - Administrator - [User Diagram:filter_banks]
File Edit Options View Window Help
ALARM SCREEN
EGD SCADA Main Screen
MAIN SUB. 480V FILTER BANK
HIGH TEMP. ALARMS
Step 1 Ack
Step 2 Ack
Step 3 Ack
Step 4 Ack
Step 5 Ack
Step 6 Ack
Step 7 Ack
Step 8 Ack
Alarm Ack
Alarm Ack
Alarm Ack
Cooling Fan Power
Internal Air Temp. 25.9 C
Vll avg : 0.0
I avg : 103.7
kVA tot : 0.0
kVAR tot : 0.0
PF sign tot : 100.0
N. LANDING WHARF SUB. 480V FILTER BANK
HIGH TEMP. ALARMS
Step #1
Step #2
Step #3
Step #4
Step #5
Step #6
Step #7
Step #8
Fixed Step #1
Fixed Step #2
Capacitor Compartment
Cooling Fan Power
Internal Air Temp. 21.9 C
Vll avg : 0.0
I avg : 72.1
kVA tot : 0.0
kVAR tot : 0.0
PF sign tot : 100.0
SOUTH SIDE SUB. 480V FILTER BANK
Acknowledge SSS Filter Bank Alarms Ack
Acknowledge SSS Global Filter Trips Ack
HIGH TEMP. ALARMS
Step1 HiTemp
Step2 HiTemp
Step3 HiTemp
Step4 HiTemp
Step5 HiTemp
Step6 HiTemp
Step7 HiTemp
Step8 HiTemp
Fixed1 HiTemp
Fixed2 HiTemp
Cap Comp HiTemp
FILTER BANK TRIPS
Harmonic Current OK Ack
Vll avg > 510V OK Ack
Vll avg > 520 V OK Ack
Vll avg > 530V OK Ack
V1 THD > 6% OK Ack
V1 THD > 10% OK Ack
V2 THD > 6% OK Ack
V2 THD > 10% OK Ack
V3 THD > 6% OK Ack
V3 THD > 10% OK Ack
Fan Brkr Trip
Internal Air Temp. 27.4 C
Alarm Setup
Vll avg : 0.0
I avg : 667.9
kVA tot : 0.0
kVAR tot : 0.0
PF sign tot : 100.0
I1 Total HD : 1.4
I2 Total HD : 1.5
I3 Total HD : 1.3
V1 Total HD : 0.0
V2 Total HD : 0.0
V3 Total HD : 0.0
Step #1
Step #2
Step #3
Step #4
Step #5
Step #6
Step #7
Step #8
Fixed #1
Fixed #2
Capacitor Compa
120x30 Numeric Object: Vll avg@North_Landing_Wharf.Filter_Bank_480V
09:20

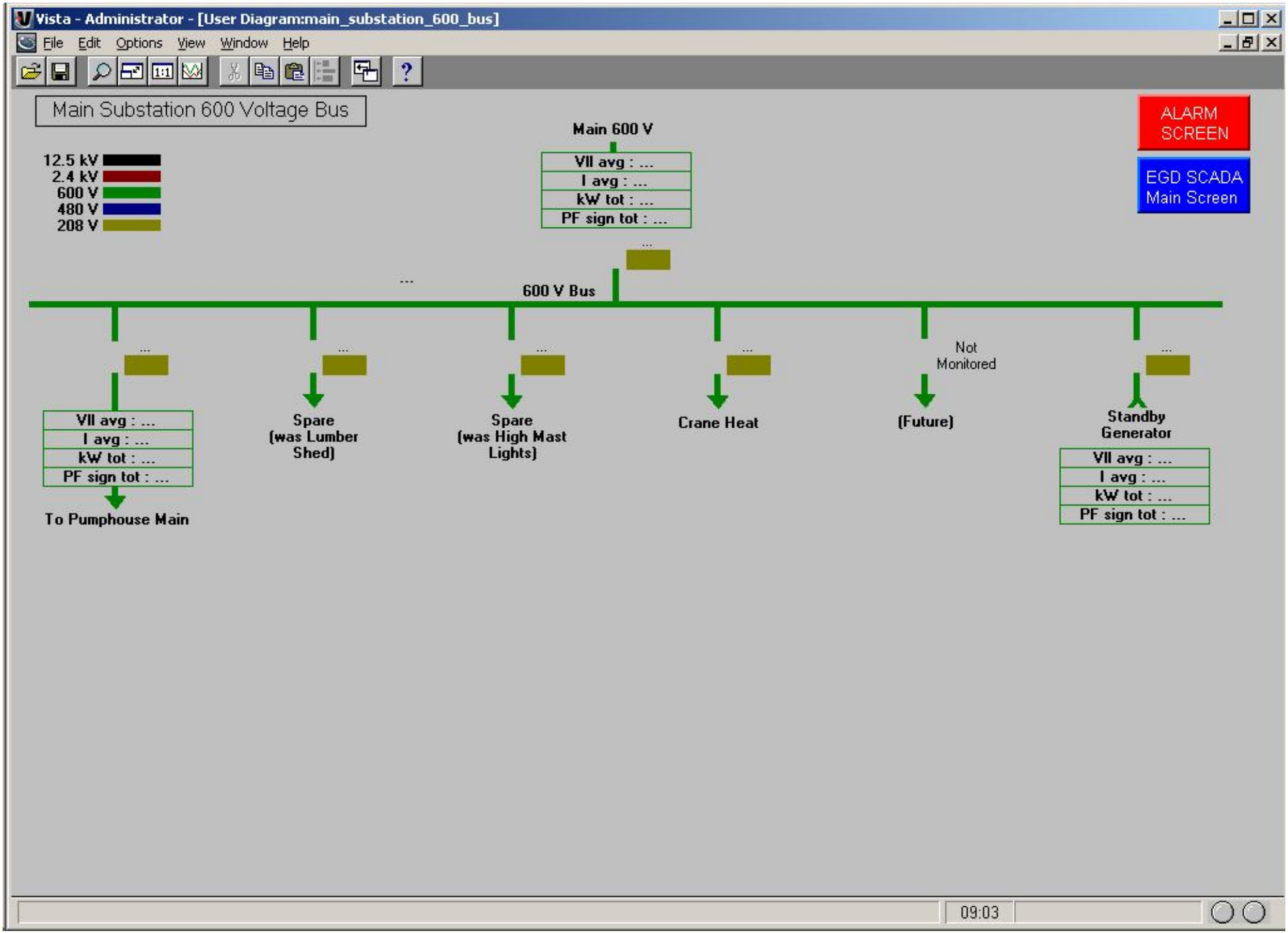

Designer - Administrator - [Historic Data Logging[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Historic Data Logging
Right-click a module to access its setup registers.
Power Meter
V1 Harmonics
V2 Harmonics
V3 Harmonics
I1 Harmonics
I2 Harmonics
I3 Harmonics
Vll avg mean
Vln avg mean
I avg mean
kW tot mean
kVAR tot mean
kVA tot mean
PF sign mean
Freq mean
V unbal mean
I unbal mean
V1 THD mean
V2 THD mean
V3 THD mean
I1 THD mean
I2 THD mean
I3 THD mean
Hist Log Trg
Hist mean Log
Hist Log Enble
Vll avg mean
10:31

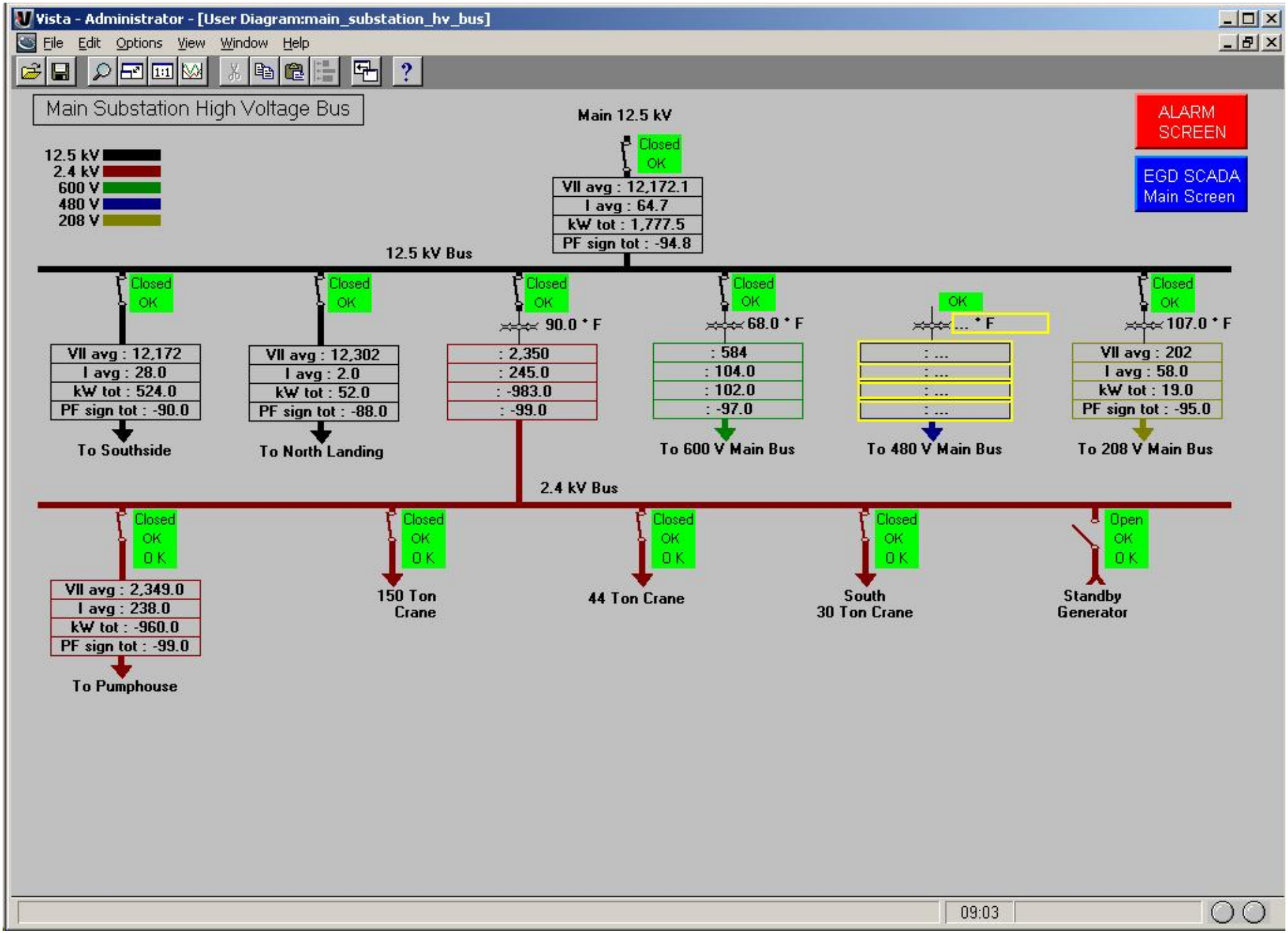

Vista - Administrator - [User Diagram:kwh_readings]
File Edit Options View Window Help
MAIN SUBSTATION
Main Substation kWh tot : 111,174,152
Main Meter kWh tot : 23,952,907
120/208 V.A.C. Sec.2 kWh tot : 36,433
480V.A.C. 2000A. kWh tot : 8,310,992
480 V.A.C. Sec. 1 kWh tot : 3,037,975
480 V.A.C. Sec. 2 kWh tot : 2,318,015
480 V.A.C. Sec. 3 kWh tot : 5,357,454
600 V.A.C, (Penn. Water) kWh tot : 511,987
600 V.A.C, (Vic. Ship Office) kWh del+rec : 1,302,465
600 V.A.C, (CME Shop) kWh del : 1,104,819
PUMPHOUSE
P/H E-C-W 120/208V Sec. 1 kWh tot : 320,206
P/H E-C-W 120/208V Sec. 2 kWh tot : 338,381
P/H E-C-W 120/208V Sec. 3 kWh tot : 541,986
Field Office kWh tot : 638,950
P/H E-C-W 120/208V Sec. 3 kWh tot : 541,986
Field Office kWh tot : 638,950
LANDING WHARF SUBSTATION
120/208 V.A.C W kWh tot : 573,373
120/208 V.A.C. E kWh tot : 225,228
480 V.A.C. W kWh tot : 1,103,673
480 V.A.C. E kWh tot : 2,272,806
480 V.A.C. Splitter 1000A. kWh tot : 717,489
480 V.A.C. KIOSK #1 kWh tot : 154,453
480 V.A.C. KIOSK #3 kWh tot : 637,418
120/208 V.A.C. KIOSK #2 kWh tot : 520,831
120/208 V.A.C. KIOSK #3 kWh tot : 195,512
208V KIOSK #4 Breakroom kWh Total : 55,276
208V KIOSK #4 Offices kWh Total : 17,095
208V KIOSK #4 Washroom kWh Total : 9,905
480V KIOSK #4 30 Amp Switch kWh Total : 74,855
SOUTH SIDE SUBSTATION
120/208 V.A.C. Kiosk 2 kWh tot : 0
120/208 V.A.C. Kiosk 3 kWh tot : 161,932
120/208 V.A.C. Jetty 1 kWh tot : 124,064
120/208 V.A.C. Jetty 2 kWh tot : 18,099
120/208 V.A.C. Jetty 3 kWh tot : 80,144
120/208 V.A.C. Jetty 4 kWh tot : 38,952
208 V.A.C. Jetty Mount 5 kWh del : 65,617
120/208 V.A.C. E-C-W Sec 1 kWh tot : 216,843
120/208 V.A.C. E-C-W Sec 2 kWh tot : 190,148
120/208 V.A.C. E-C-W Sec 3 kWh tot : 312,062
120/208 V.A.C. West Wall kWh tot : 970
120/208 V.A.C. East Wall kWh tot : 0
480 V.A.C. Kiosk 2 kWh tot : 75,688
480 V.A.C. Kiosk 3 kWh tot : 368,280
480 V.A.C. Jetty 1 kWh tot : 104,686
480 V.A.C. Jetty 2 kWh tot : 1,795,275
480 V.A.C. Jetty 3 kWh tot : 1,841,840
480 V.A.C. Jetty 4 kWh tot : 1,599,858
480 V.A.C. Jetty Mount 5 kWh del : 859,194
480 V.A.C. Sec. 1 kWh tot : 776,375
480 V.A.C. Sec. 2 kWh tot : 778,047
480 V.A.C. Sec. 3 kWh tot : 1,529,288
South Side Machine Shop kWh tot : 0
South Side 2000A. kWh tot : 454,504
480 Volt East Wall kWh tot : 2,860
Machine Shop #2 kWh tot : 5,451,975
Tug Wharf #1 kWh tot : 16,757
Tug Wharf #2 kWh tot : 11,590
Butler Building :
K Building :
Valve Shop kWh tot : 2,166,865
ALARM SCREEN
EGD SCADA Main Screen
Time Clock : 10/07/2013 09:19:07.000
VSL READINGS
Text Box
09:19

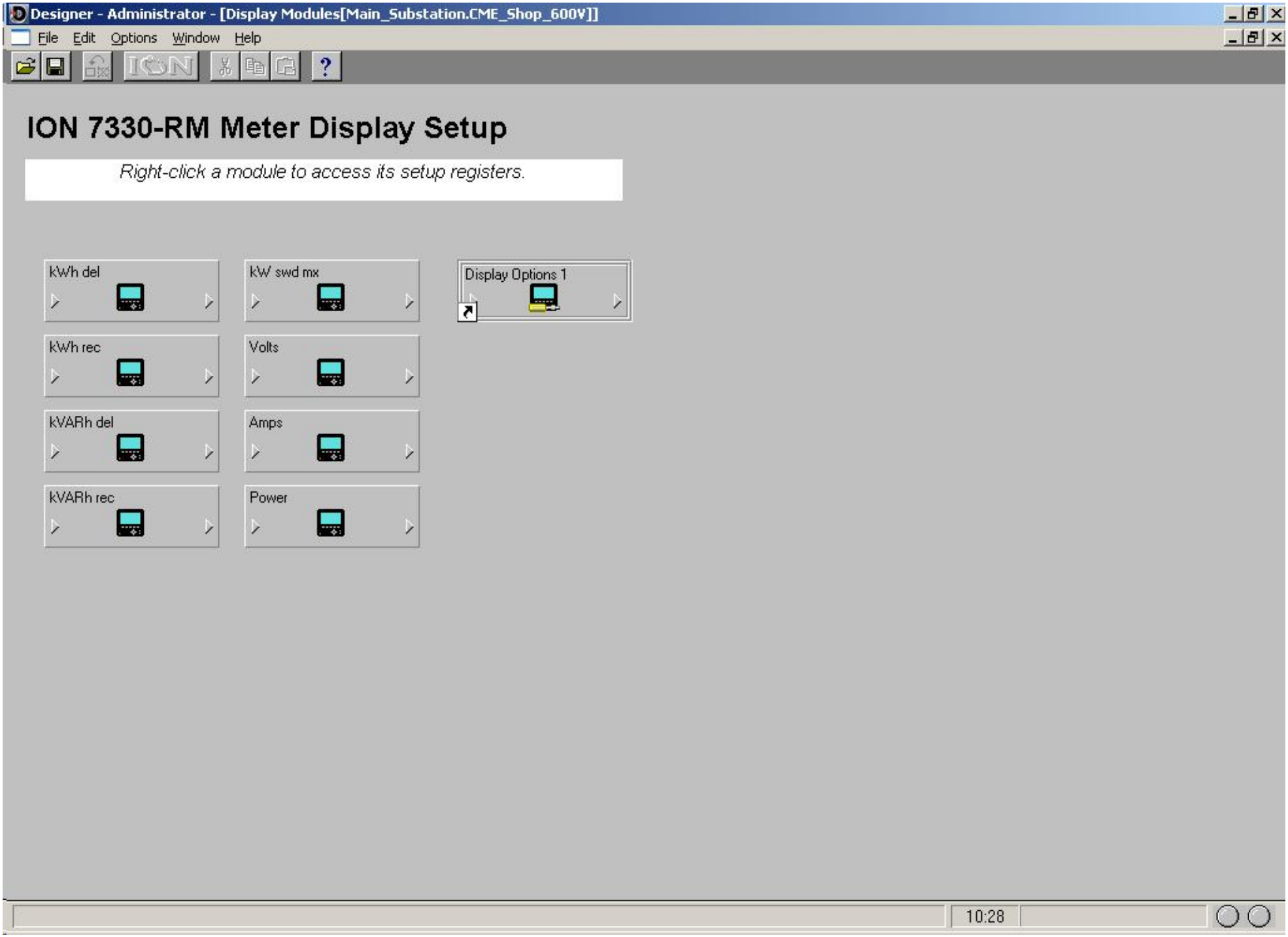

Vista - Administrator - [User Diagram:main_substation]
File Edit Options View Window Help
Main Substation
ALARM SCREEN
EGD SCADA Main Screen
Main_Sub_12k5V
Main_Sub_600V
North_Sub_12k5V
North Standby Generator
PumpHouse_2k4V
Main_Sub_480V
South_Sub_12k5V
Sec_2_Recept_208V
Main_Sub_208V
Main_Sub_2k4V
Splitter_480V
Filter Bank 480V
Main_S1
Sec_1_480V
PumpHouse_600V
Main_S2
Sec_2_480V
PumpHouse_208V
Vic Ship Office 600V
Sec_3_480V
CME Shop 600V
Penn. Water Treatment 600V
MAIN SERVICE kWhr RECORDS
System Diagrams
Air Compressors
Pumping Systems
Auxilary Pumps
Pumphouse - 208V
Main Sub - HV Bus
South Sub - HV Bus
Main Sub - 600V
South Sub - 480V
Main Sub - 480V
South Sub - 208V
Main Sub - 208V
South Sub - Air Comp.
NLW 480V & 208V
NLW Status Test
Single Devices
Main Substation
North Landing Wharf
Pumphouse
South Side Substation
Air Comp
Pumping System
(future)
08:59

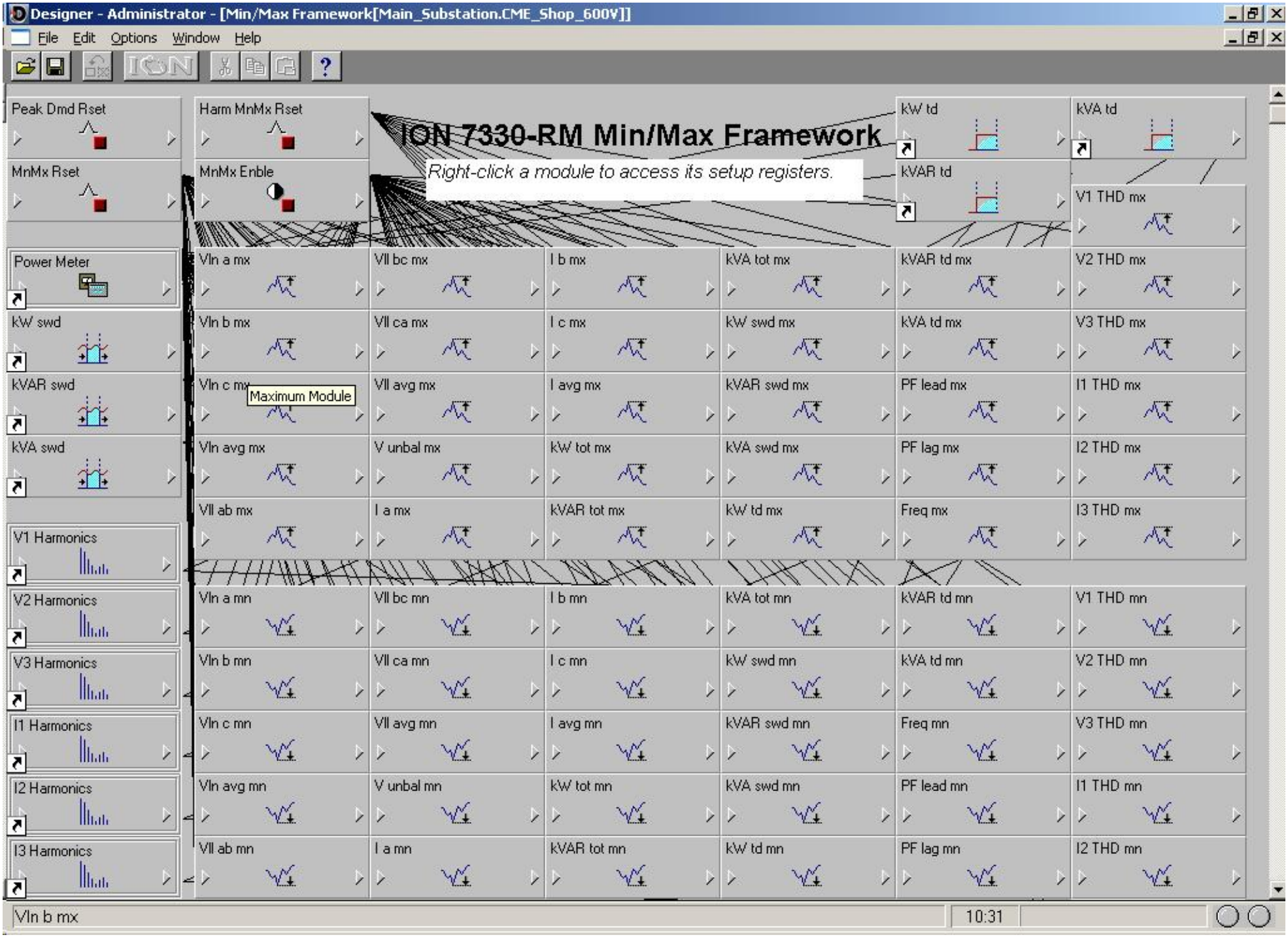

Vista - Administrator - [User Diagram:main_substation_208_bus]
File Edit Options View Window Help
Main Substation 208 Voltage Bus
12.5 kV
2.4 kV
600 V
480 V
208 V
Main 208 V
VII avg : 201.0
I avg : 73.0
kW tot : 24.0
PF sign tot : -96.0
Closed OK
ALARM SCREEN
EGD SCADA Main Screen
O K
208 V Bus
Closed OK
VII avg : 202.0
I avg : 31.0
kW tot : 11.0
PF sign tot : 100.0
Pumphouse Main
Closed OK
Future Meter
Not Monitored
Sec #1 Dockside
Closed OK
VII avg : 201.0
I avg : 10.0
kW tot : 3.0
PF sign tot : -84.0
Not Monitored
Sec #2 Dockside
Not Monitored
Future Meter
Not Monitored
Future Sec #3 Dockside
Closed OK
Service Building
Closed OK
Office
Open OK
Standby Generator
Text Box
09:05

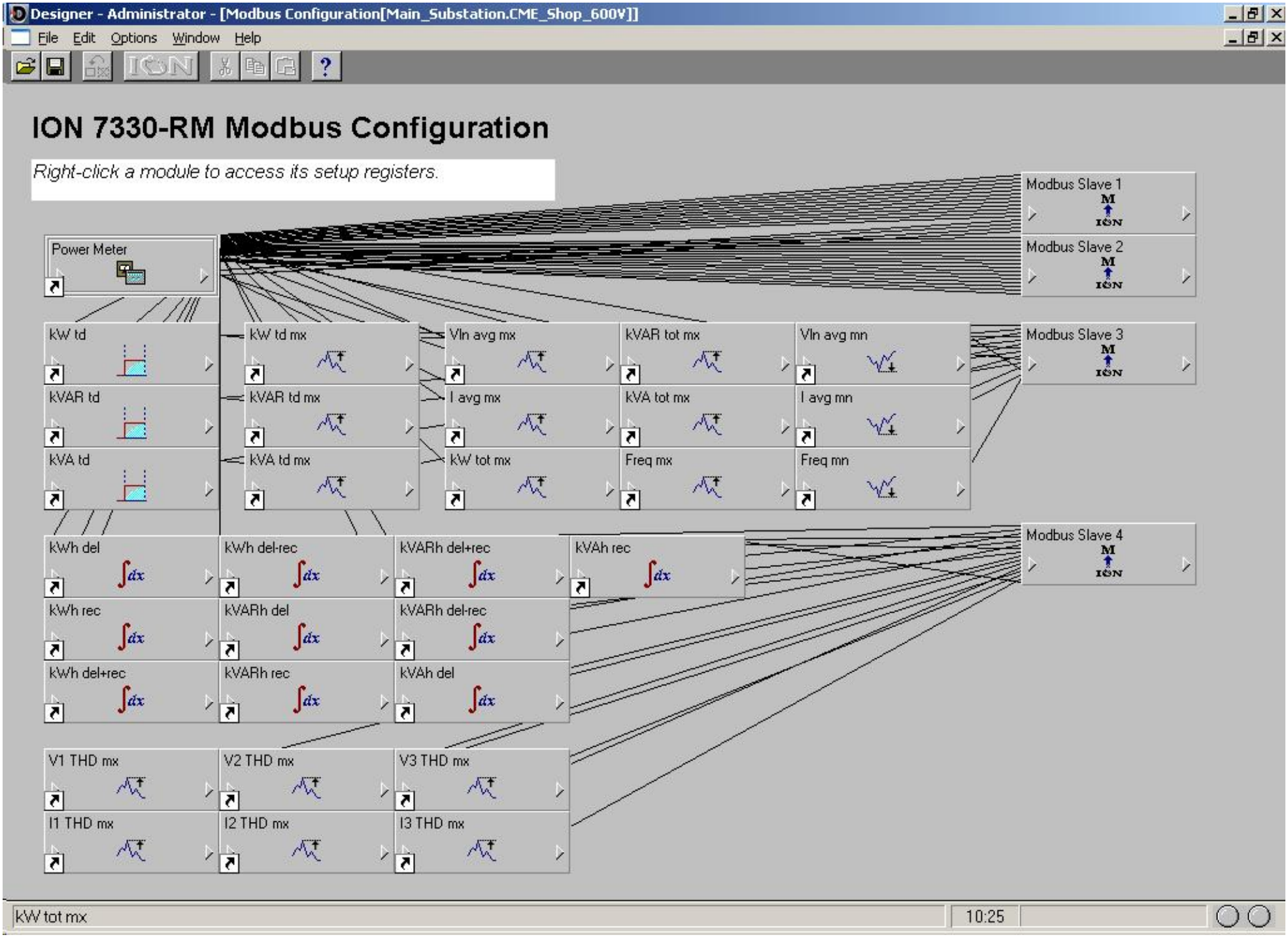

Vista - Administrator - [User Diagram:main_substation_480_bus]
File Edit Options View Window Help
Main Substation 480 Voltage Bus
12.5 kV
2.4 kV
600 V
480 V
208 V
Main 480 V
: ...
: ...
: ...
: ...
Open
OK
ALARM SCREEN
EGD SCADA Main Screen
480 V Bus
Open
OK
O K
Closed
OK
VII avg : 495.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
VII avg : 489.0
Current Setting
800.00
East
Centre
West
Section #1
Section #2
Section #3
1600 AMP & 2000 AMP Splitters
Standby Generator
09:04

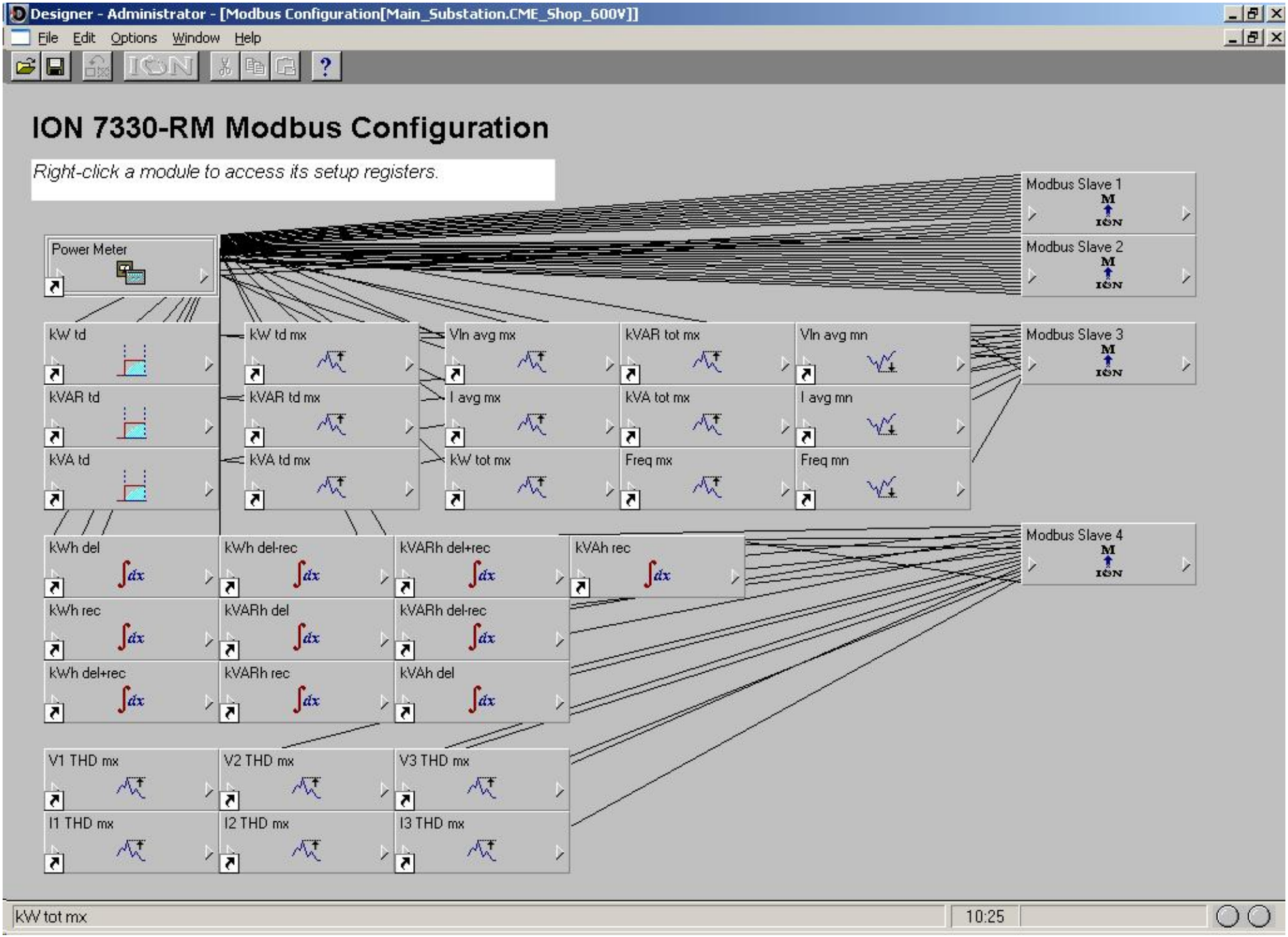

Vista - Administrator - [User Diagram:main_substation_600_bus]
File Edit Options View Window Help
Main Substation 600 Voltage Bus
12.5 kV
2.4 kV
600 V
480 V
208 V
Main 600 V
Vll avg : ...
I avg : ...
kW tot : ...
PF sign tot : ...
600 V Bus
ALARM SCREEN
EGD SCADA Main Screen
Vll avg : ...
I avg : ...
kW tot : ...
PF sign tot : ...
To Pumphouse Main
Spare (was Lumber Shed)
Spare (was High Mast Lights)
Crane Heat
Not Monitored
(Future)
Standby Generator
Vll avg : ...
I avg : ...
kW tot : ...
PF sign tot : ...
09:03

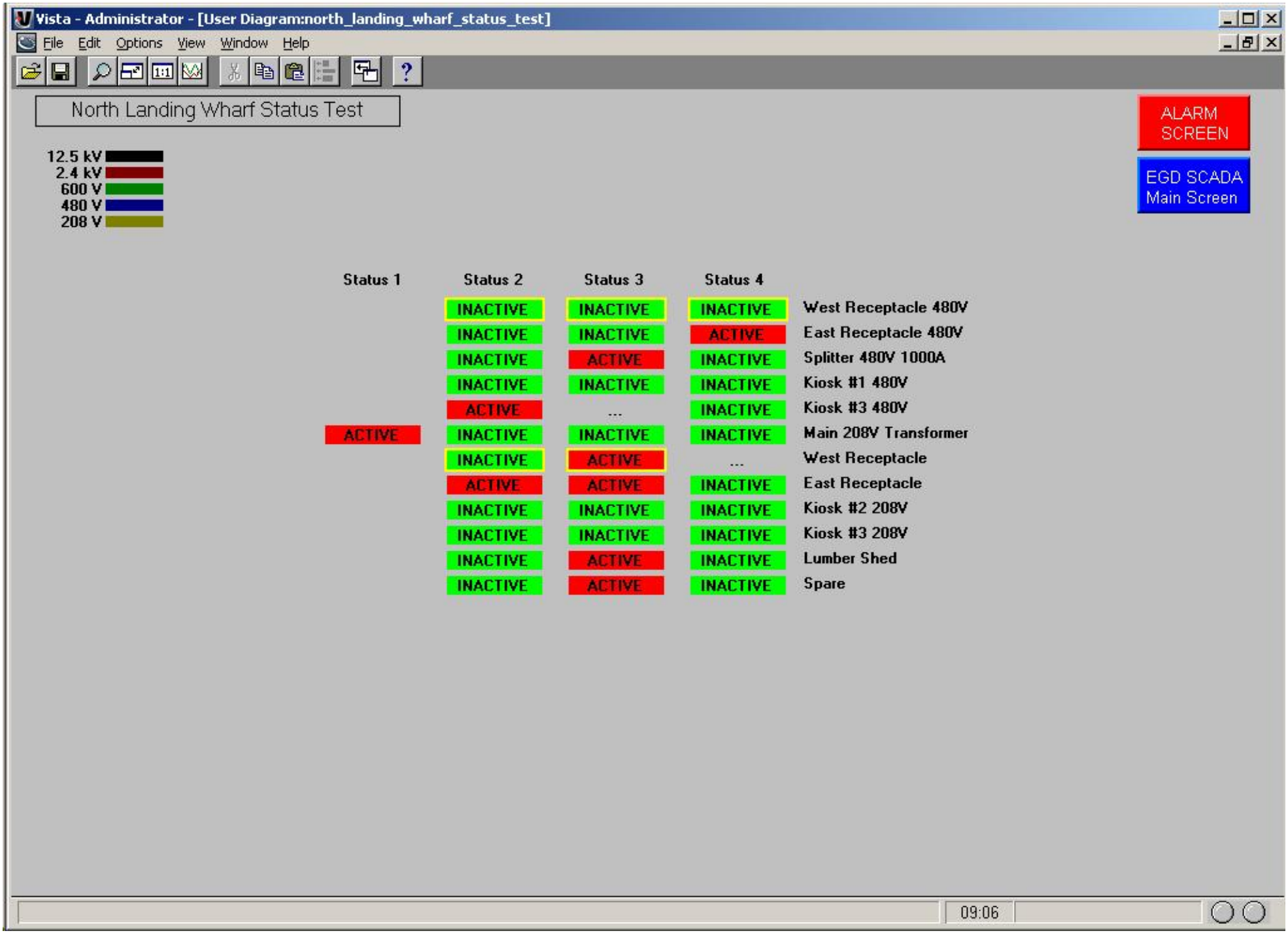

Vista - Administrator - [User Diagram:main_substation_hv_bus]
File Edit Options View Window Help
Main Substation High Voltage Bus
12.5 kV
2.4 kV
600 V
480 V
208 V
Main 12.5 kV
Closed
OK
VII avg : 12,172.1
I avg : 64.7
kW tot : 1,777.5
PF sign tot : -94.8
ALARM SCREEN
EGD SCADA Main Screen
12.5 kV Bus
Closed
OK
VII avg : 12,172
I avg : 28.0
kW tot : 524.0
PF sign tot : -90.0
To Southside
Closed
OK
VII avg : 12,302
I avg : 2.0
kW tot : 52.0
PF sign tot : -88.0
To North Landing
Closed
OK
90.0 * F
: 2,350
: 245.0
: -983.0
: -99.0
Closed
OK
68.0 * F
: 584
: 104.0
: 102.0
: -97.0
To 600 V Main Bus
OK
... * F
: ...
: ...
: ...
: ...
To 480 V Main Bus
Closed
OK
107.0 * F
VII avg : 202
I avg : 58.0
kW tot : 19.0
PF sign tot : -95.0
To 208 V Main Bus
2.4 kV Bus
Closed
OK
O K
VII avg : 2,349.0
I avg : 238.0
kW tot : -960.0
PF sign tot : -99.0
To Pumphouse
Closed
OK
O K
150 Ton Crane
Closed
OK
O K
44 Ton Crane
Closed
OK
O K
South 30 Ton Crane
Open
OK
O K
Standby Generator
09:03

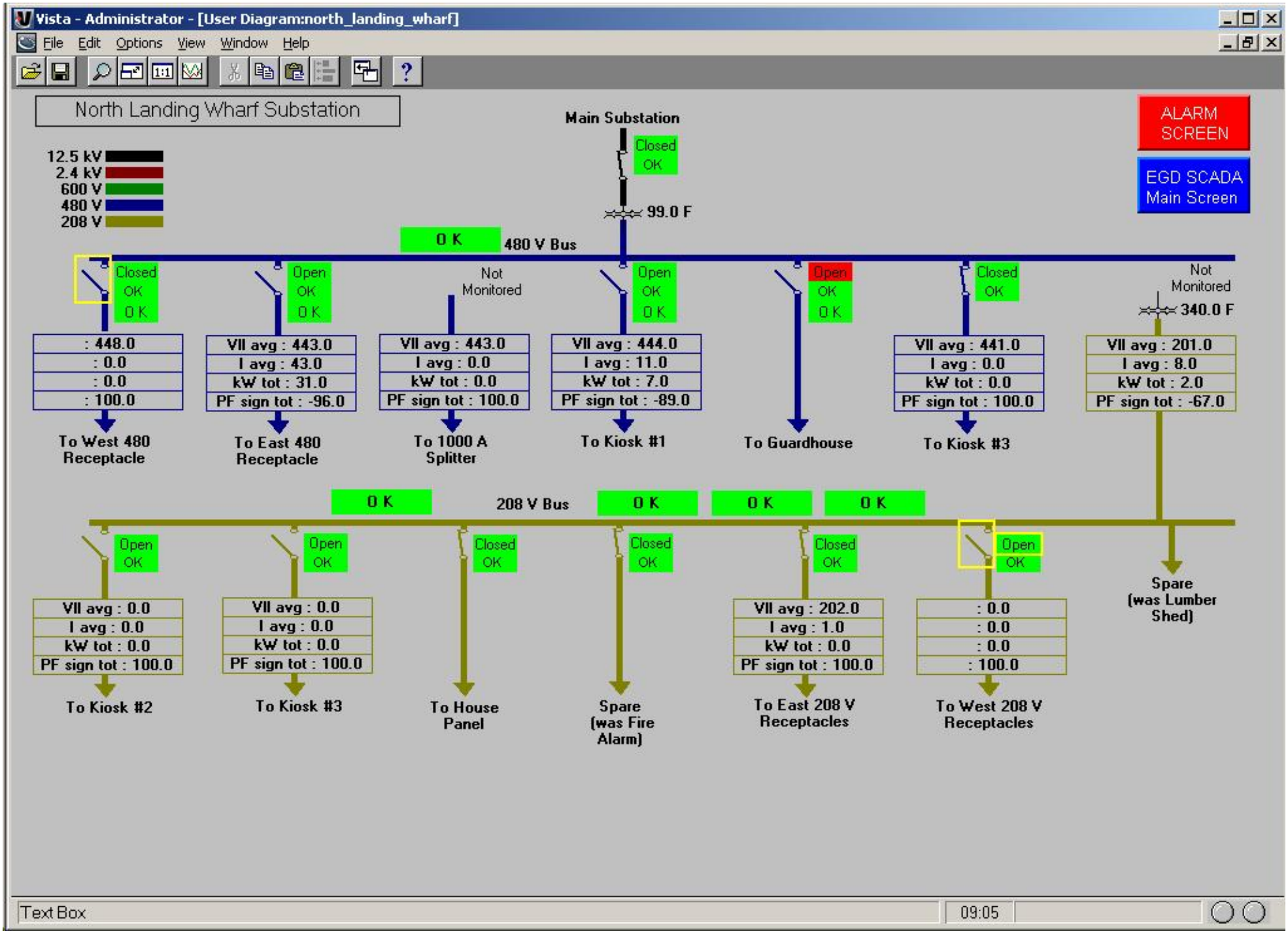

Designer - Administrator - [Display Modules[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Meter Display Setup
Right-click a module to access its setup registers.
kWh del
kW swd mx
Display Options 1
kWh rec
Volts
kVARh del
Amps
kVARh rec
Power
10:28

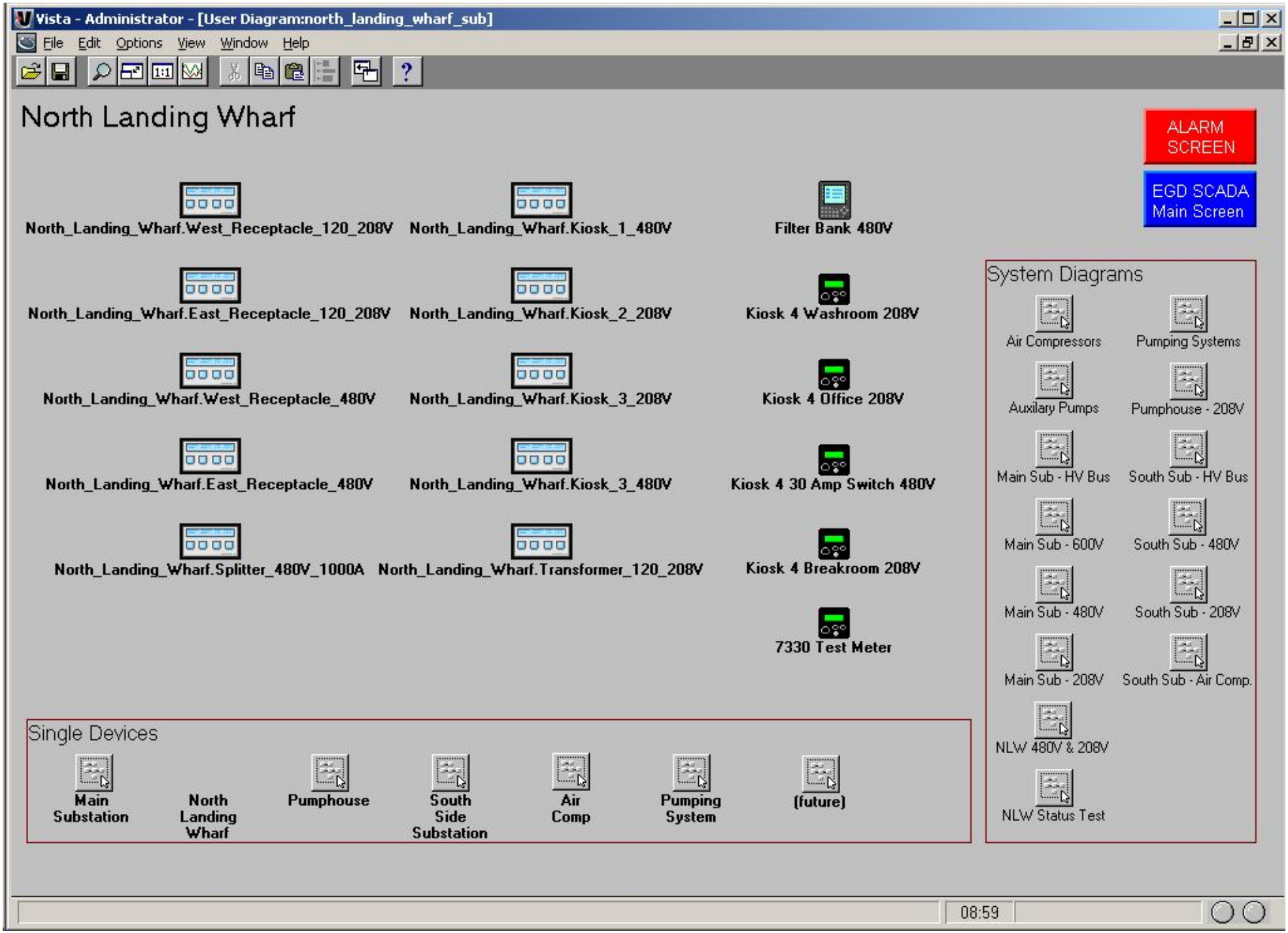

Designer - Administrator - [Min/Max Framework[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Min/Max Framework
Right-click a module to access its setup registers.
Peak Dmd Rset
MnMx Rset
Harm MnMx Rset
MnMx Enble
kW td
kVA td
kVAR td
V1 THD mx
Power Meter
kW swd
kVAR swd
kVA swd
Vln a mx
Vll bc mx
I b mx
kVA tot mx
kVAR td mx
V2 THD mx
Vln b mx
Vll ca mx
I c mx
kW swd mx
kVA td mx
V3 THD mx
Vln c mx
Maximum Module
Vll avg mx
I avg mx
kVAR swd mx
PF lead mx
I1 THD mx
Vln avg mx
V unbal mx
kW tot mx
kVA swd mx
PF lag mx
I2 THD mx
Vll ab mx
I a mx
kVAR tot mx
kW td mx
Freq mx
I3 THD mx
V1 Harmonics
V2 Harmonics
V3 Harmonics
I1 Harmonics
I2 Harmonics
I3 Harmonics
Vln a mn
Vll bc mn
I b mn
kVA tot mn
kVAR td mn
V1 THD mn
Vln b mn
Vll ca mn
I c mn
kW swd mn
kVA td mn
V2 THD mn
Vln c mn
Vll avg mn
I avg mn
kVAR swd mn
Freq mn
V3 THD mn
Vln avg mn
V unbal mn
kW tot mn
kVA swd mn
PF lead mn
I1 THD mn
Vll ab mn
I a mn
kVAR tot mn
kW td mn
PF lag mn
I2 THD mn
Vln b mx
10:31

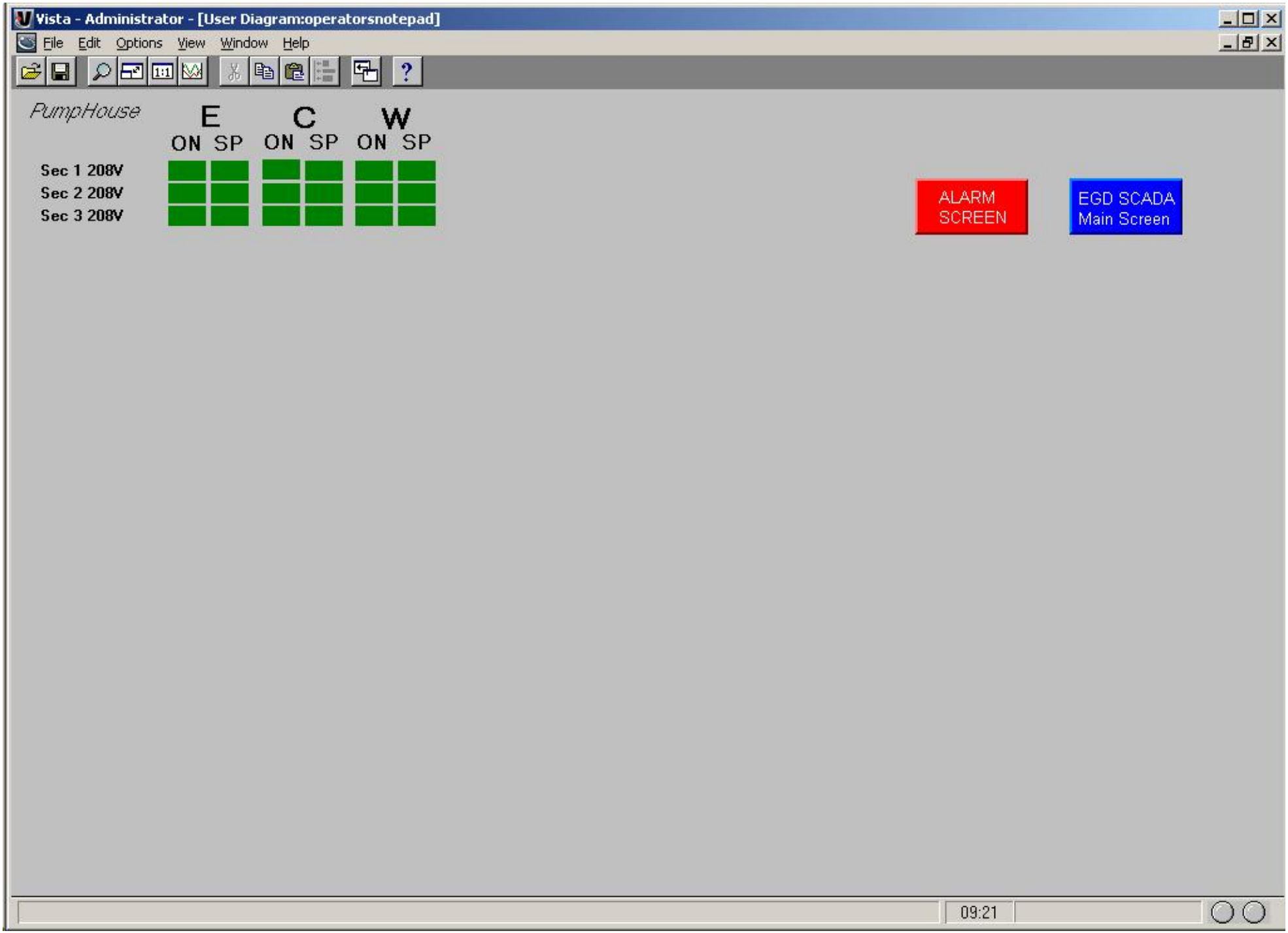

Designer - Administrator - [Modbus Configuration[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Modbus Configuration
Right-click a module to access its setup registers.
Power Meter
kW td
kVAR td
kVA td
kW td mx
kVAR td mx
kVA td mx
Vln avg mx
I avg mx
kW tot mx
kVAR tot mx
kVA tot mx
Freq mx
Vln avg mn
I avg mn
Freq mn
kWh del
kWh rec
kWh del+rec
kWh del-rec
kVARh del
kVARh rec
kVARh del+rec
kVARh del-rec
kVAh del
kVAh rec
V1 THD mx
V2 THD mx
V3 THD mx
I1 THD mx
I2 THD mx
I3 THD mx
Modbus Slave 1
Modbus Slave 2
Modbus Slave 3
Modbus Slave 4
kW tot mx
10:25

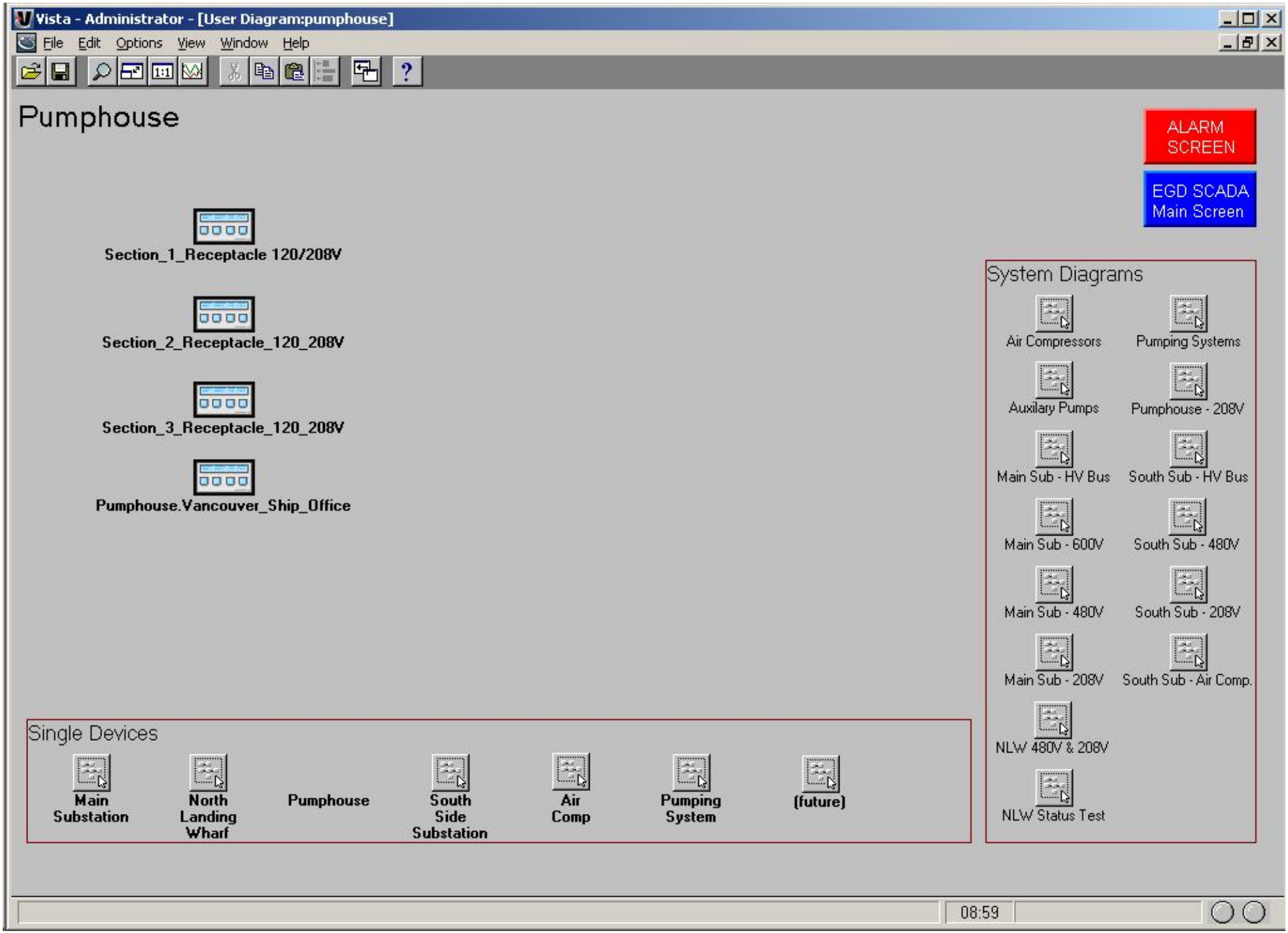

Designer - Administrator - [Modbus Configuration[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Modbus Configuration
Right-click a module to access its setup registers.
Power Meter
kW td
kVAR td
kVA td
kW td mx
kVAR td mx
kVA td mx
Vln avg mx
I avg mx
kW tot mx
kVAR tot mx
kVA tot mx
Freq mx
Vln avg mn
I avg mn
Freq mn
kWh del
kWh rec
kWh del+rec
kWh del-rec
kVARh del
kVARh rec
kVARh del+rec
kVARh del-rec
kVAh del
kVAh rec
V1 THD mx
V2 THD mx
V3 THD mx
I1 THD mx
I2 THD mx
I3 THD mx
Modbus Slave 1
Modbus Slave 2
Modbus Slave 3
Modbus Slave 4
kW tot mx
10:25

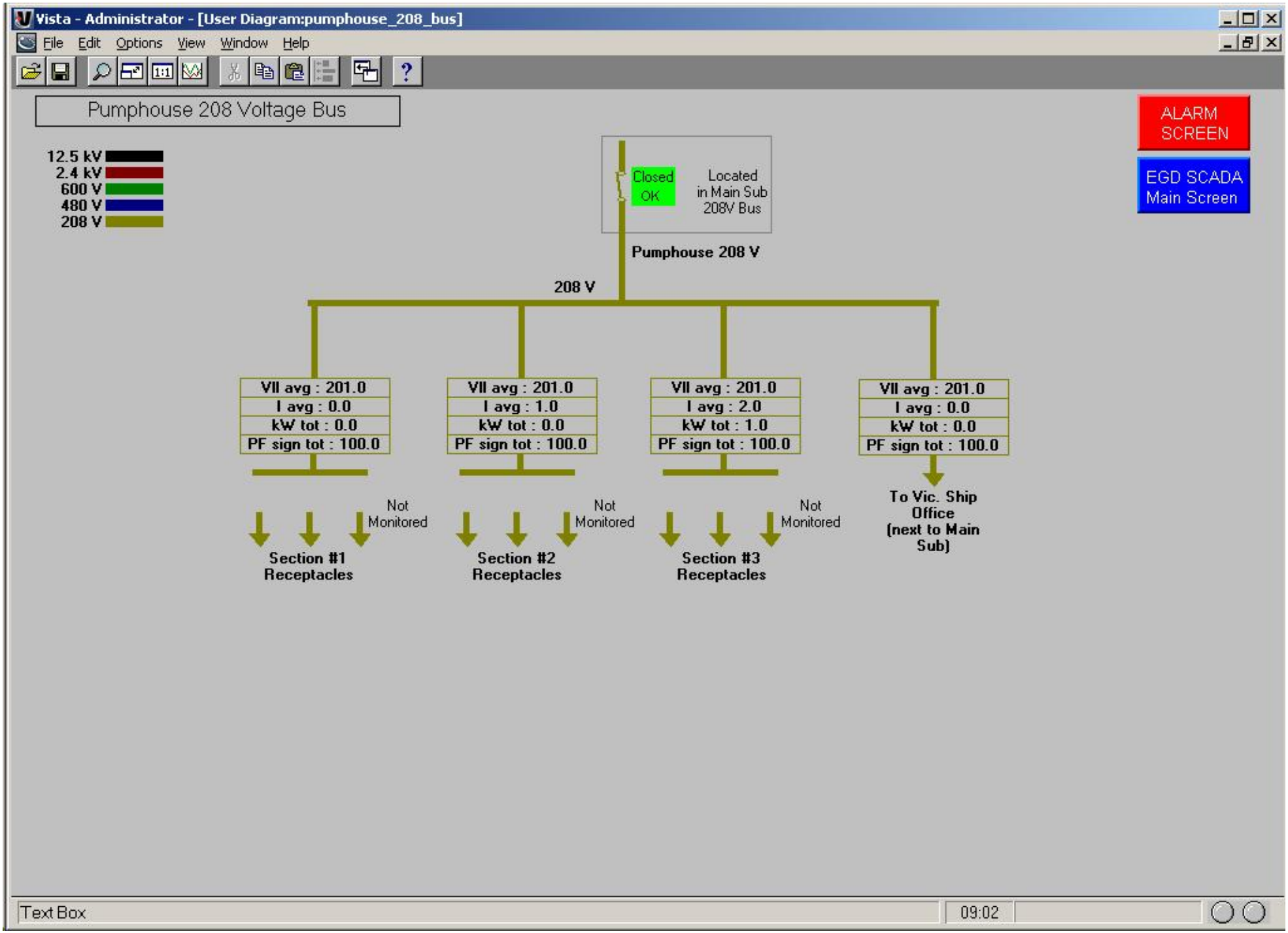

Vista - Administrator - [User Diagram:north_landing_wharf_status_test]
File Edit Options View Window Help
North Landing Wharf Status Test
12.5 kV
2.4 kV
600 V
480 V
208 V
ALARM SCREEN
EGD SCADA Main Screen
Status 1 Status 2 Status 3 Status 4
INACTIVE INACTIVE INACTIVE West Receptacle 480V
INACTIVE INACTIVE ACTIVE East Receptacle 480V
INACTIVE ACTIVE INACTIVE Splitter 480V 1000A
INACTIVE INACTIVE INACTIVE Kiosk #1 480V
ACTIVE ... INACTIVE Kiosk #3 480V
ACTIVE INACTIVE INACTIVE INACTIVE Main 208V Transformer
INACTIVE ACTIVE ... West Receptacle
ACTIVE ACTIVE INACTIVE East Receptacle
INACTIVE INACTIVE INACTIVE Kiosk #2 208V
INACTIVE INACTIVE INACTIVE Kiosk #3 208V
INACTIVE ACTIVE INACTIVE Lumber Shed
INACTIVE ACTIVE INACTIVE Spare
09:06

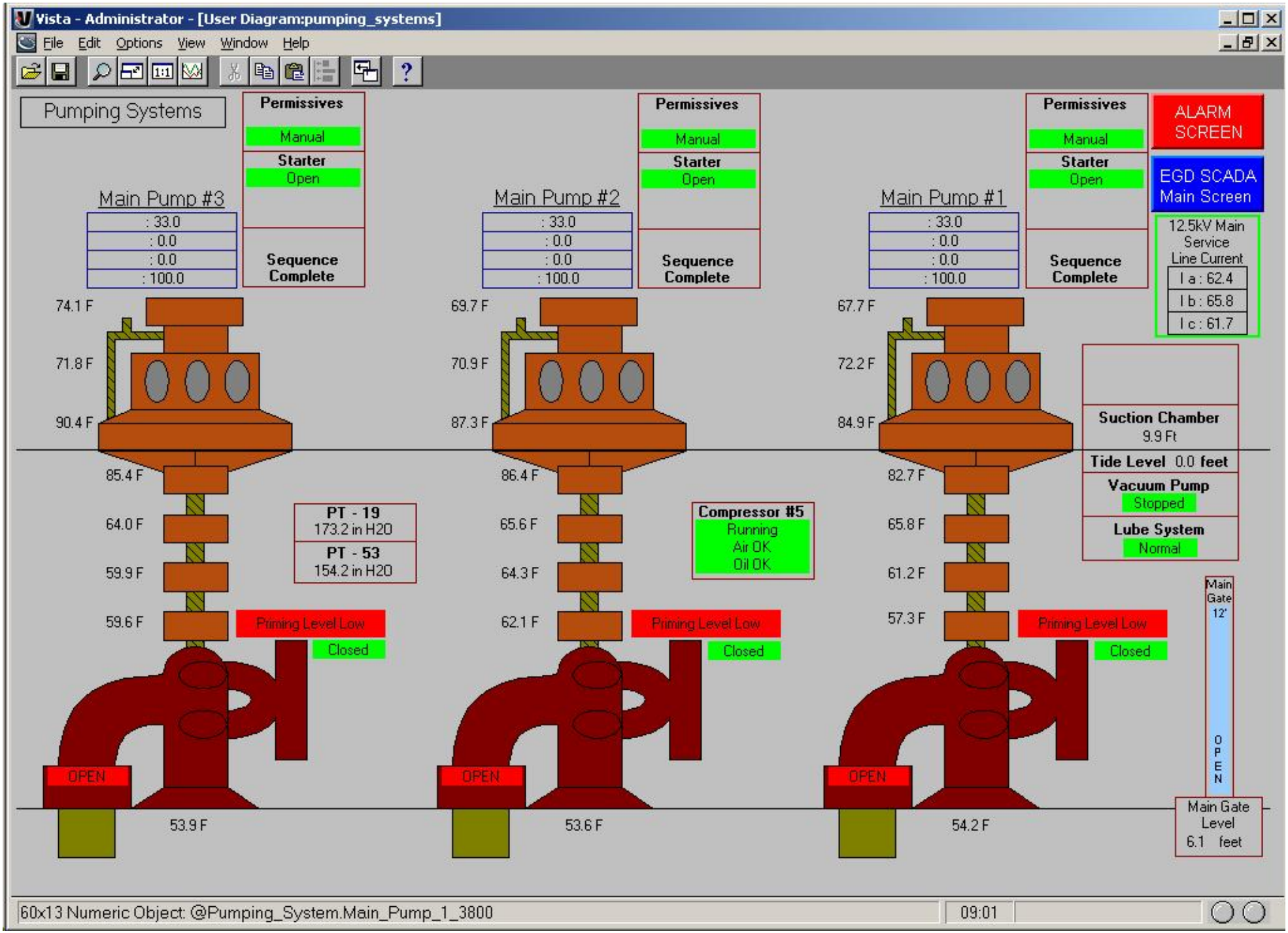

Vista - Administrator - [User Diagram:north_landing_wharf]
File Edit Options View Window Help
North Landing Wharf Substation
ALARM SCREEN
EGD SCADA Main Screen
12.5 kV
2.4 kV
600 V
480 V
208 V
Main Substation
Closed OK
99.0 F
O K
480 V Bus
Closed OK O K
: 448.0
: 0.0
: 0.0
: 100.0
To West 480 Receptacle
Open OK O K
VII avg : 443.0
I avg : 43.0
kW tot : 31.0
PF sign tot : -96.0
To East 480 Receptacle
Not Monitored
VII avg : 443.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To 1000 A Splitter
Open OK O K
VII avg : 444.0
I avg : 11.0
kW tot : 7.0
PF sign tot : -89.0
To Kiosk #1
Open OK O K
To Guardhouse
Closed OK
VII avg : 441.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To Kiosk #3
Not Monitored
340.0 F
VII avg : 201.0
I avg : 8.0
kW tot : 2.0
PF sign tot : -67.0
O K
208 V Bus
O K
O K
O K
Open OK
VII avg : 0.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To Kiosk #2
Open OK
VII avg : 0.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To Kiosk #3
Closed OK
To House Panel
Closed OK
Spare (was Fire Alarm)
Closed OK
VII avg : 202.0
I avg : 1.0
kW tot : 0.0
PF sign tot : 100.0
To East 208 V Receptacles
Open OK
: 0.0
: 0.0
: 0.0
: 100.0
To West 208 V Receptacles
Spare (was Lumber Shed)
Text Box
09:05

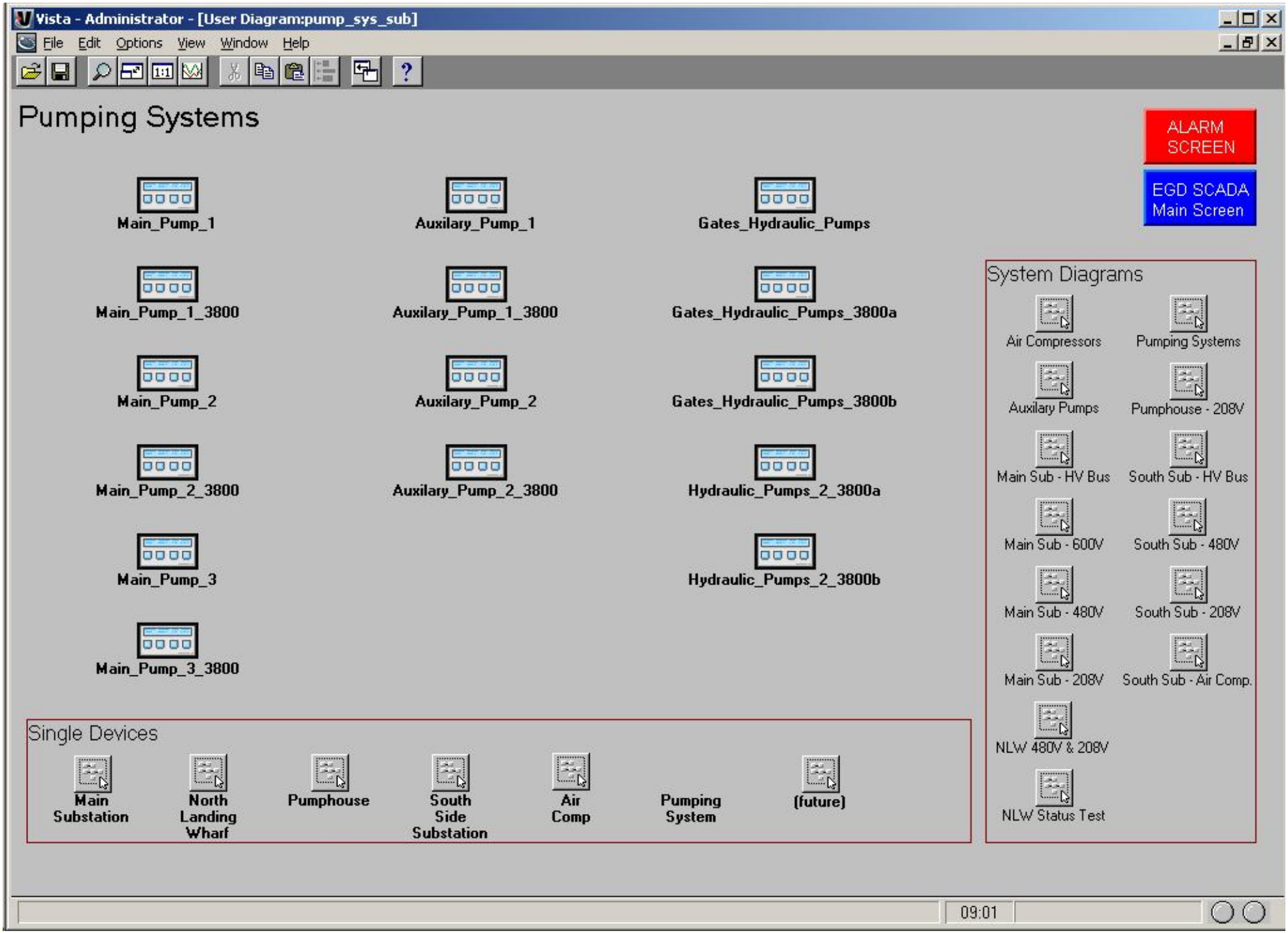

Vista - Administrator - [User Diagram:north_landing_wharf_sub]
File Edit Options View Window Help
North Landing Wharf
ALARM SCREEN
EGD SCADA Main Screen
North_Landing_Wharf.West_Receptacle_120_208V
North_Landing_Wharf.Kiosk_1_480V
Filter Bank 480V
North_Landing_Wharf.East_Receptacle_120_208V
North_Landing_Wharf.Kiosk_2_208V
Kiosk 4 Washroom 208V
North_Landing_Wharf.West_Receptacle_480V
North_Landing_Wharf.Kiosk_3_208V
Kiosk 4 Office 208V
North_Landing_Wharf.East_Receptacle_480V
North_Landing_Wharf.Kiosk_3_480V
Kiosk 4 30 Amp Switch 480V
North_Landing_Wharf.Splitter_480V_1000A
North_Landing_Wharf.Transformer_120_208V
Kiosk 4 Breakroom 208V
7330 Test Meter
System Diagrams
Air Compressors
Pumping Systems
Auxilary Pumps
Pumphouse - 208V
Main Sub - HV Bus
South Sub - HV Bus
Main Sub - 600V
South Sub - 480V
Main Sub - 480V
South Sub - 208V
Main Sub - 208V
South Sub - Air Comp.
NLW 480V & 208V
NLW Status Test
Single Devices
Main Substation
North Landing Wharf
Pumphouse
South Side Substation
Air Comp
Pumping System
(future)
08:59

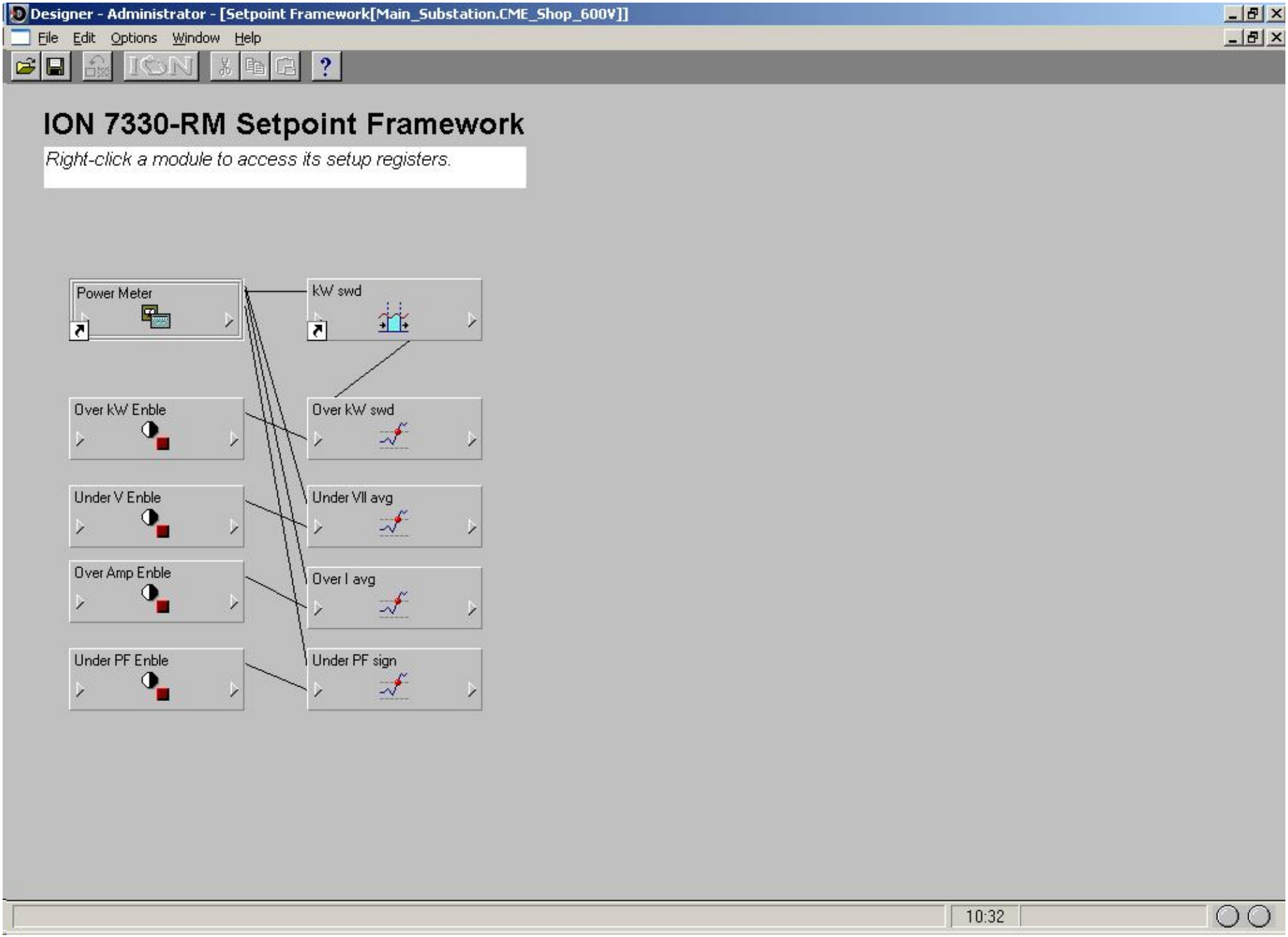

Vista - Administrator - [User Diagram:operatorsnotepad]
File Edit Options View Window Help
PumpHouse
E C W
ON SP ON SP ON SP
Sec 1 208V
Sec 2 208V
Sec 3 208V
ALARM SCREEN
EGD SCADA Main Screen
09:21

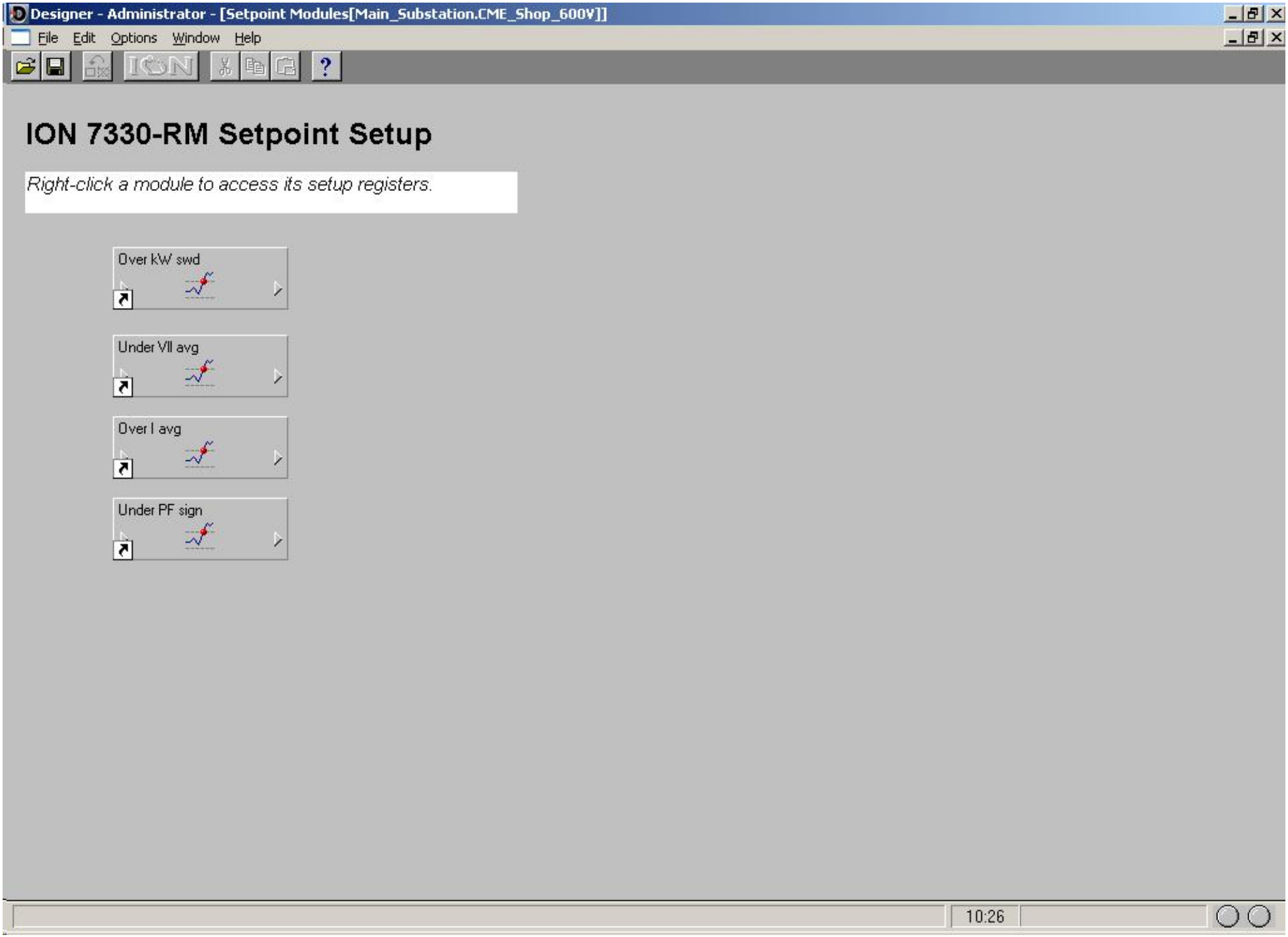

Vista - Administrator - [User Diagram:pumphouse]
File Edit Options View Window Help
Pumphouse
ALARM SCREEN
EGD SCADA Main Screen
Section_1_Receptacle 120/208V
Section_2_Receptacle_120_208V
Section_3_Receptacle_120_208V
Pumphouse.Vancouver_Ship_Office
System Diagrams
Air Compressors
Pumping Systems
Auxilary Pumps
Pumphouse - 208V
Main Sub - HV Bus
South Sub - HV Bus
Main Sub - 600V
South Sub - 480V
Main Sub - 480V
South Sub - 208V
Main Sub - 208V
South Sub - Air Comp.
NLW 480V & 208V
NLW Status Test
Single Devices
Main Substation
North Landing Wharf
Pumphouse
South Side Substation
Air Comp
Pumping System
(future)
08:59

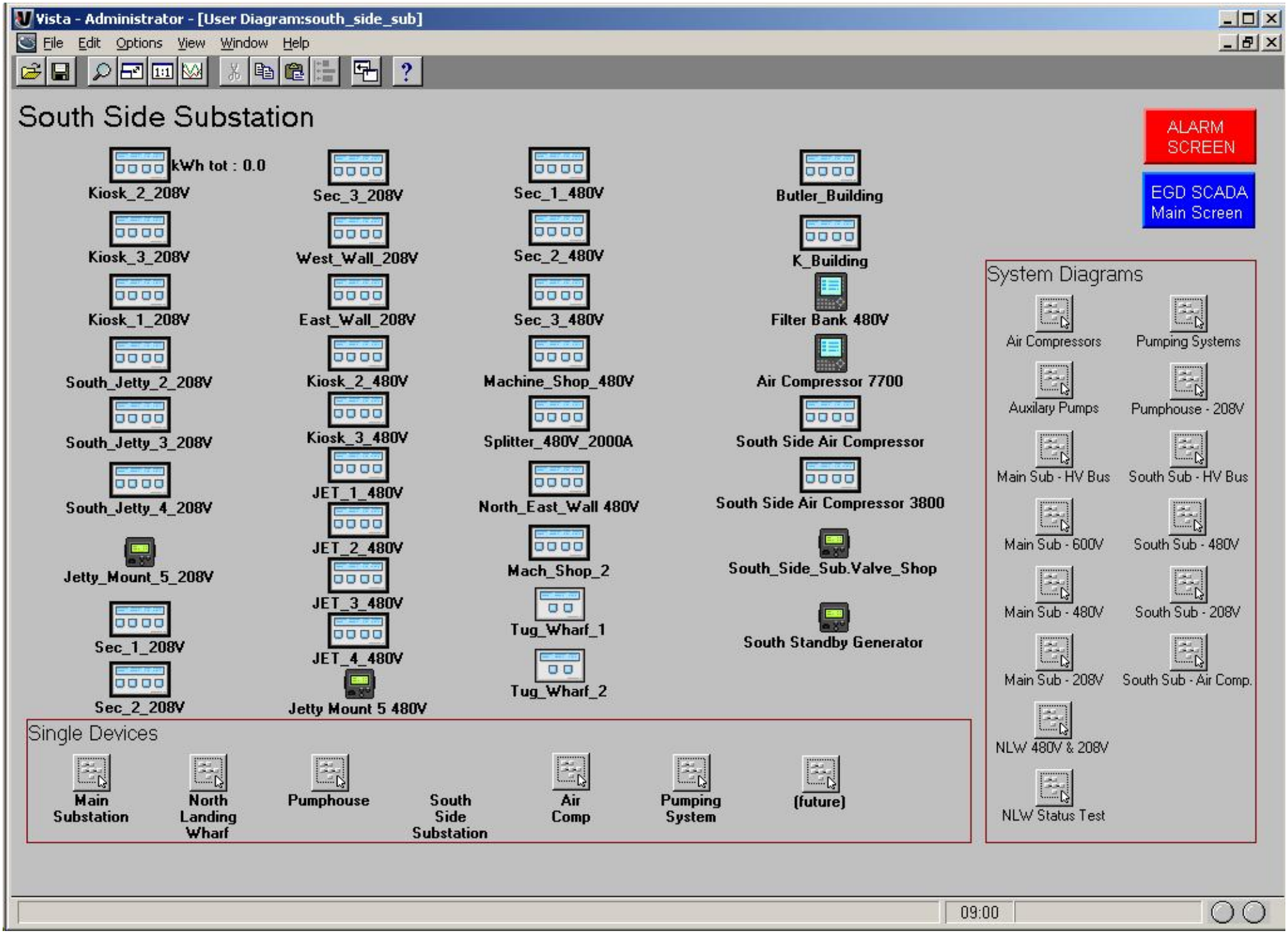

Vista - Administrator - [User Diagram:pumphouse_208_bus]
File Edit Options View Window Help
Pumphouse 208 Voltage Bus
12.5 kV
2.4 kV
600 V
480 V
208 V
ALARM SCREEN
EGD SCADA Main Screen
Closed OK
Located in Main Sub 208V Bus
Pumphouse 208 V
208 V
VII avg : 201.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
VII avg : 201.0
I avg : 1.0
kW tot : 0.0
PF sign tot : 100.0
VII avg : 201.0
I avg : 2.0
kW tot : 1.0
PF sign tot : 100.0
VII avg : 201.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
Not Monitored
Not Monitored
Not Monitored
Section #1 Receptacles
Section #2 Receptacles
Section #3 Receptacles
To Vic. Ship Office (next to Main Sub)
Text Box
09:02

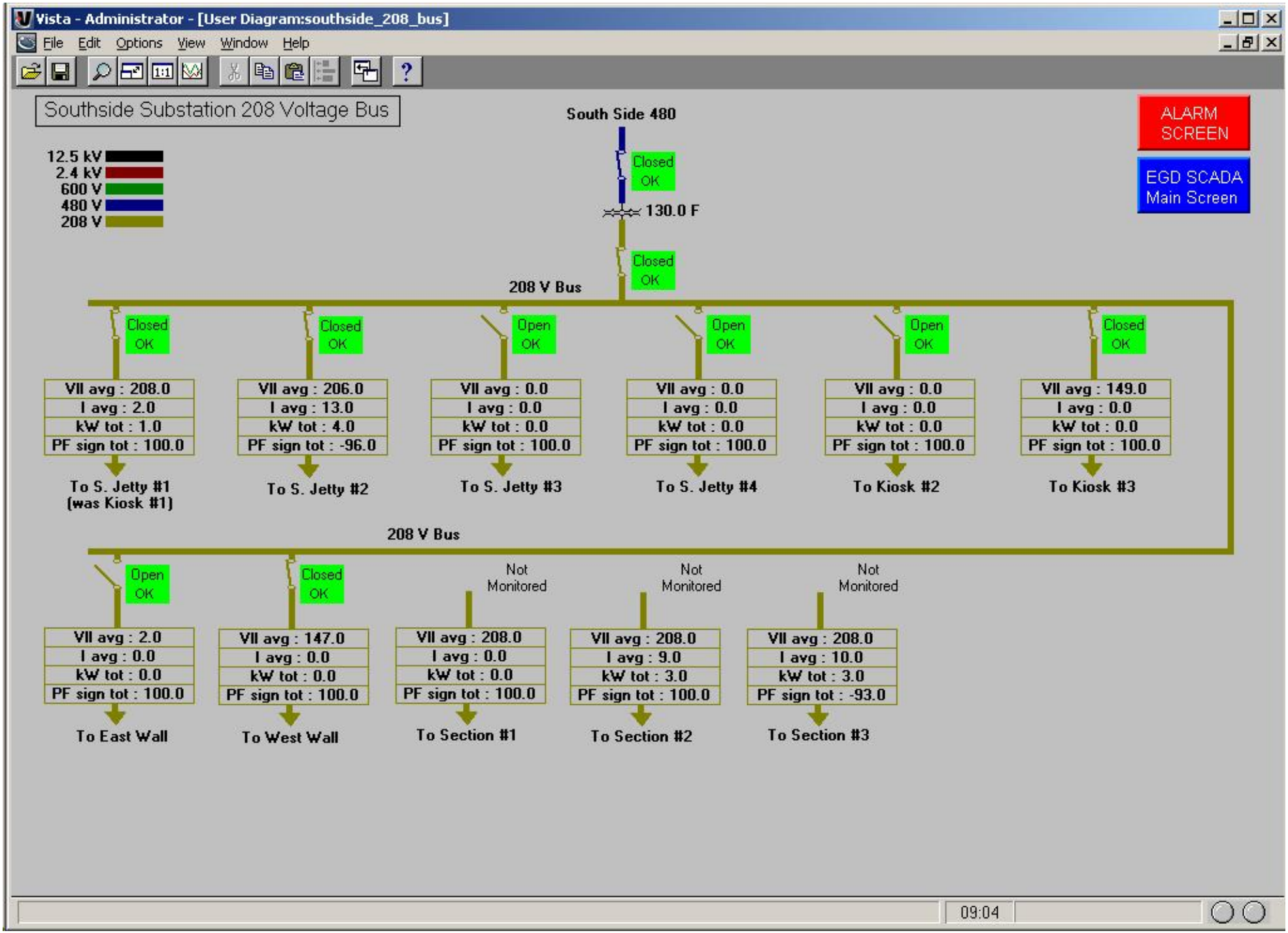

Vista - Administrator - [User Diagram:pumping_systems]
File Edit Options View Window Help
Pumping Systems
Permissives
Manual
Starter
Open
Sequence Complete
Main Pump #3
: 33.0
: 0.0
: 0.0
: 100.0
74.1 F
71.8 F
90.4 F
85.4 F
64.0 F
59.9 F
59.6 F
Priming Level Low
Closed
OPEN
53.9 F
Main Pump #2
: 33.0
: 0.0
: 0.0
: 100.0
69.7 F
70.9 F
87.3 F
86.4 F
65.6 F
64.3 F
62.1 F
Priming Level Low
Closed
OPEN
53.6 F
Main Pump #1
: 33.0
: 0.0
: 0.0
: 100.0
67.7 F
72.2 F
84.9 F
82.7 F
65.8 F
61.2 F
57.3 F
Priming Level Low
Closed
OPEN
54.2 F
ALARM SCREEN
EGD SCADA Main Screen
12.5kV Main Service Line Current
I a : 62.4
I b : 65.8
I c : 61.7
Suction Chamber
9.9 Ft
Tide Level 0.0 feet
Vacuum Pump
Stopped
Lube System
Normal
PT - 19
173.2 in H20
PT - 53
154.2 in H20
Compressor #5
Running
Air OK
Oil OK
Main Gate 12'
OPEN
Main Gate Level
6.1 feet
60x13 Numeric Object: @Pumping_System.Main_Pump_1_3800
09:01

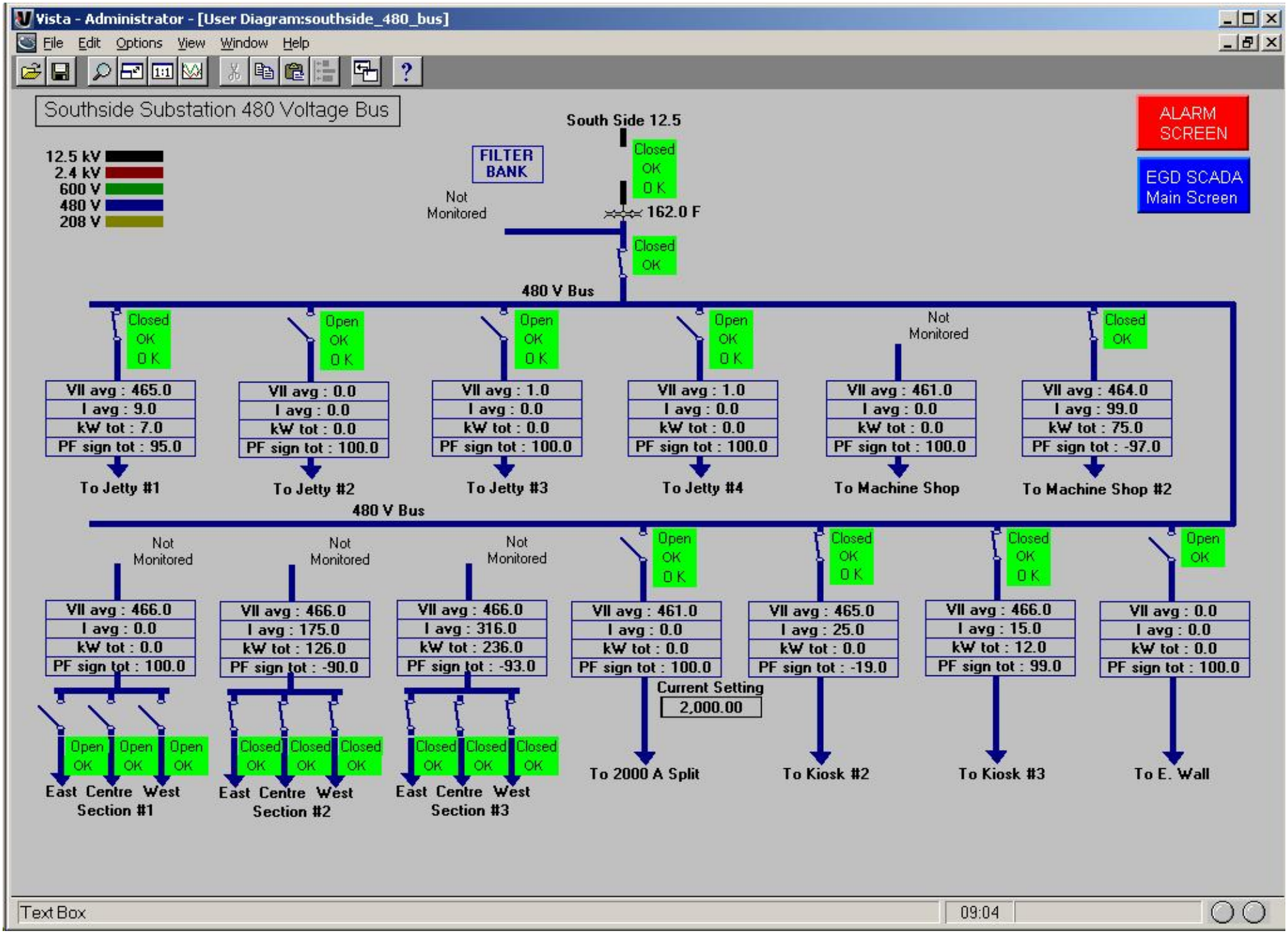

Vista - Administrator - [User Diagram:pump_sys_sub]
File Edit Options View Window Help
Pumping Systems
ALARM SCREEN
EGD SCADA Main Screen
Main_Pump_1
Auxilary_Pump_1
Gates_Hydraulic_Pumps
Main_Pump_1_3800
Auxilary_Pump_1_3800
Gates_Hydraulic_Pumps_3800a
Main_Pump_2
Auxilary_Pump_2
Gates_Hydraulic_Pumps_3800b
Main_Pump_2_3800
Auxilary_Pump_2_3800
Hydraulic_Pumps_2_3800a
Main_Pump_3
Hydraulic_Pumps_2_3800b
Main_Pump_3_3800
System Diagrams
Air Compressors
Pumping Systems
Auxilary Pumps
Pumphouse - 208V
Main Sub - HV Bus
South Sub - HV Bus
Main Sub - 600V
South Sub - 480V
Main Sub - 480V
South Sub - 208V
Main Sub - 208V
South Sub - Air Comp.
NLW 480V & 208V
NLW Status Test
Single Devices
Main Substation
North Landing Wharf
Pumphouse
South Side Substation
Air Comp
Pumping System
(future)
09:01

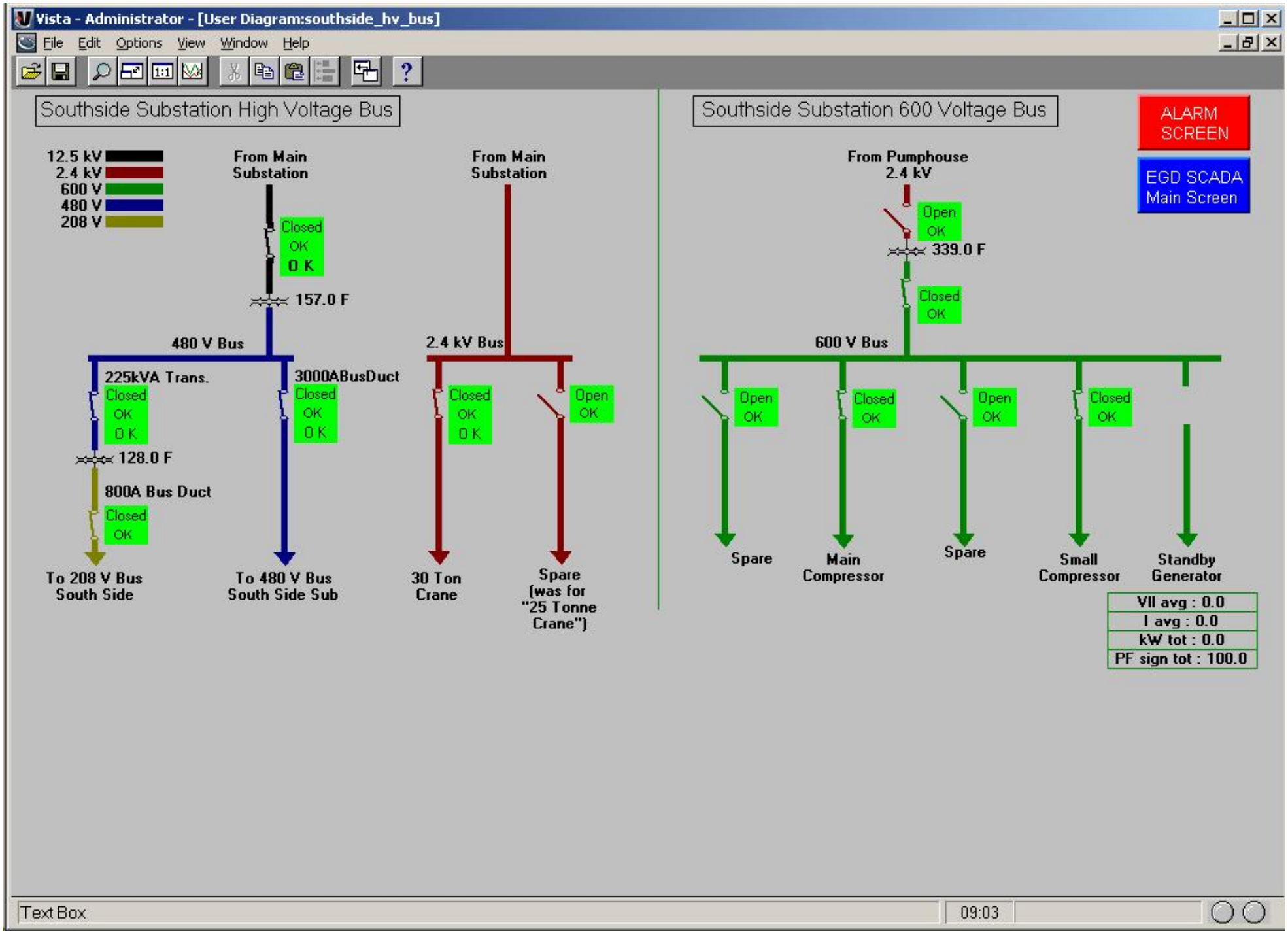

Designer - Administrator - [Setpoint Framework[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Setpoint Framework
Right-click a module to access its setup registers.
Power Meter
kW swd
Over kW Enble
Over kW swd
Under V Enble
Under Vll avg
Over Amp Enble
Over I avg
Under PF Enble
Under PF sign
10:32


Designer - Administrator - [Setpoint Modules[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Setpoint Setup
Right-click a module to access its setup registers.
Over kW swd
Under Vll avg
Over I avg
Under PF sign
10:26


Vista - Administrator - [User Diagram:south_side_sub]
File Edit Options View Window Help
South Side Substation
ALARM SCREEN
EGD SCADA Main Screen
kWh tot : 0.0
Kiosk_2_208V
Kiosk_3_208V
Kiosk_1_208V
South_Jetty_2_208V
South_Jetty_3_208V
South_Jetty_4_208V
Jetty_Mount_5_208V
Sec_1_208V
Sec_2_208V
Sec_3_208V
West_Wall_208V
East_Wall_208V
Kiosk_2_480V
Kiosk_3_480V
JET_1_480V
JET_2_480V
JET_3_480V
JET_4_480V
Jetty Mount 5 480V
Sec_1_480V
Sec_2_480V
Sec_3_480V
Machine_Shop_480V
Splitter_480V_2000A
North_East_Wall 480V
Mach_Shop_2
Tug_Wharf_1
Tug_Wharf_2
Butler_Building
K_Building
Filter Bank 480V
Air Compressor 7700
South Side Air Compressor
South Side Air Compressor 3800
South_Side_Sub.Valve_Shop
South Standby Generator
System Diagrams
Air Compressors
Pumping Systems
Auxilary Pumps
Pumphouse - 208V
Main Sub - HV Bus
South Sub - HV Bus
Main Sub - 600V
South Sub - 480V
Main Sub - 480V
South Sub - 208V
Main Sub - 208V
South Sub - Air Comp.
NLW 480V & 208V
NLW Status Test
Single Devices
Main Substation
North Landing Wharf
Pumphouse
South Side Substation
Air Comp
Pumping System
(future)
09:00


Vista - Administrator - [User Diagram:southside_208_bus]
File Edit Options View Window Help
Southside Substation 208 Voltage Bus
12.5 kV
2.4 kV
600 V
480 V
208 V
South Side 480
Closed OK
130.0 F
Closed OK
208 V Bus
ALARM SCREEN
EGD SCADA Main Screen
Closed OK
Vll avg : 208.0
I avg : 2.0
kW tot : 1.0
PF sign tot : 100.0
To S. Jetty #1 (was Kiosk #1)
Closed OK
Vll avg : 206.0
I avg : 13.0
kW tot : 4.0
PF sign tot : -96.0
To S. Jetty #2
Open OK
Vll avg : 0.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To S. Jetty #3
Open OK
Vll avg : 0.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To S. Jetty #4
Open OK
Vll avg : 0.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To Kiosk #2
Closed OK
Vll avg : 149.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To Kiosk #3
208 V Bus
Open OK
Vll avg : 2.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To East Wall
Closed OK
Vll avg : 147.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To West Wall
Not Monitored
Vll avg : 208.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To Section #1
Not Monitored
Vll avg : 208.0
I avg : 9.0
kW tot : 3.0
PF sign tot : 100.0
To Section #2
Not Monitored
Vll avg : 208.0
I avg : 10.0
kW tot : 3.0
PF sign tot : -93.0
To Section #3
09:04


Vista - Administrator - [User Diagram:southside_480_bus]
File Edit Options View Window Help
Southside Substation 480 Voltage Bus
12.5 kV
2.4 kV
600 V
480 V
208 V
South Side 12.5
Closed OK O K
FILTER BANK
Not Monitored
162.0 F
Closed OK
480 V Bus
ALARM SCREEN
EGD SCADA Main Screen
Closed OK O K
VII avg : 465.0
I avg : 9.0
kW tot : 7.0
PF sign tot : 95.0
To Jetty #1
Open OK O K
VII avg : 0.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To Jetty #2
Open OK O K
VII avg : 1.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To Jetty #3
Open OK O K
VII avg : 1.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To Jetty #4
Not Monitored
VII avg : 461.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To Machine Shop
Closed OK
VII avg : 464.0
I avg : 99.0
kW tot : 75.0
PF sign tot : -97.0
To Machine Shop #2
480 V Bus
Not Monitored
VII avg : 466.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
Open OK
Open OK
Open OK
East Centre West
Section #1
Not Monitored
VII avg : 466.0
I avg : 175.0
kW tot : 126.0
PF sign tot : -90.0
Closed OK
Closed OK
Closed OK
East Centre West
Section #2
Not Monitored
VII avg : 466.0
I avg : 316.0
kW tot : 236.0
PF sign tot : -93.0
Closed OK
Closed OK
Closed OK
East Centre West
Section #3
Open OK O K
VII avg : 461.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
Current Setting
2,000.00
To 2000 A Split
Closed OK O K
VII avg : 465.0
I avg : 25.0
kW tot : 0.0
PF sign tot : -19.0
To Kiosk #2
Closed OK O K
VII avg : 466.0
I avg : 15.0
kW tot : 12.0
PF sign tot : 99.0
To Kiosk #3
Open OK
VII avg : 0.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
To E. Wall
Text Box
09:04


Vista - Administrator - [User Diagram:southside_hv_bus]
File Edit Options View Window Help
Southside Substation High Voltage Bus
12.5 kV
2.4 kV
600 V
480 V
208 V
From Main Substation
Closed OK 0 K
157.0 F
480 V Bus
225kVA Trans.
Closed OK 0 K
128.0 F
800A Bus Duct
Closed OK
To 208 V Bus South Side
3000ABusDuct
Closed OK 0 K
To 480 V Bus South Side Sub
From Main Substation
2.4 kV Bus
Closed OK 0 K
30 Ton Crane
Open OK
Spare (was for "25 Tonne Crane")
Southside Substation 600 Voltage Bus
ALARM SCREEN
EGD SCADA Main Screen
From Pumphouse 2.4 kV
Open OK
339.0 F
Closed OK
600 V Bus
Open OK
Spare
Closed OK
Main Compressor
Open OK
Spare
Closed OK
Small Compressor
Standby Generator
VII avg : 0.0
I avg : 0.0
kW tot : 0.0
PF sign tot : 100.0
Text Box
09:03

Vista - Administrator - [User Diagram:ss_air_comp]

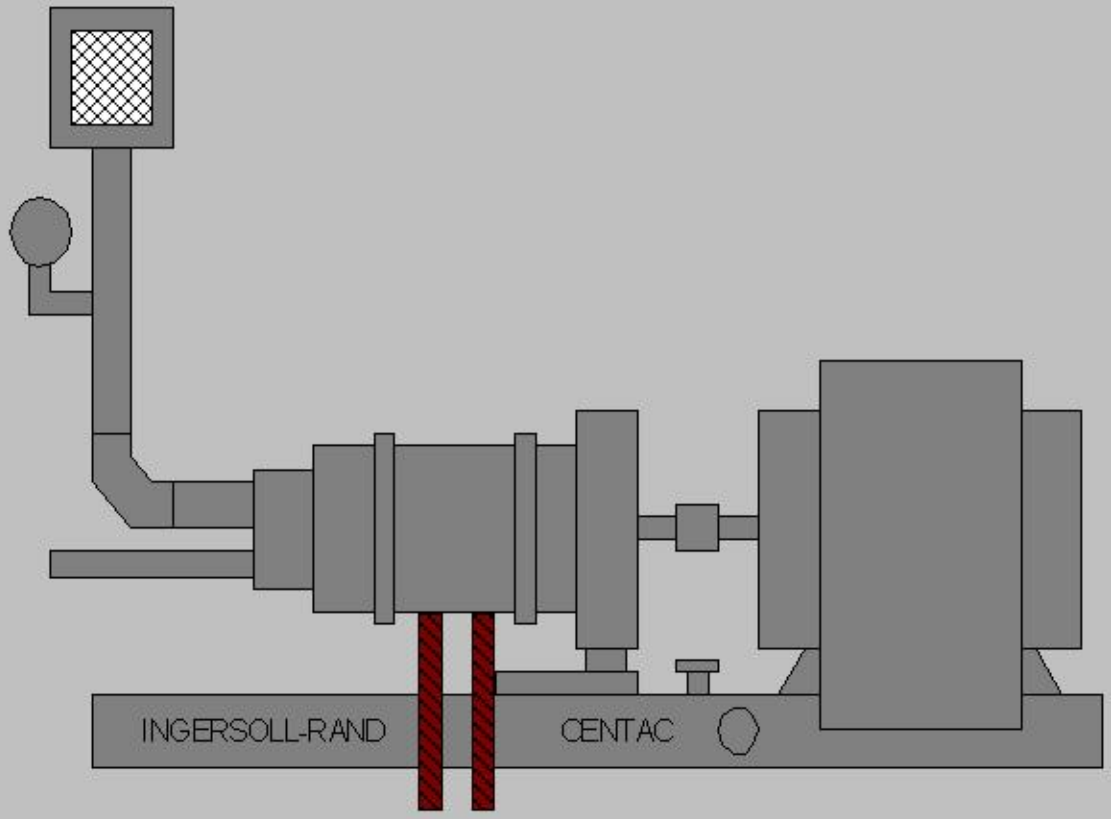
File Edit Options View Window Help

Southside Air Compressor Room

ALARM SCREEN

EGD SCADA Main Screen

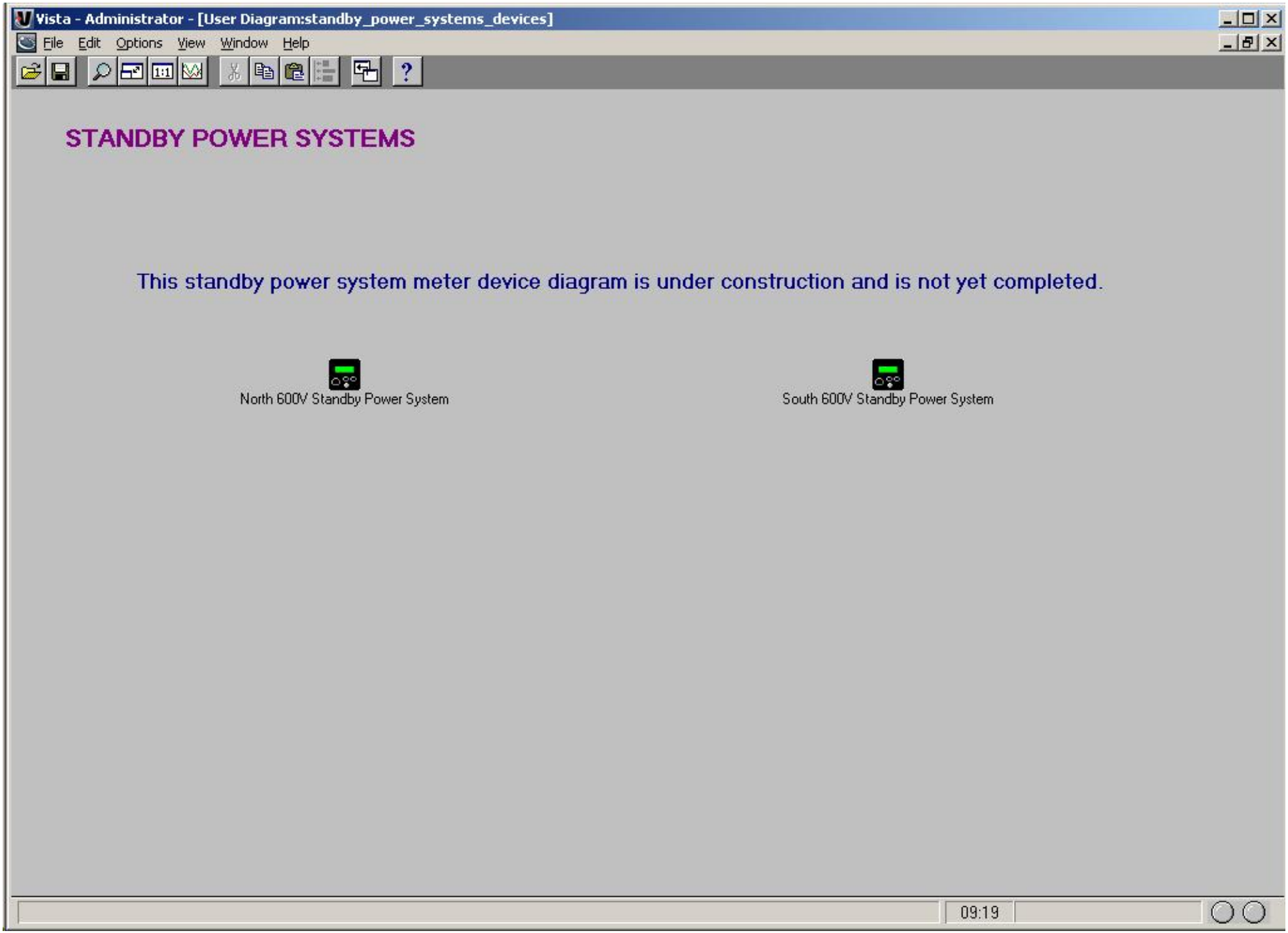
Air Compressor #4

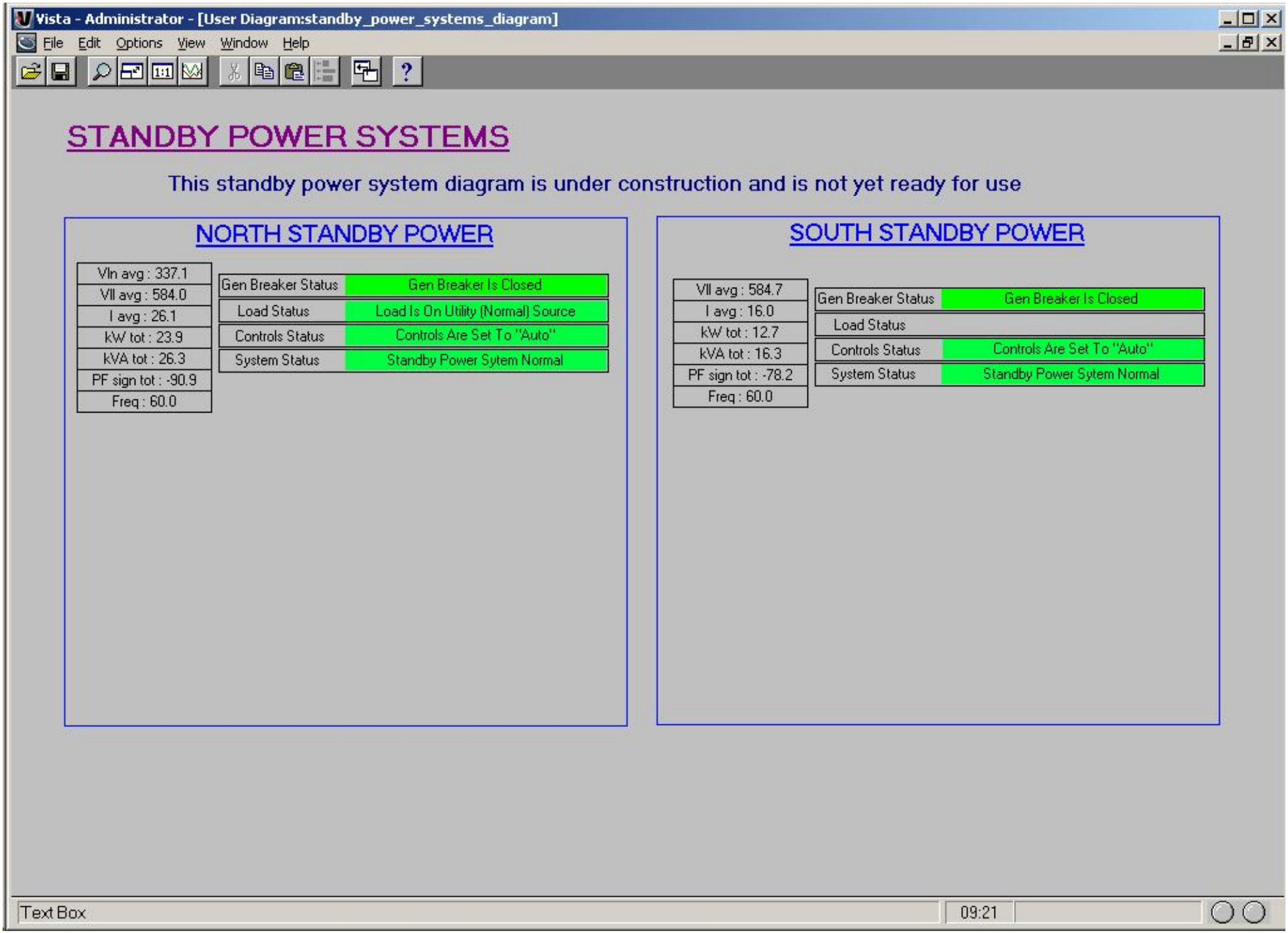


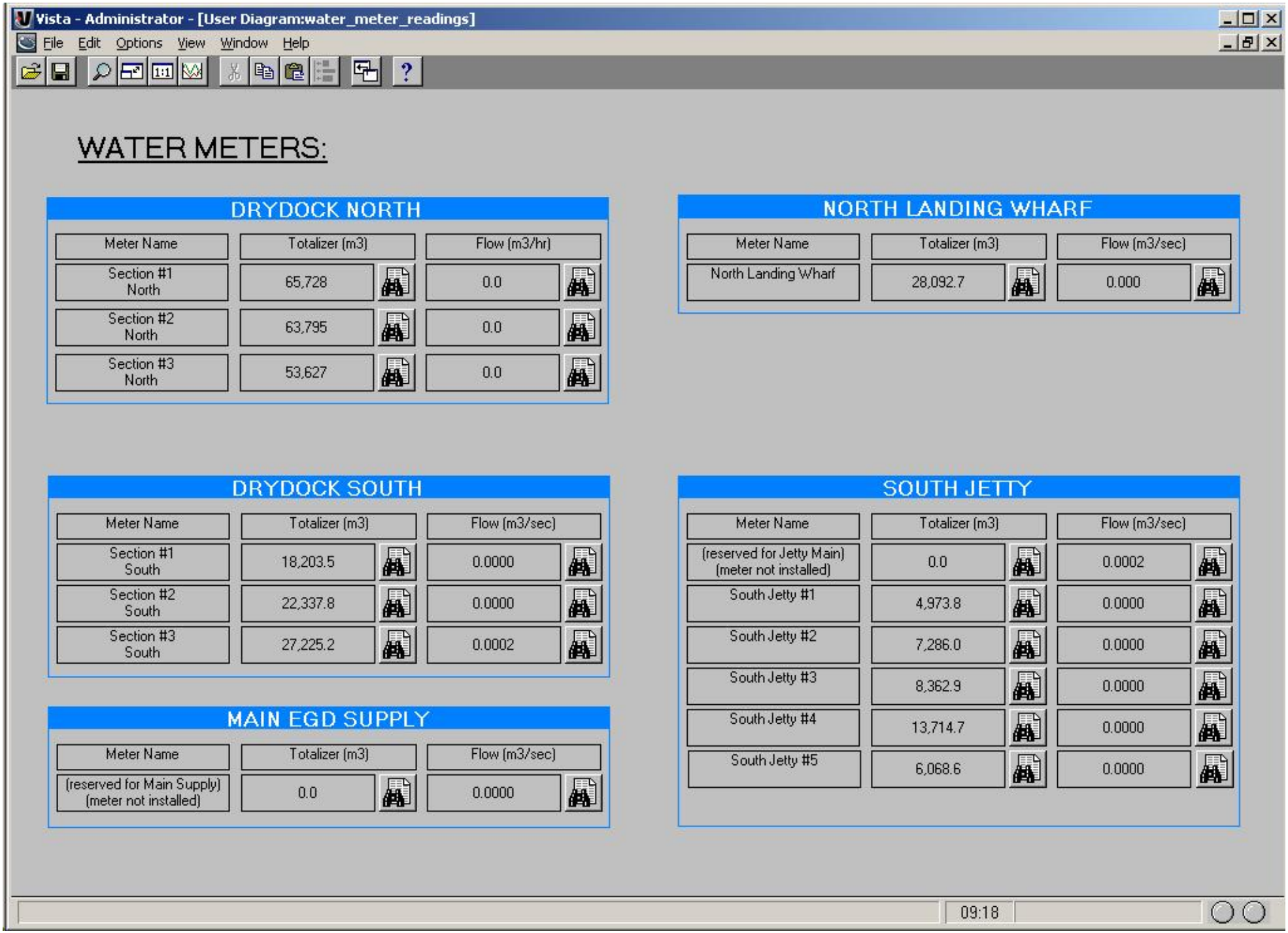
Compressor Status	
Lub. Oil Pressure	...
Lub. Oil Temperature	... F
Discharge Air Temp.	... F
Surge	
Seal Air Pressure	
Vibration Detector	
Vibration Detector	

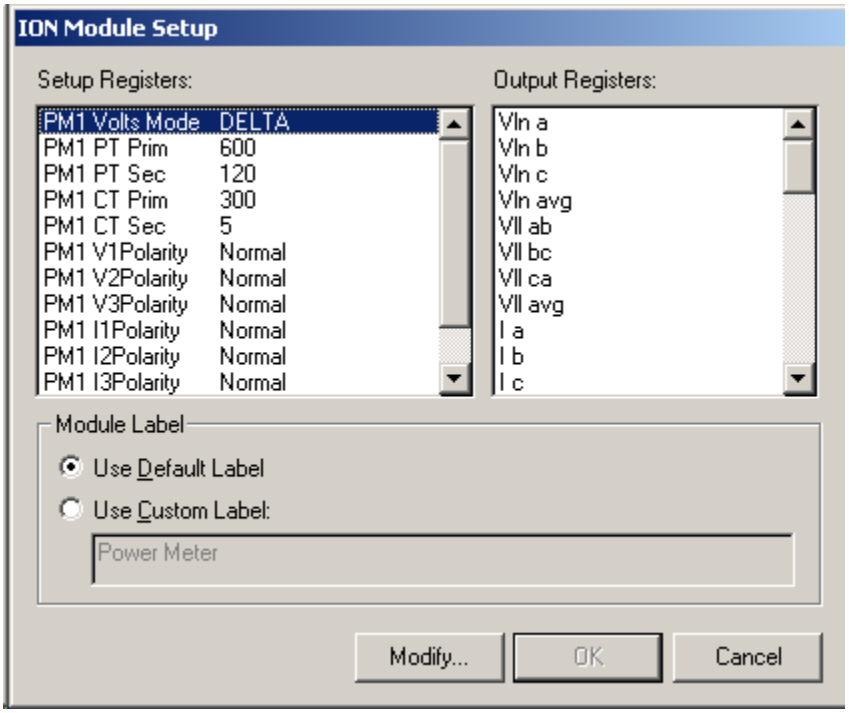
VII avg : ...
I avg : ...
kW tot : ...
PF sign tot : ...

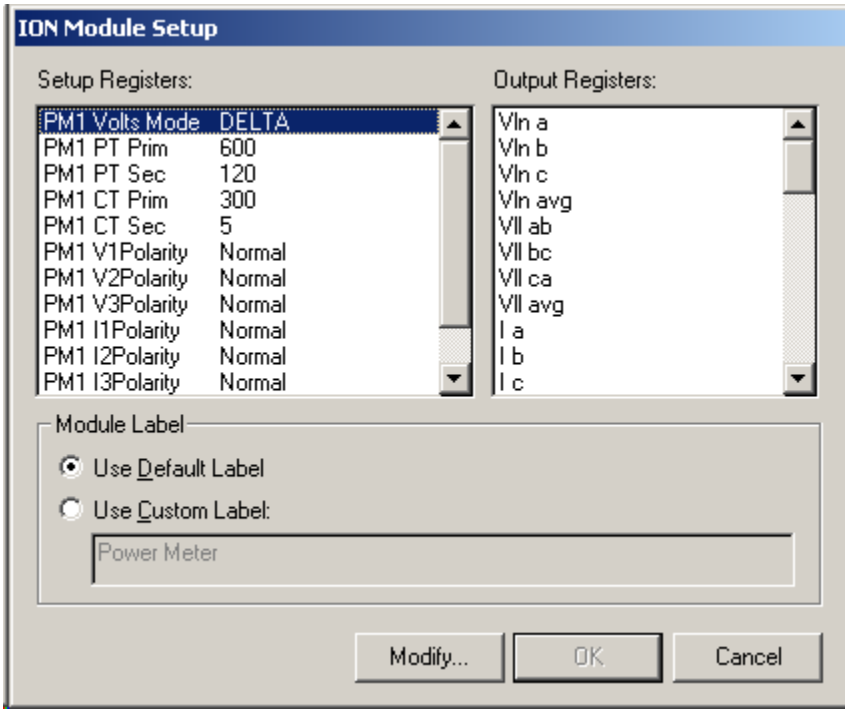
09:05

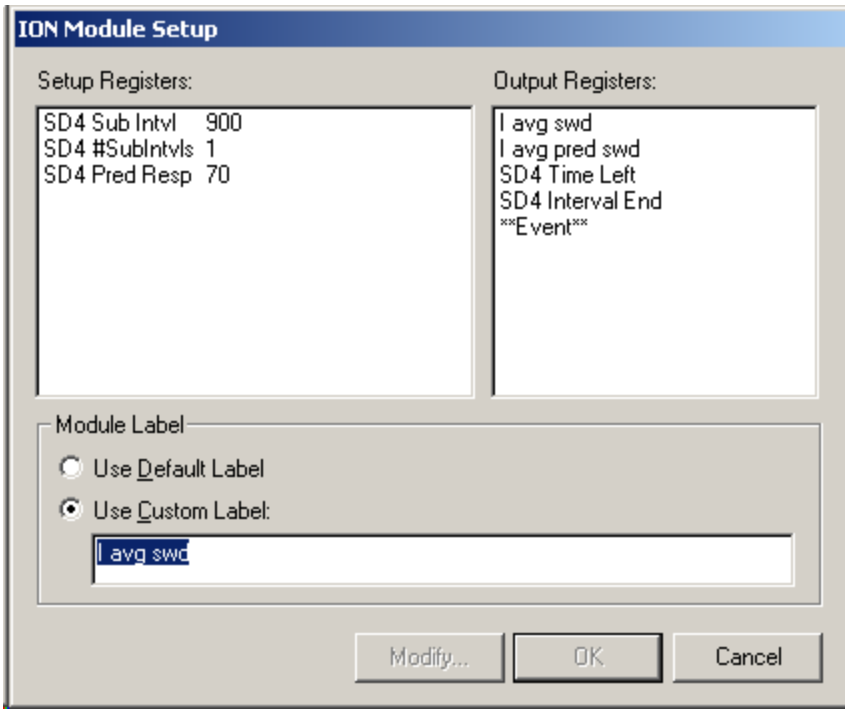

Vista - Administrator - [User Diagram:standby_power_systems_devices]
File Edit Options View Window Help
STANDBY POWER SYSTEMS
This standby power system meter device diagram is under construction and is not yet completed.
North 600V Standby Power System
South 600V Standby Power System
09:19

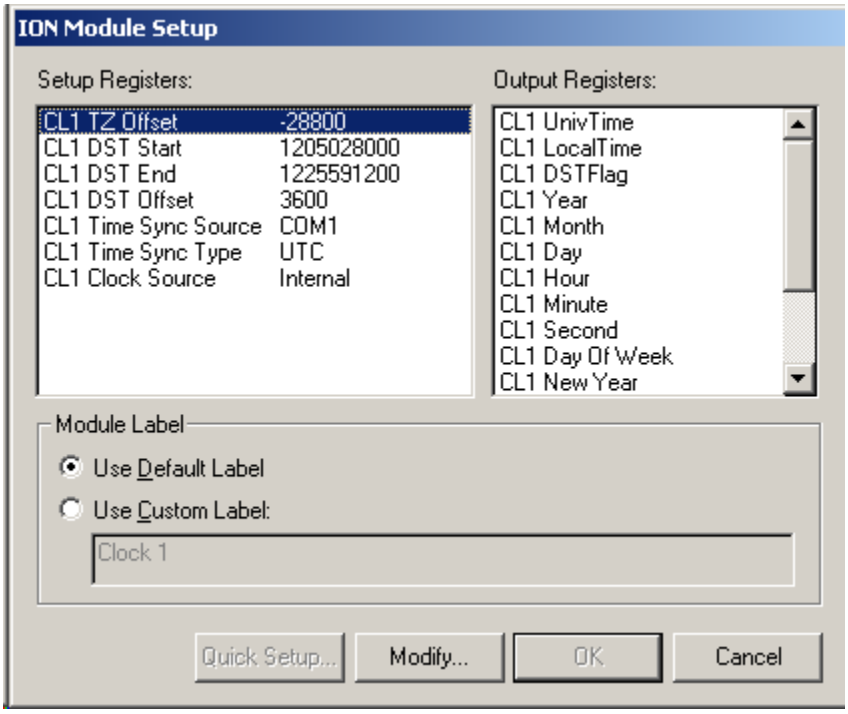

Vista - Administrator - [User Diagram:standby_power_systems_diagram]
File Edit Options View Window Help
STANDBY POWER SYSTEMS
This standby power system diagram is under construction and is not yet ready for use
NORTH STANDBY POWER
Vln avg : 337.1
Vll avg : 584.0
I avg : 26.1
kW tot : 23.9
kVA tot : 26.3
PF sign tot : -90.9
Freq : 60.0
Gen Breaker Status
Gen Breaker Is Closed
Load Status
Load Is On Utility (Normal) Source
Controls Status
Controls Are Set To "Auto"
System Status
Standby Power Sytem Normal
SOUTH STANDBY POWER
Vll avg : 584.7
I avg : 16.0
kW tot : 12.7
kVA tot : 16.3
PF sign tot : -78.2
Freq : 60.0
Gen Breaker Status
Gen Breaker Is Closed
Load Status
Controls Status
Controls Are Set To "Auto"
System Status
Standby Power Sytem Normal
Text Box
09:21

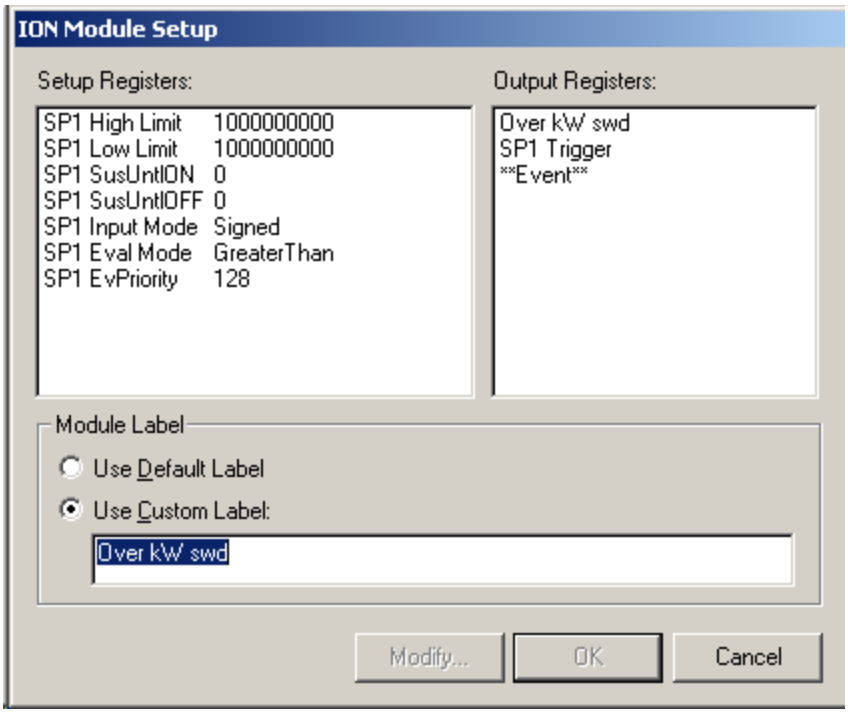

Vista - Administrator - [User Diagram:water_meter_readings]
File Edit Options View Window Help
WATER METERS:
DRYDOCK NORTH
Meter Name | Totalizer (m3) | Flow (m3/hr)
Section #1 North | 65,728 | 0.0
Section #2 North | 63,795 | 0.0
Section #3 North | 53,627 | 0.0
NORTH LANDING WHARF
Meter Name | Totalizer (m3) | Flow (m3/sec)
North Landing Wharf | 28,092.7 | 0.000
DRYDOCK SOUTH
Meter Name | Totalizer (m3) | Flow (m3/sec)
Section #1 South | 18,203.5 | 0.0000
Section #2 South | 22,337.8 | 0.0000
Section #3 South | 27,225.2 | 0.0002
SOUTH JETTY
Meter Name | Totalizer (m3) | Flow (m3/sec)
(reserved for Jetty Main) (meter not installed) | 0.0 | 0.0002
South Jetty #1 | 4,973.8 | 0.0000
South Jetty #2 | 7,286.0 | 0.0000
South Jetty #3 | 8,362.9 | 0.0000
South Jetty #4 | 13,714.7 | 0.0000
South Jetty #5 | 6,068.6 | 0.0000
MAIN EGD SUPPLY
Meter Name | Totalizer (m3) | Flow (m3/sec)
(reserved for Main Supply) (meter not installed) | 0.0 | 0.0000
09:18

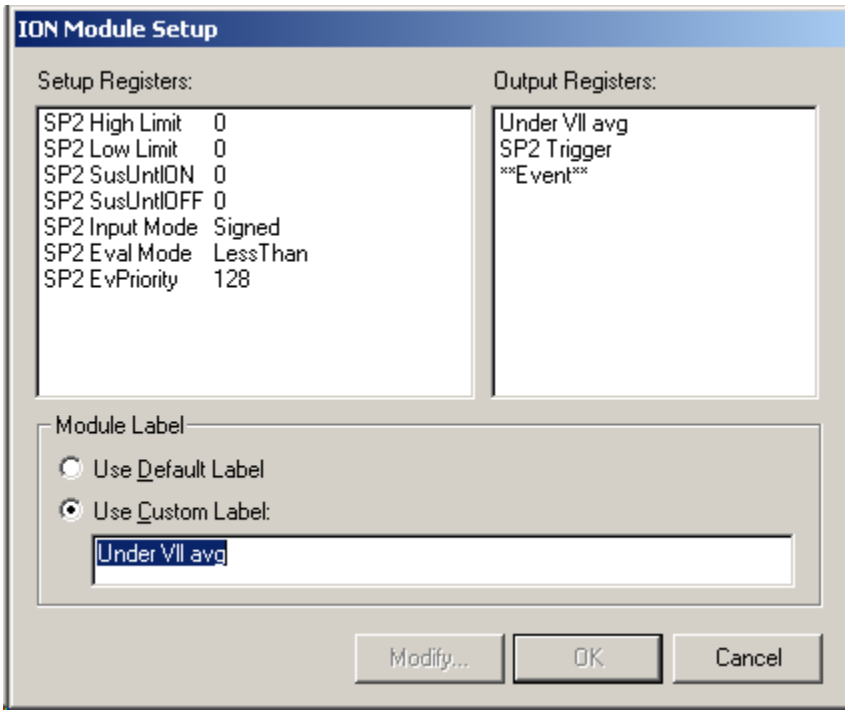

ION Module Setup
Setup Registers:
PM1 Volts Mode DELTA
PM1 PT Prim 600
PM1 PT Sec 120
PM1 CT Prim 300
PM1 CT Sec 5
PM1 V1Polarity Normal
PM1 V2Polarity Normal
PM1 V3Polarity Normal
PM1 I1Polarity Normal
PM1 I2Polarity Normal
PM1 I3Polarity Normal
Output Registers:
Vln a
Vln b
Vln c
Vln avg
Vll ab
Vll bc
Vll ca
Vll avg
I a
I b
I c
Module Label
Use Default Label
Use Custom Label:
Power Meter
Modify...
OK
Cancel

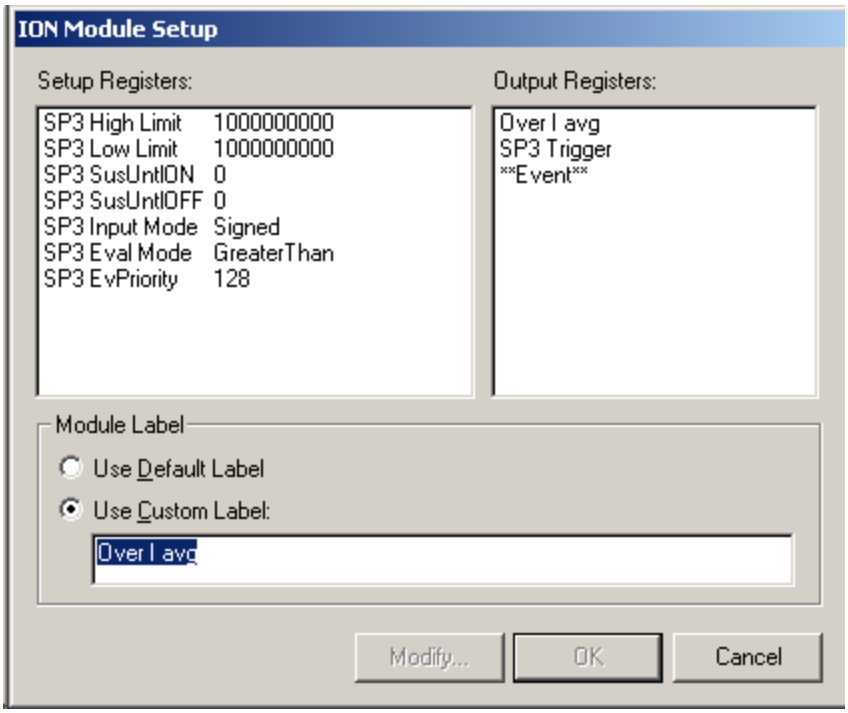

ION Module Setup
Setup Registers:
PM1 Volts Mode DELTA
PM1 PT Prim 600
PM1 PT Sec 120
PM1 CT Prim 300
PM1 CT Sec 5
PM1 V1Polarity Normal
PM1 V2Polarity Normal
PM1 V3Polarity Normal
PM1 I1Polarity Normal
PM1 I2Polarity Normal
PM1 I3Polarity Normal
Output Registers:
Vln a
Vln b
Vln c
Vln avg
Vll ab
Vll bc
Vll ca
Vll avg
I a
I b
I c
Module Label
Use Default Label
Use Custom Label:
Power Meter
Modify...
OK
Cancel

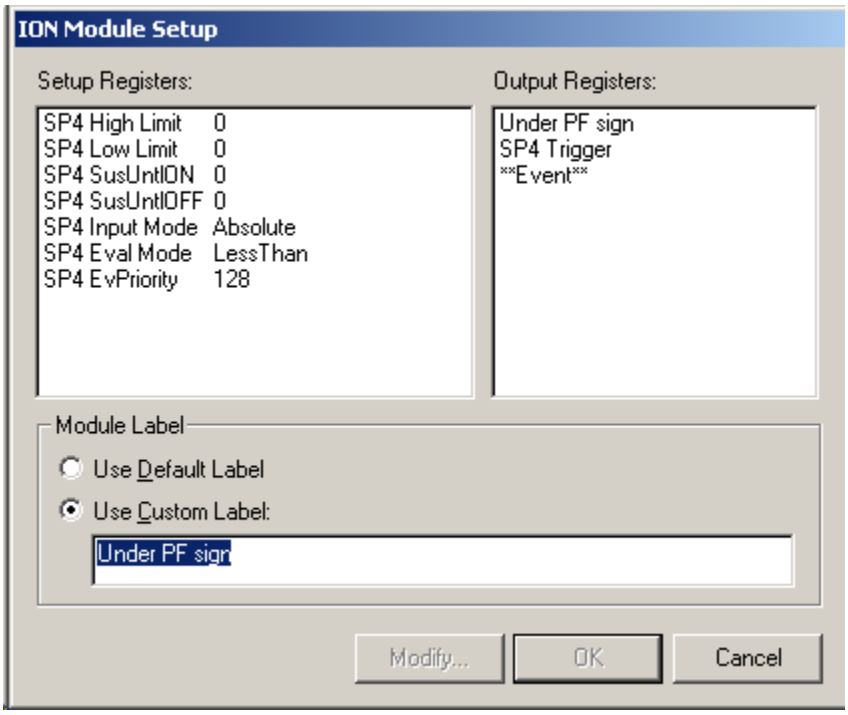

ION Module Setup
Setup Registers:
SD4 Sub Intvl 900
SD4 #SubIntvls 1
SD4 Pred Resp 70
Output Registers:
I avg swd
I avg pred swd
SD4 Time Left
SD4 Interval End
Event
Module Label
Use Default Label
Use Custom Label:
I avg swd
Modify...
OK
Cancel

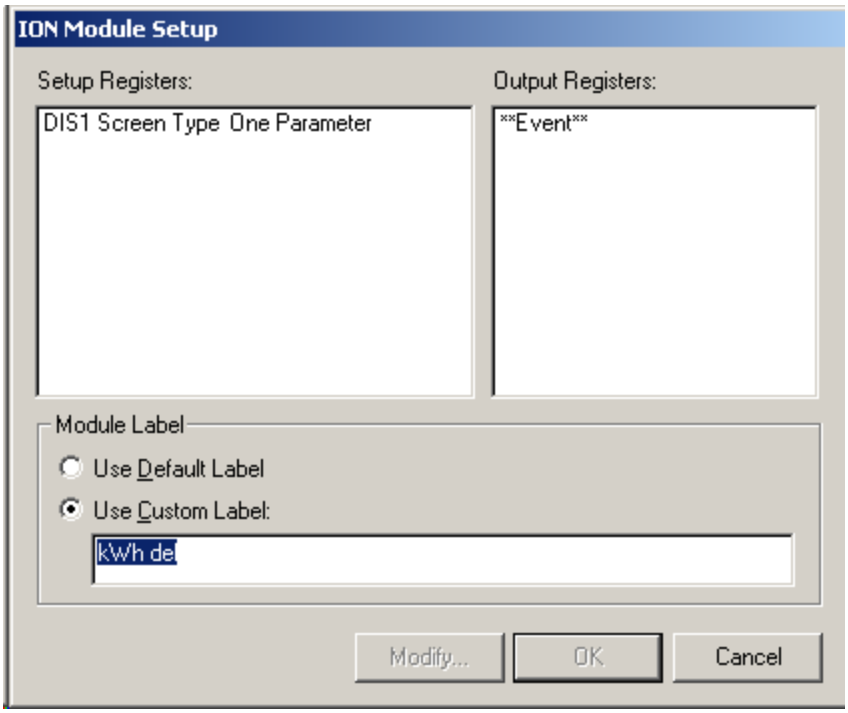

ION Module Setup
Setup Registers:
CL1 TZ Offset -28800
CL1 DST Start 1205028000
CL1 DST End 1225591200
CL1 DST Offset 3600
CL1 Time Sync Source COM1
CL1 Time Sync Type UTC
CL1 Clock Source Internal
Output Registers:
CL1 UnivTime
CL1 LocalTime
CL1 DSTFlag
CL1 Year
CL1 Month
CL1 Day
CL1 Hour
CL1 Minute
CL1 Second
CL1 Day Of Week
CL1 New Year
Module Label
Use Default Label
Use Custom Label:
Clock 1
Quick Setup...
Modify...
OK
Cancel

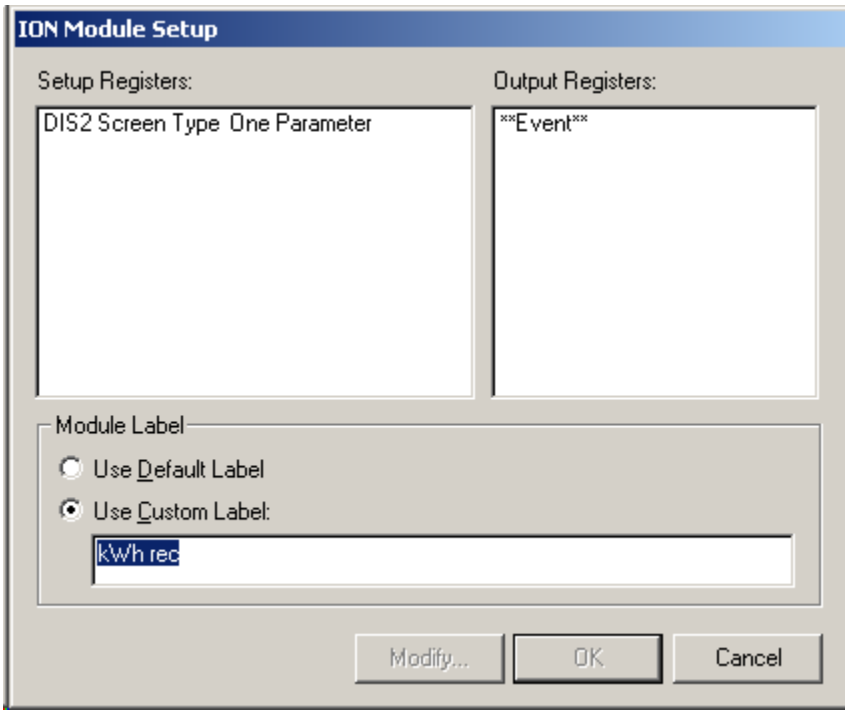

ION Module Setup
Setup Registers:
SP1 High Limit 1000000000
SP1 Low Limit 1000000000
SP1 SusUntlON 0
SP1 SusUntlOFF 0
SP1 Input Mode Signed
SP1 Eval Mode GreaterThan
SP1 EvPriority 128
Output Registers:
Over kW swd
SP1 Trigger
Event
Module Label
Use Default Label
Use Custom Label:
Over kW swd
Modify...
OK
Cancel

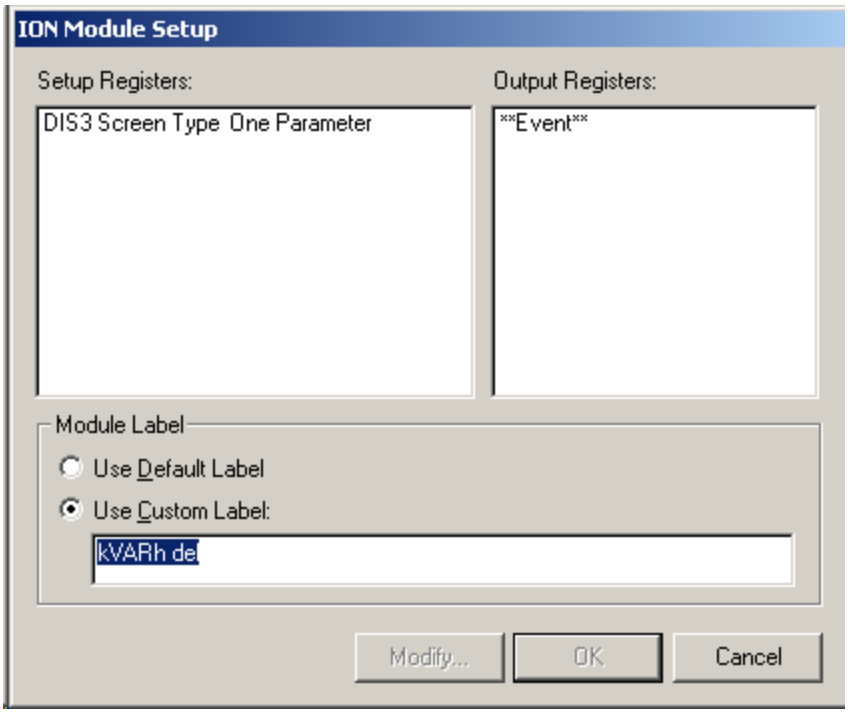

ION Module Setup
Setup Registers:
SP2 High Limit 0
SP2 Low Limit 0
SP2 SusUntlON 0
SP2 SusUntlOFF 0
SP2 Input Mode Signed
SP2 Eval Mode LessThan
SP2 EvPriority 128
Output Registers:
Under Vll avg
SP2 Trigger
Event
Module Label
Use Default Label
Use Custom Label:
Under Vll avg
Modify...
OK
Cancel

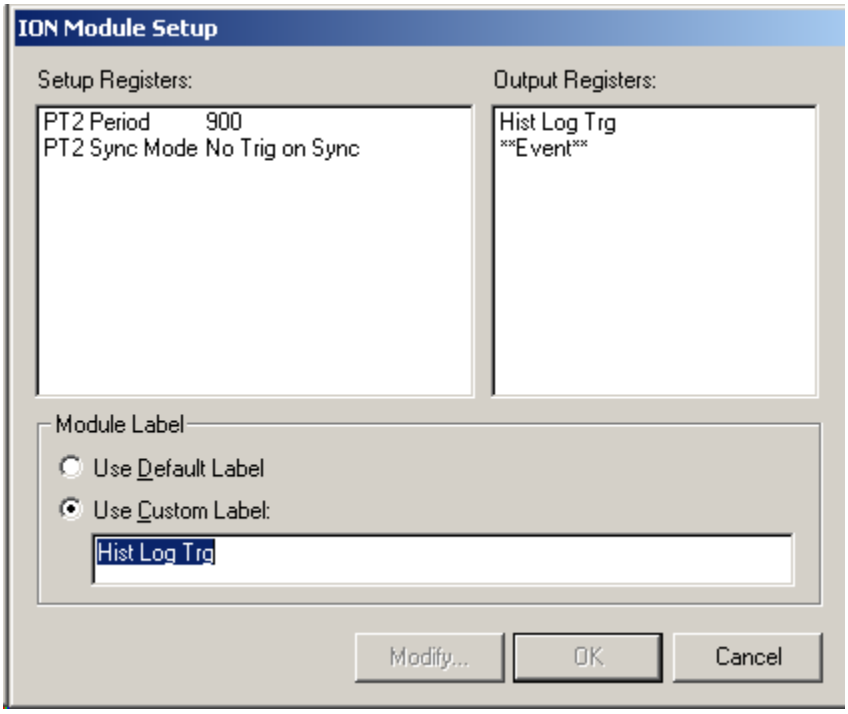

ION Module Setup
Setup Registers:
SP3 High Limit 1000000000
SP3 Low Limit 1000000000
SP3 SusUntlON 0
SP3 SusUntlOFF 0
SP3 Input Mode Signed
SP3 Eval Mode GreaterThan
SP3 EvPriority 128
Output Registers:
Over I avg
SP3 Trigger
Event
Module Label
Use Default Label
Use Custom Label:
Over I avg
Modify...
OK
Cancel

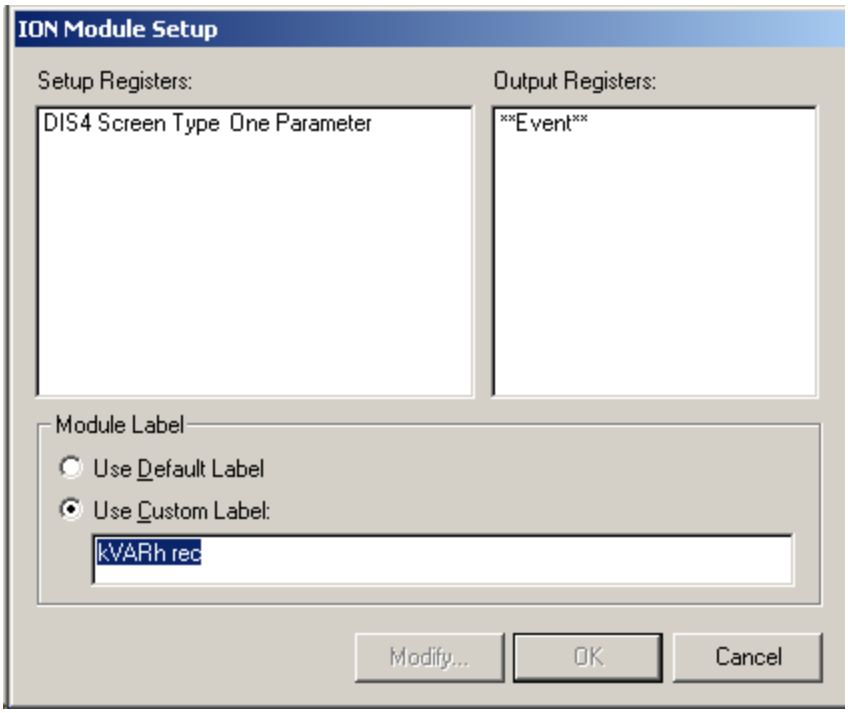

ION Module Setup
Setup Registers:
SP4 High Limit 0
SP4 Low Limit 0
SP4 SusUntlON 0
SP4 SusUntlOFF 0
SP4 Input Mode Absolute
SP4 Eval Mode LessThan
SP4 EvPriority 128
Output Registers:
Under PF sign
SP4 Trigger
Event
Module Label
Use Default Label
Use Custom Label:
Under PF sign
Modify...
OK
Cancel

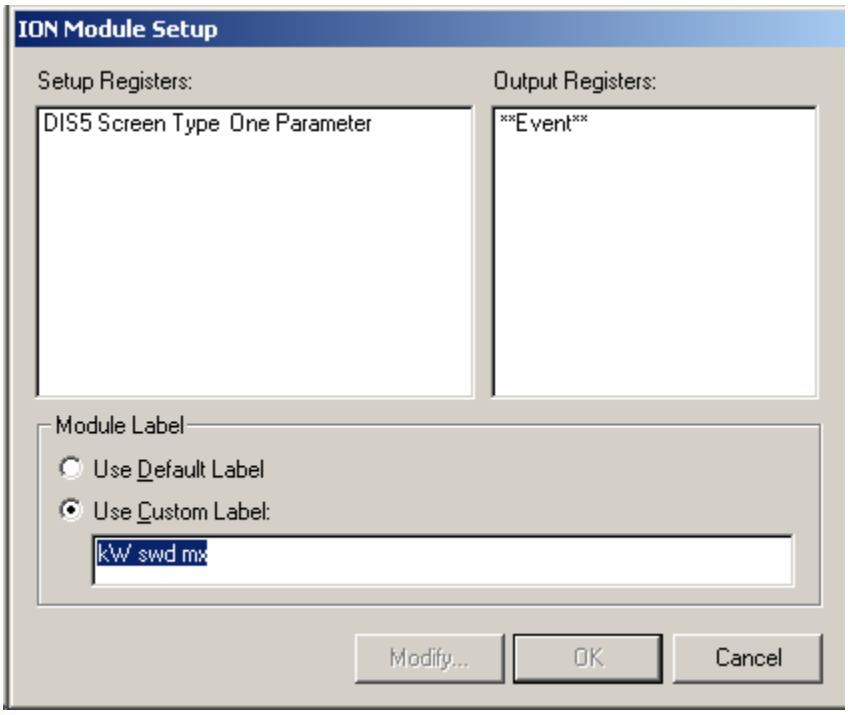

ION Module Setup
Setup Registers:
DIS1 Screen Type One Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
kWh de
Modify...
OK
Cancel

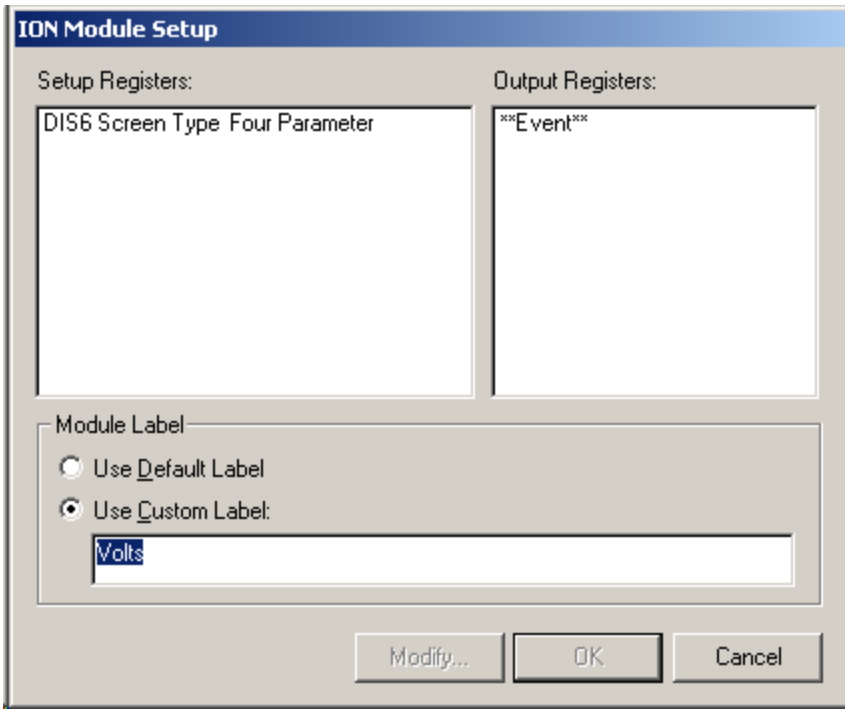

ION Module Setup
Setup Registers:
DIS2 Screen Type One Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
kWh rec
Modify...
OK
Cancel

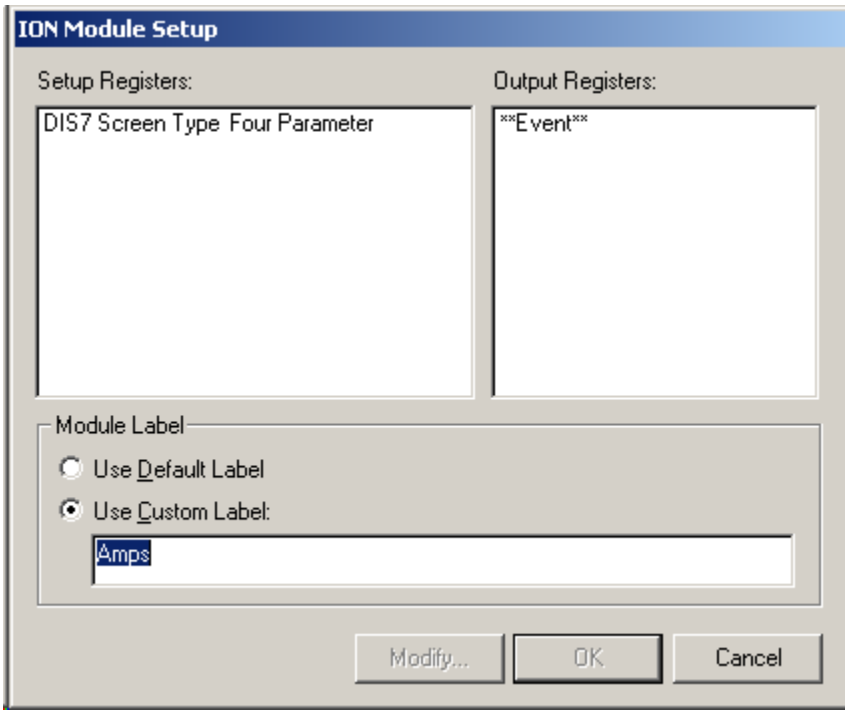

ION Module Setup
Setup Registers:
DIS3 Screen Type One Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
kVARh del
Modify...
OK
Cancel

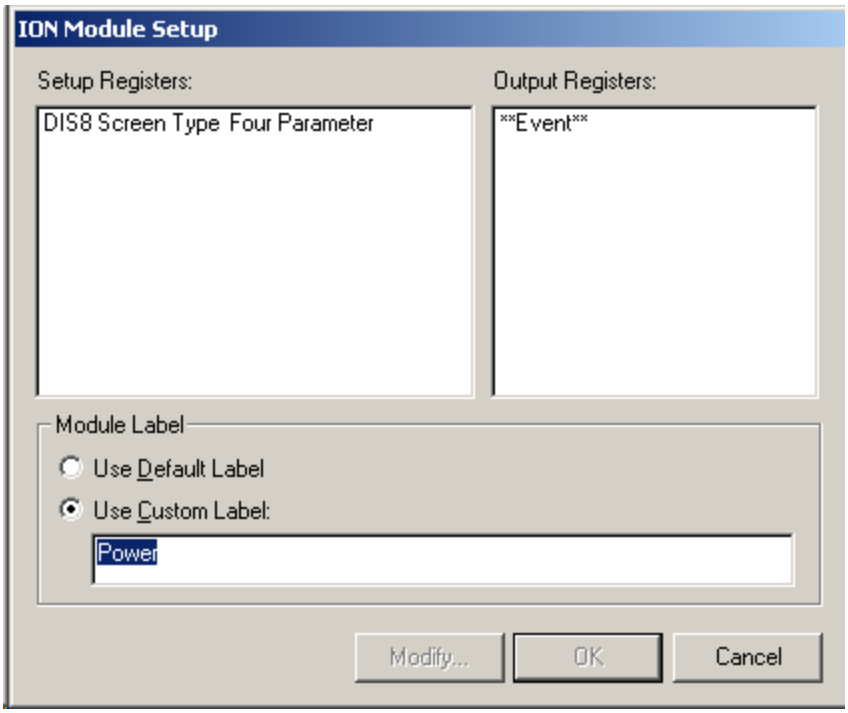

ION Module Setup
Setup Registers:
PT2 Period 900
PT2 Sync Mode No Trig on Sync
Output Registers:
Hist Log Trg
Event
Module Label
Use Default Label
Use Custom Label:
Hist Log Trg
Modify...
OK
Cancel

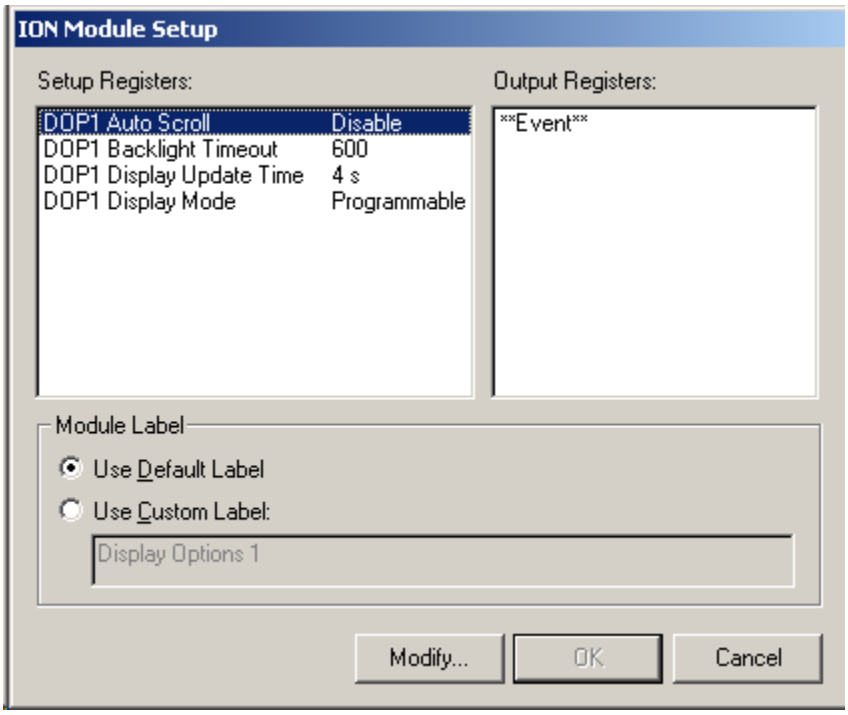

ION Module Setup
Setup Registers:
DIS4 Screen Type One Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
kVARh rec
Modify...
OK
Cancel

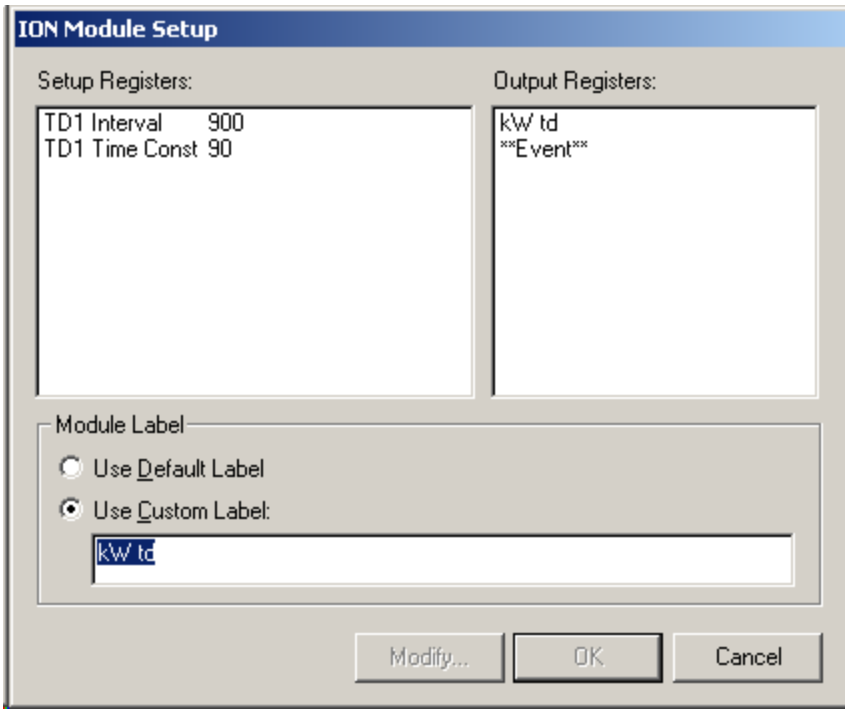

ION Module Setup
Setup Registers:
DIS5 Screen Type One Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
kW swd mx
Modify...
OK
Cancel

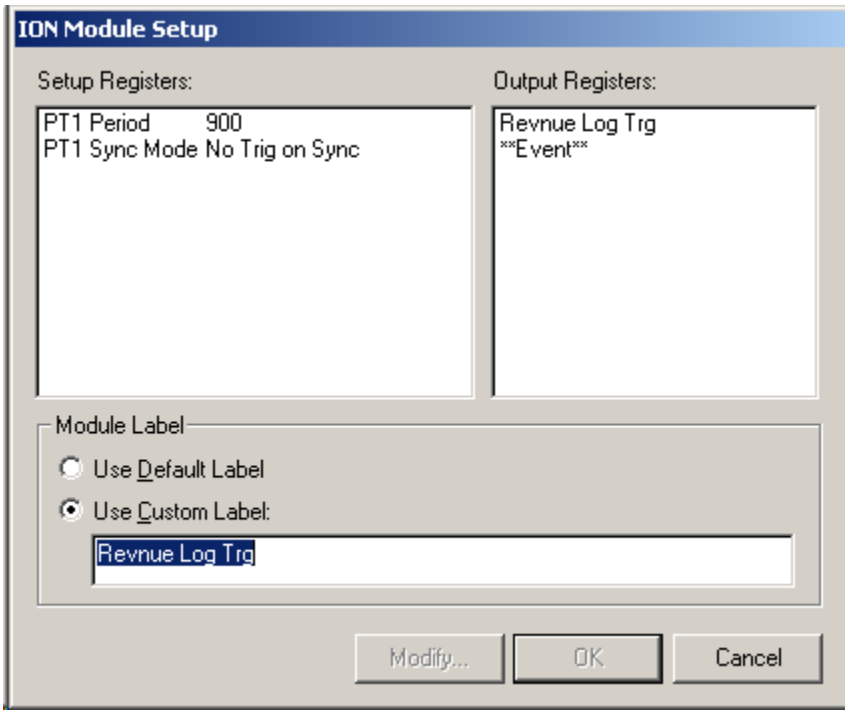

ION Module Setup
Setup Registers:
DIS6 Screen Type Four Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
Volts
Modify...
OK
Cancel

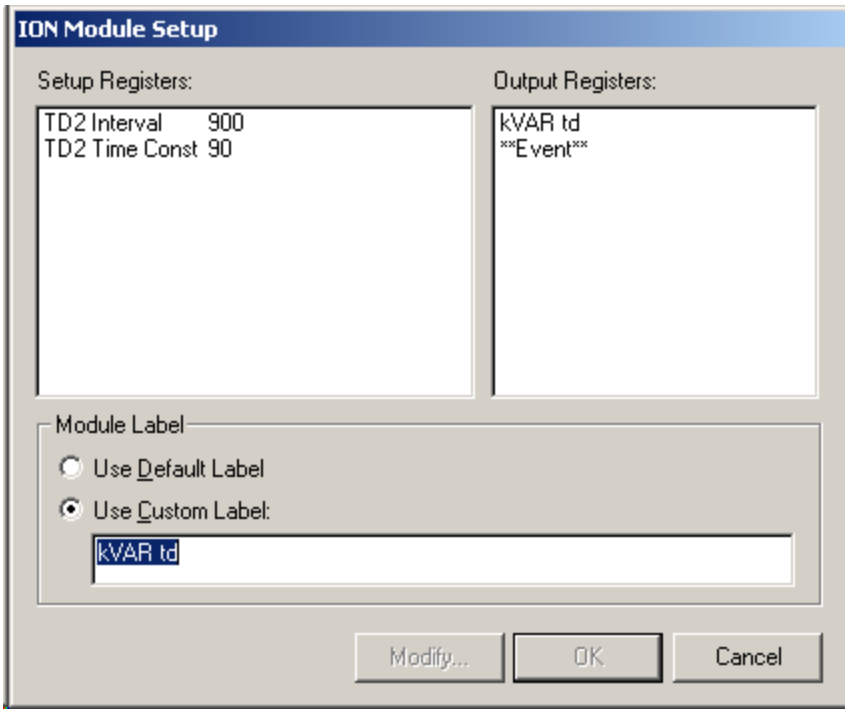

ION Module Setup
Setup Registers:
DIS7 Screen Type Four Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
Amps
Modify...
OK
Cancel

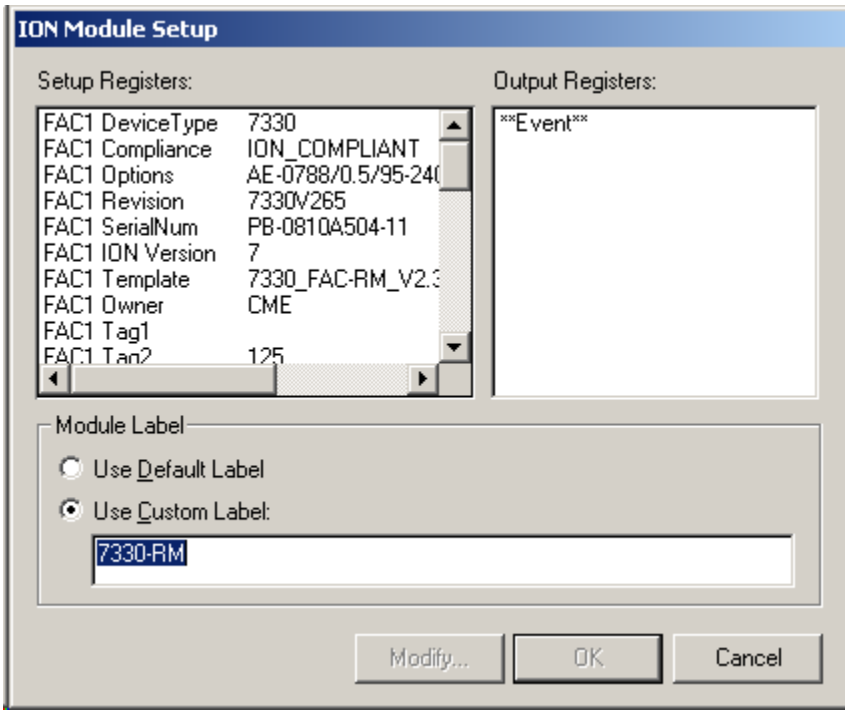

ION Module Setup
Setup Registers:
DIS8 Screen Type Four Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
Power
Modify...
OK
Cancel

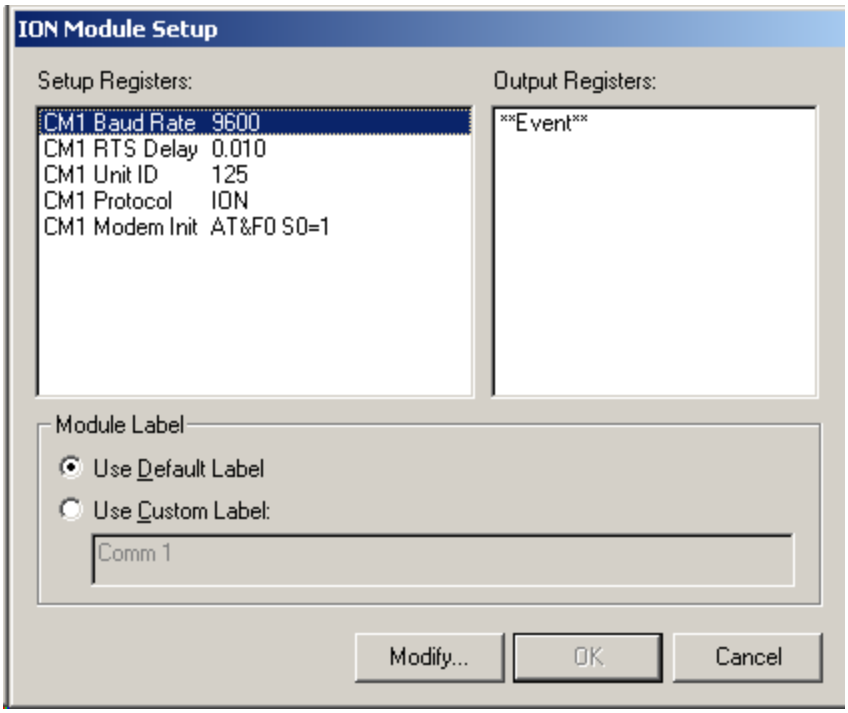

ION Module Setup
Setup Registers:
DOP1 Auto Scroll Disable
DOP1 Backlight Timeout 600
DOP1 Display Update Time 4 s
DOP1 Display Mode Programmable
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
Display Options 1
Modify...
OK
Cancel

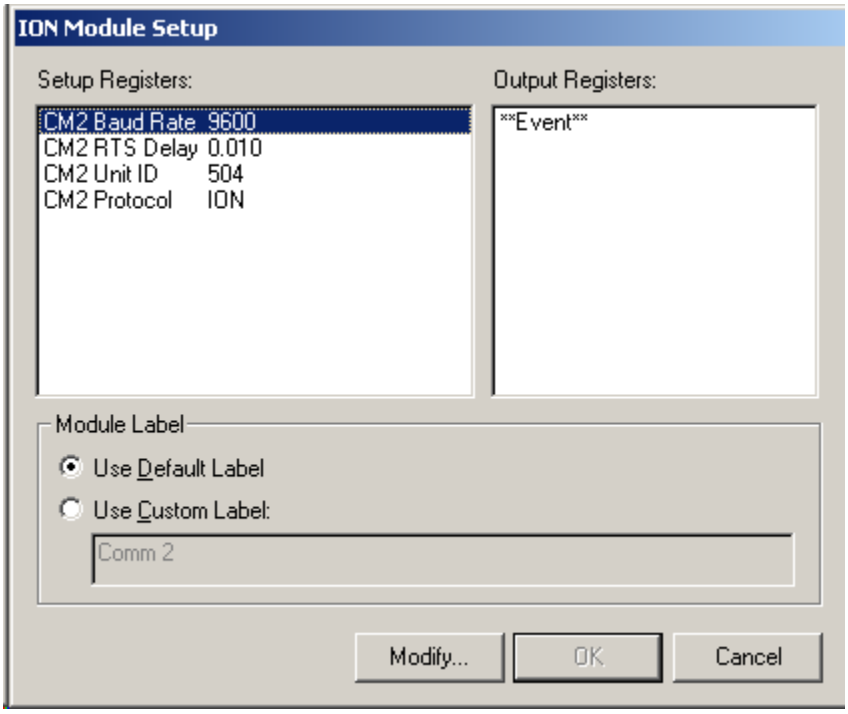

ION Module Setup
Setup Registers:
TD1 Interval 900
TD1 Time Const 90
Output Registers:
kW td
Event
Module Label
Use Default Label
Use Custom Label:
kW td
Modify...
OK
Cancel

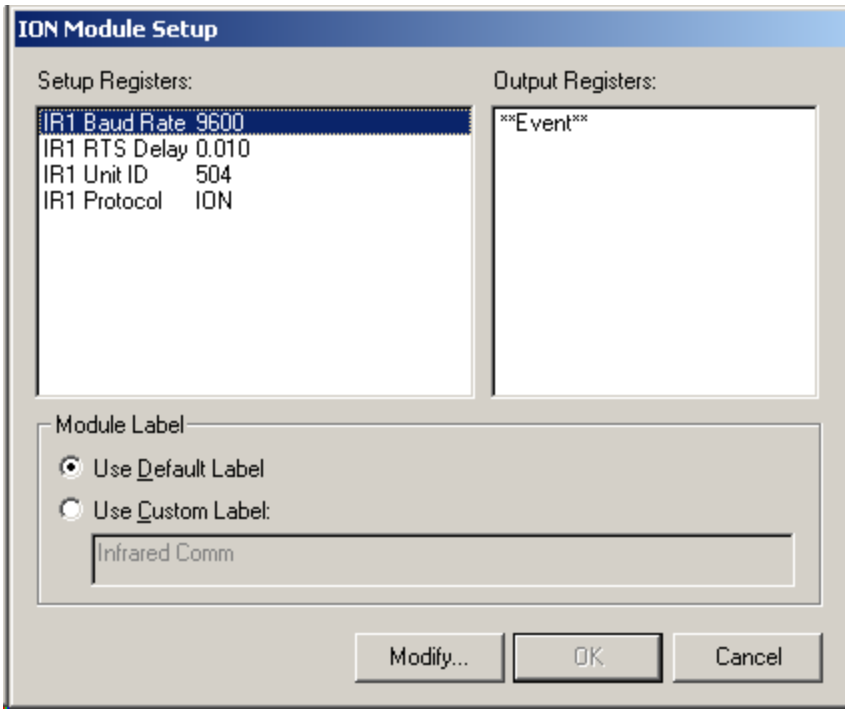

ION Module Setup
Setup Registers:
PT1 Period 900
PT1 Sync Mode No Trig on Sync
Output Registers:
Revnue Log Trg
Event
Module Label
Use Default Label
Use Custom Label:
Revnue Log Trg
Modify...
OK
Cancel

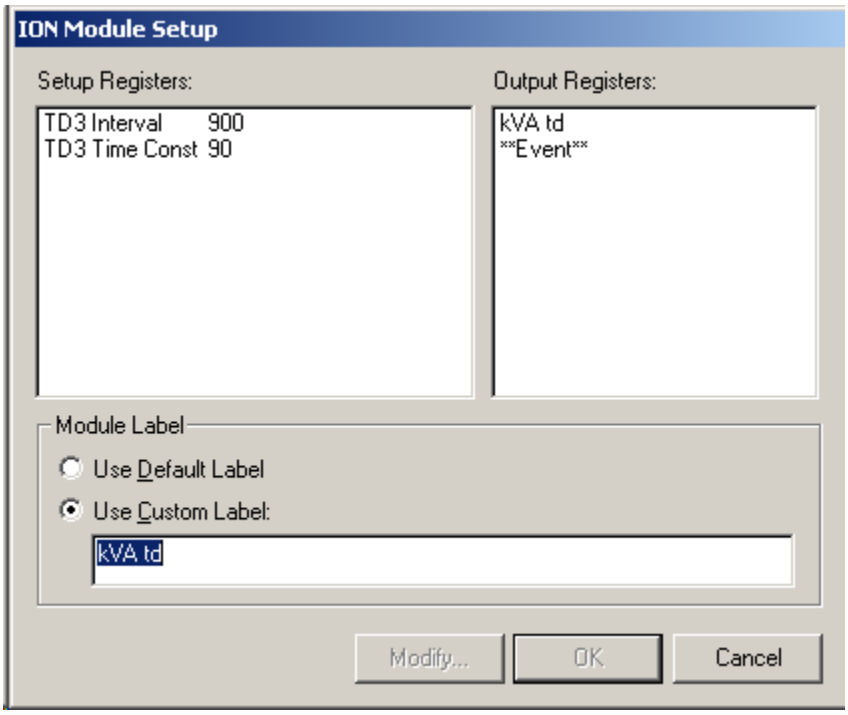

ION Module Setup
Setup Registers:
TD2 Interval 900
TD2 Time Const 90
Output Registers:
kVAR td
Event
Module Label
Use Default Label
Use Custom Label:
kVAR td
Modify...
OK
Cancel

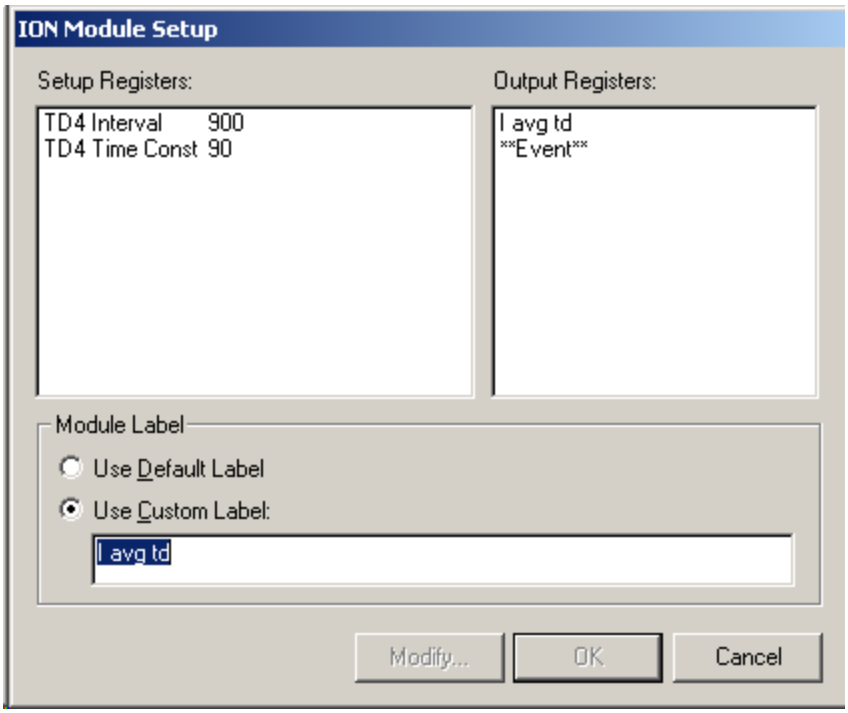

ION Module Setup
Setup Registers:
FAC1 DeviceType 7330
FAC1 Compliance ION_COMPLIANT
FAC1 Options AE-0788/0.5/95-24(
FAC1 Revision 7330V265
FAC1 SerialNum PB-0810A504-11
FAC1 ION Version 7
FAC1 Template 7330_FAC-RM_V2.3
FAC1 Owner CME
FAC1 Tag1
FAC1 Tag2 125
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
7330-RM
Modify...
OK
Cancel

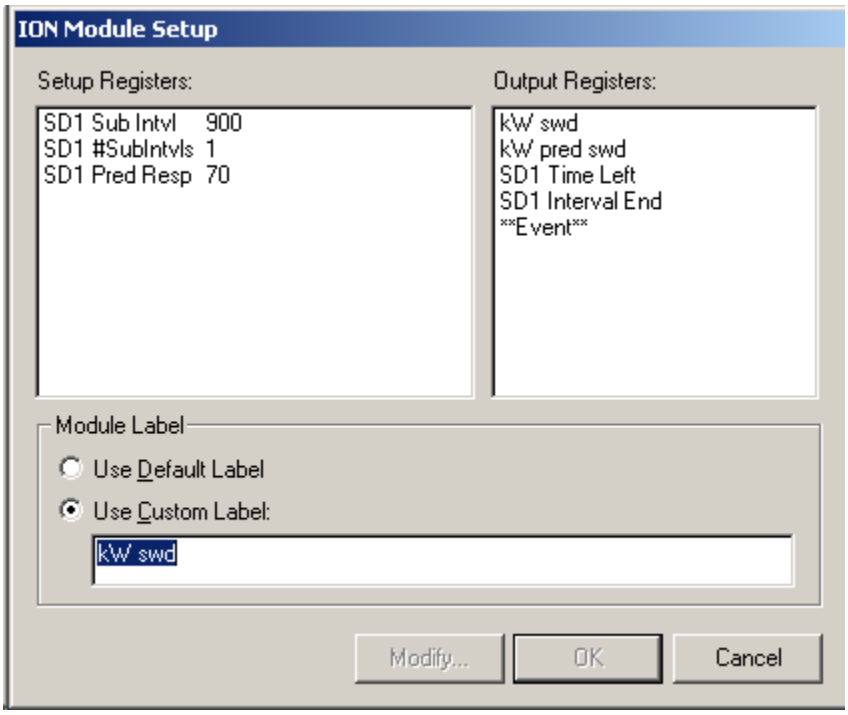

ION Module Setup
Setup Registers:
CM1 Baud Rate 9600
CM1 RTS Delay 0.010
CM1 Unit ID 125
CM1 Protocol ION
CM1 Modem Init AT&F0 S0=1
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
Comm 1
Modify...
OK
Cancel

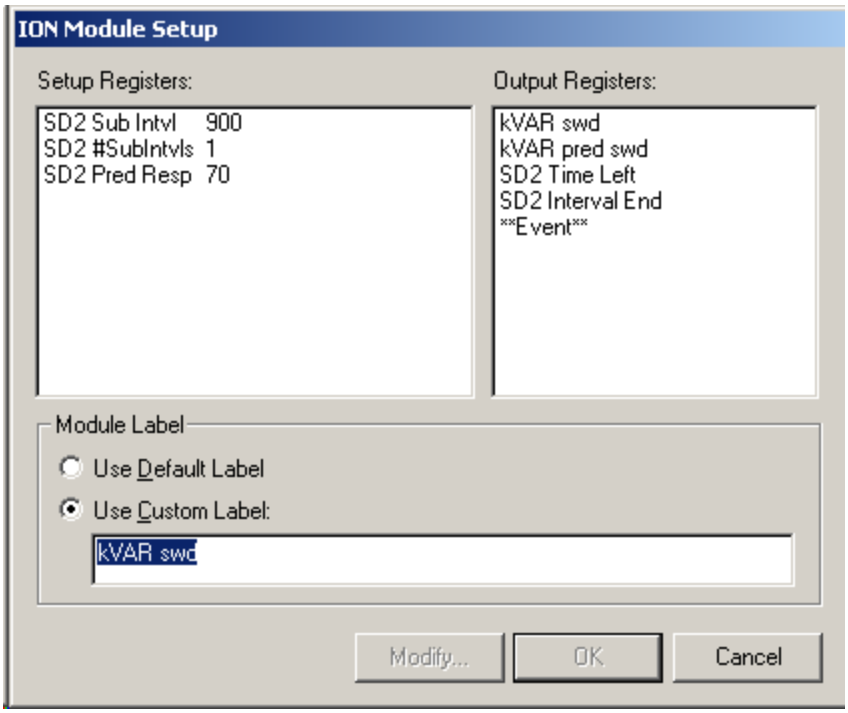

ION Module Setup
Setup Registers:
CM2 Baud Rate 9600
CM2 RTS Delay 0.010
CM2 Unit ID 504
CM2 Protocol ION
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
Comm 2
Modify...
OK
Cancel

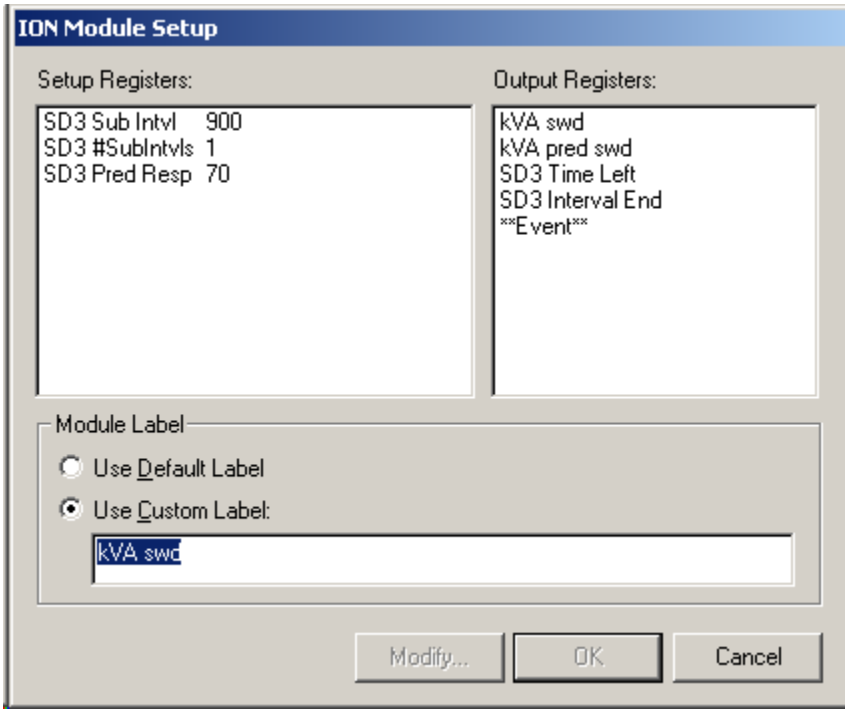

ION Module Setup
Setup Registers:
IR1 Baud Rate 9600
IR1 RTS Delay 0.010
IR1 Unit ID 504
IR1 Protocol ION
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
Infrared Comm
Modify...
OK
Cancel

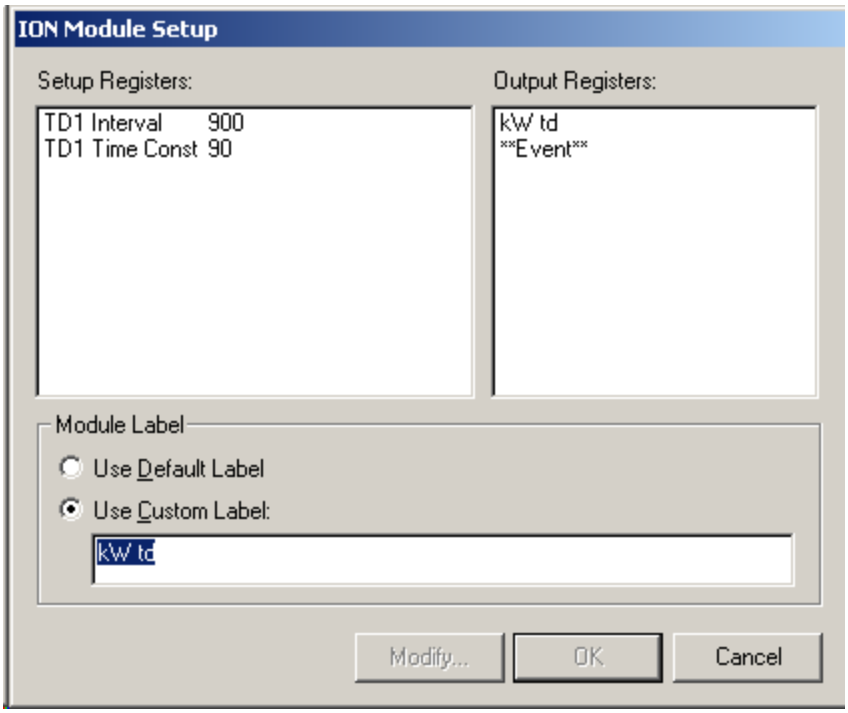

ION Module Setup
Setup Registers:
TD3 Interval 900
TD3 Time Const 90
Output Registers:
kVA td
Event
Module Label
Use Default Label
Use Custom Label:
kVA td
Modify...
OK
Cancel

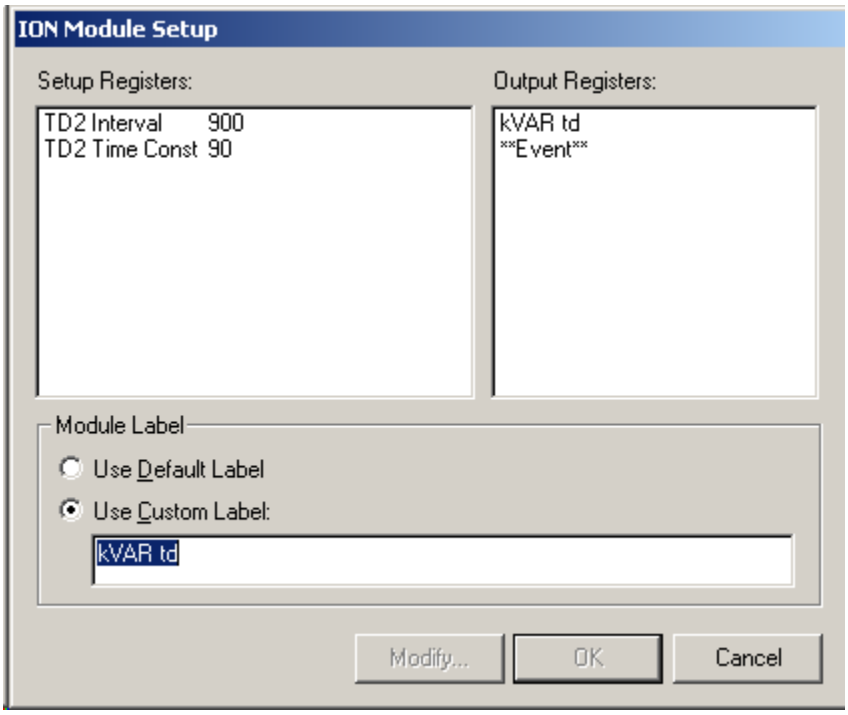

ION Module Setup
Setup Registers:
TD4 Interval 900
TD4 Time Const 90
Output Registers:
I avg td
Event
Module Label
Use Default Label
Use Custom Label:
I avg td
Modify...
OK
Cancel

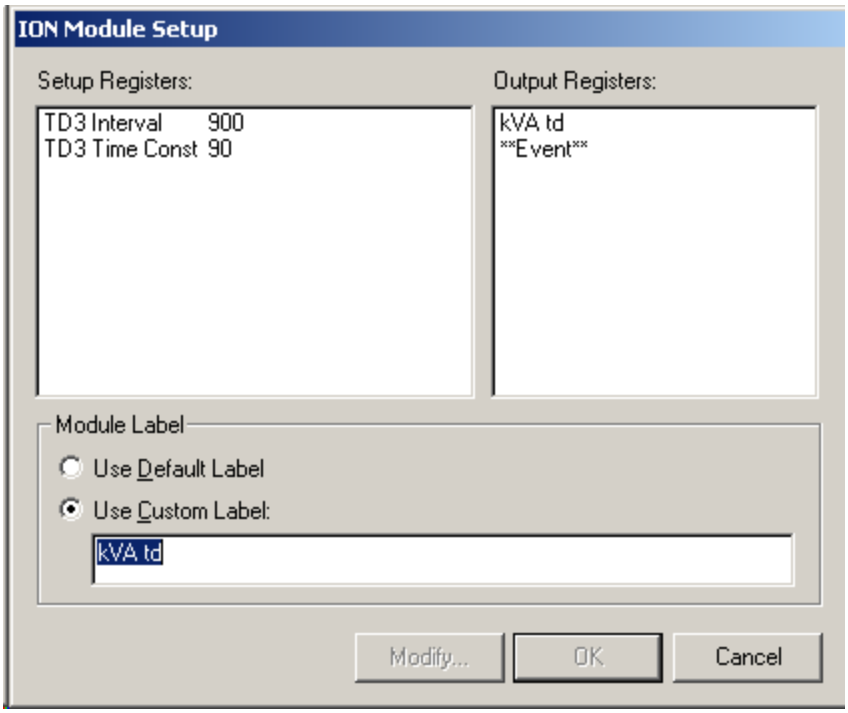

ION Module Setup
Setup Registers:
SD1 Sub Intvl 900
SD1 #SubIntvls 1
SD1 Pred Resp 70
Output Registers:
kW swd
kW pred swd
SD1 Time Left
SD1 Interval End
Event
Module Label
Use Default Label
Use Custom Label:
kW swd
Modify...
OK
Cancel

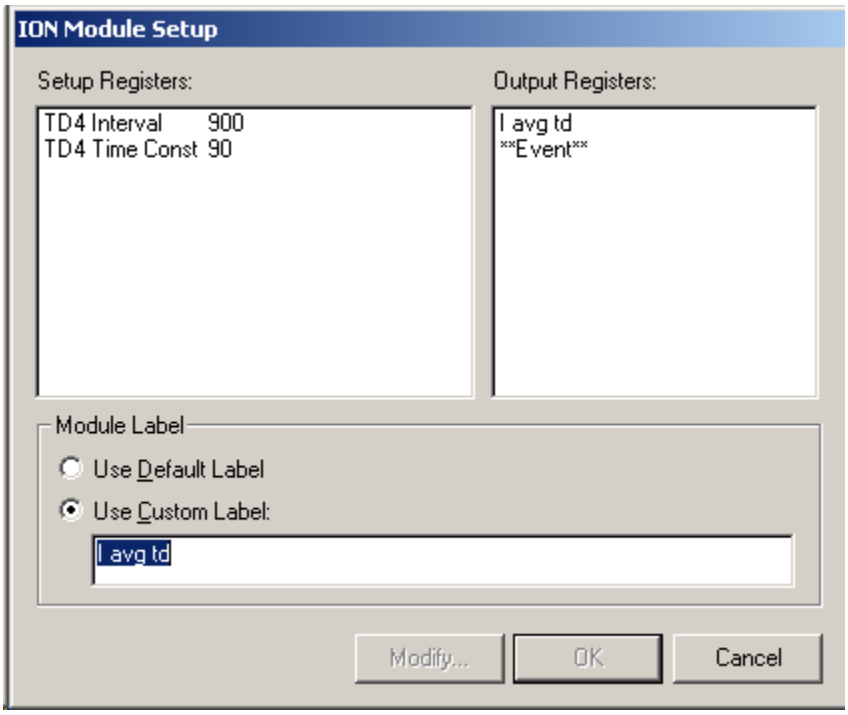

ION Module Setup
Setup Registers:
SD2 Sub Intvl 900
SD2 #SubIntvls 1
SD2 Pred Resp 70
Output Registers:
kVAR swd
kVAR pred swd
SD2 Time Left
SD2 Interval End
Event
Module Label
Use Default Label
Use Custom Label:
kVAR swd
Modify...
OK
Cancel

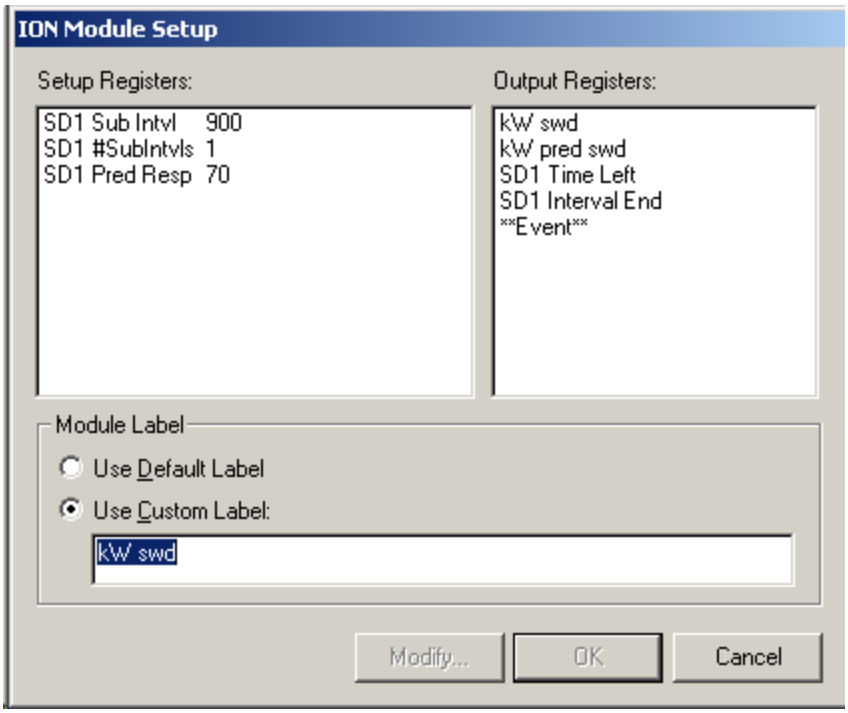

ION Module Setup
Setup Registers:
SD3 Sub Intvl 900
SD3 #SubIntvls 1
SD3 Pred Resp 70
Output Registers:
kVA swd
kVA pred swd
SD3 Time Left
SD3 Interval End
Event
Module Label
Use Default Label
Use Custom Label:
kVA swd
Modify...
OK
Cancel

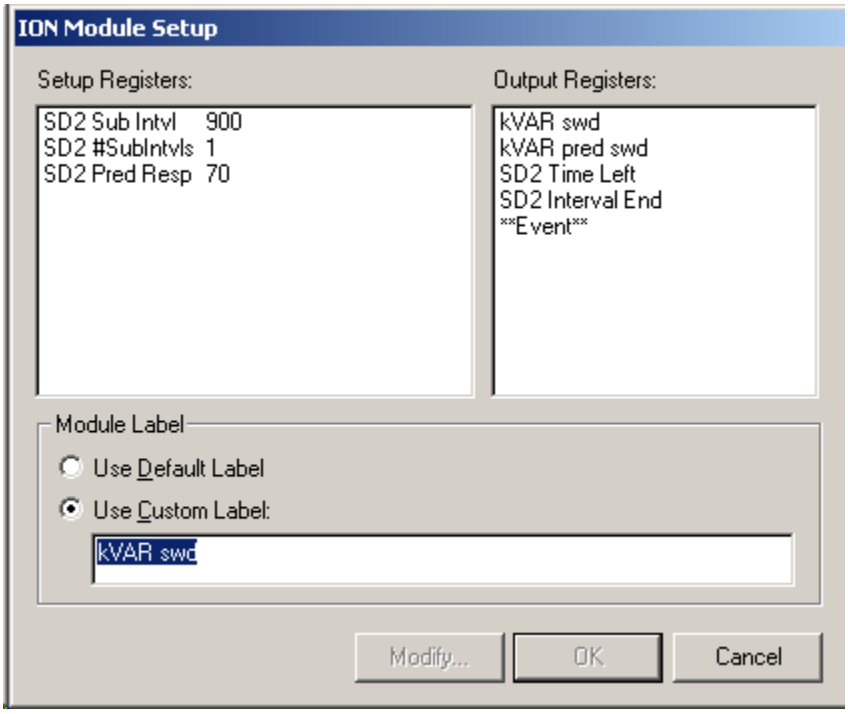

ION Module Setup
Setup Registers:
TD1 Interval 900
TD1 Time Const 90
Output Registers:
kW td
Event
Module Label
Use Default Label
Use Custom Label:
kW td
Modify...
OK
Cancel

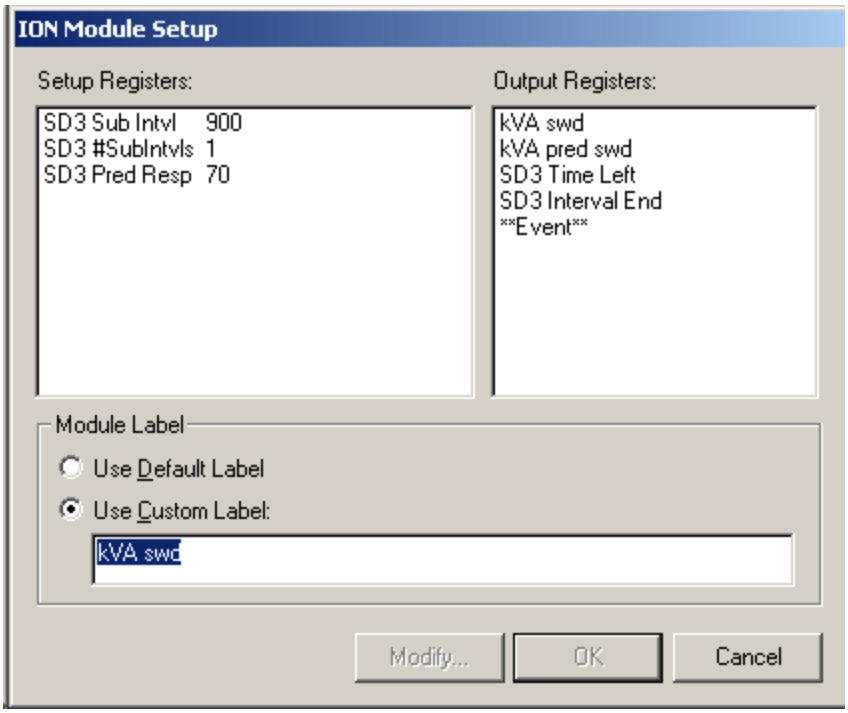

ION Module Setup
Setup Registers:
TD2 Interval 900
TD2 Time Const 90
Output Registers:
kVAR td
Event
Module Label
Use Default Label
Use Custom Label:
kVAR td
Modify...
OK
Cancel

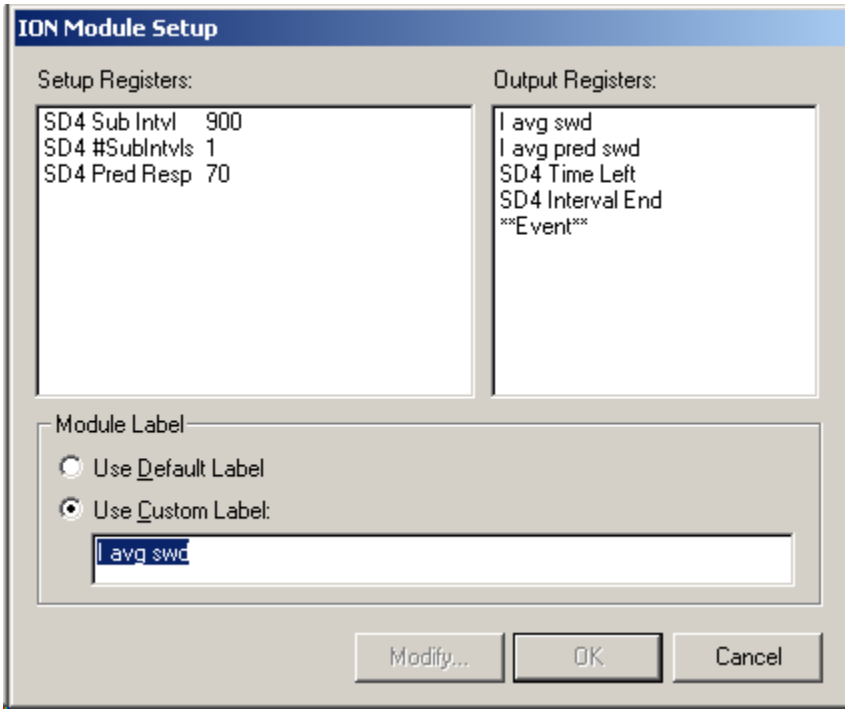

ION Module Setup
Setup Registers:
TD3 Interval 900
TD3 Time Const 90
Output Registers:
kVA td
Event
Module Label
Use Default Label
Use Custom Label:
kVA td
Modify...
OK
Cancel

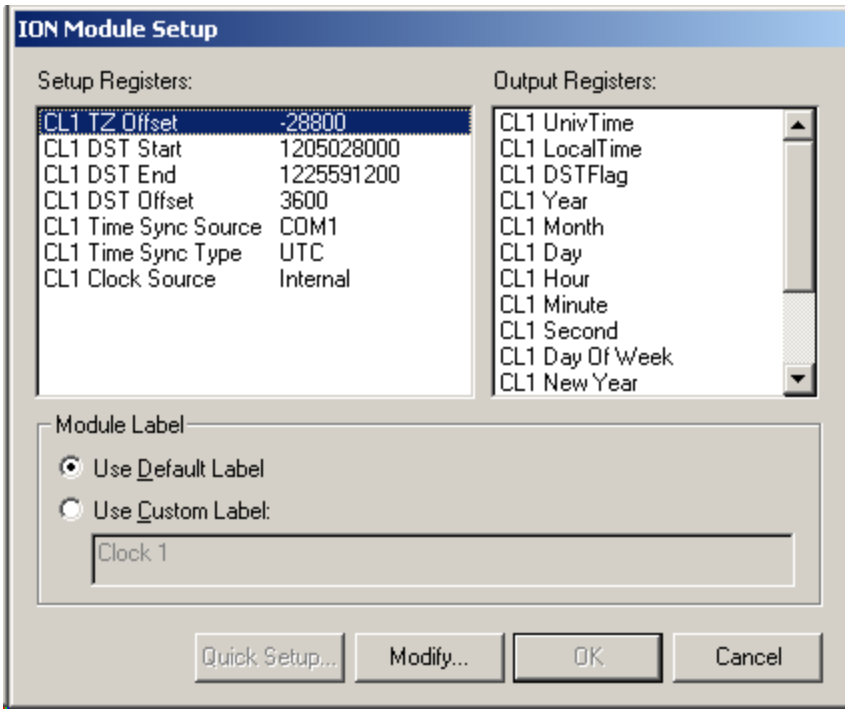

ION Module Setup
Setup Registers:
TD4 Interval 900
TD4 Time Const 90
Output Registers:
I avg td
Event
Module Label
Use Default Label
Use Custom Label:
I avg td
Modify...
OK
Cancel

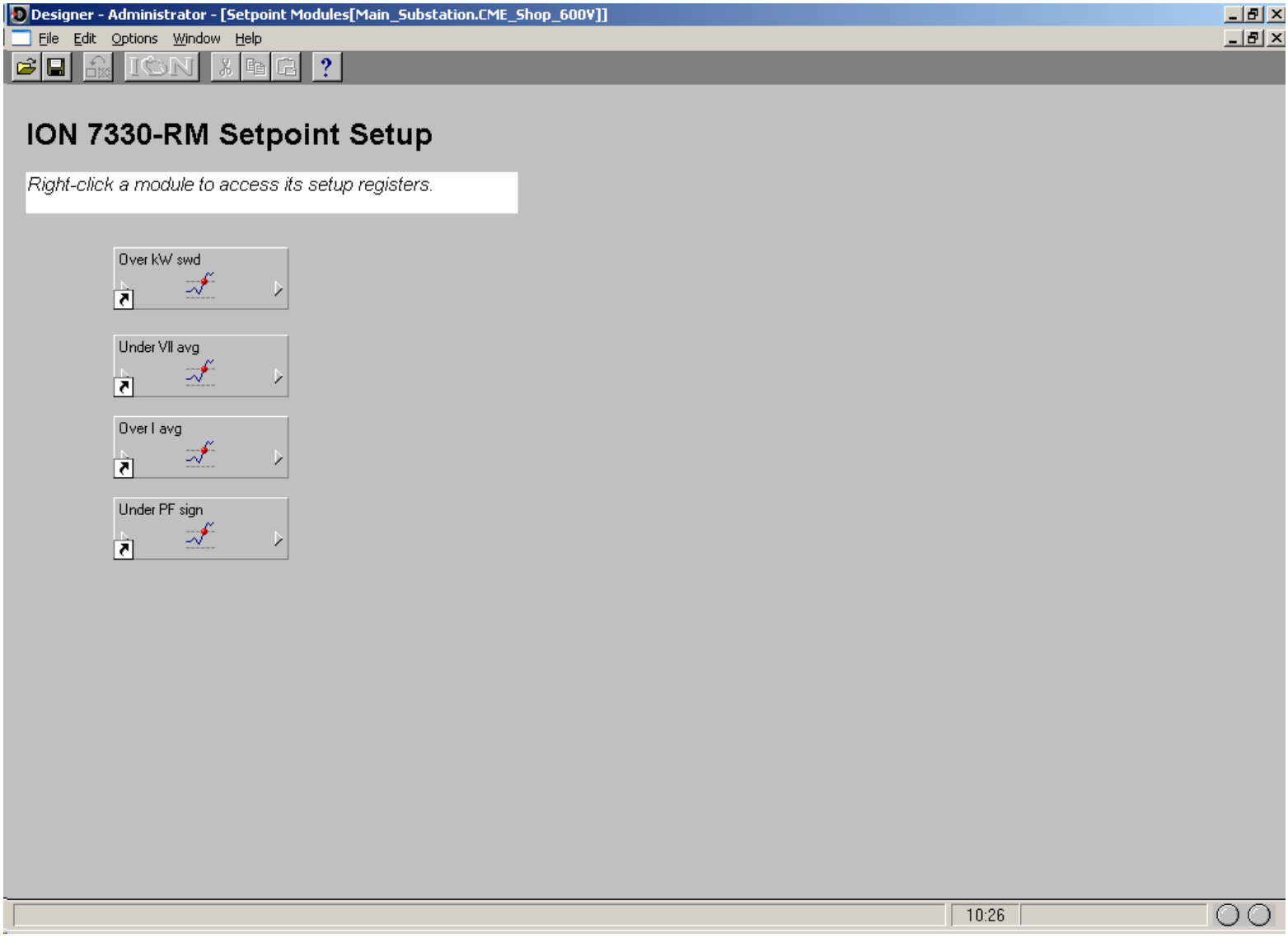

ION Module Setup
Setup Registers:
SD1 Sub Intvl 900
SD1 #SubIntvls 1
SD1 Pred Resp 70
Output Registers:
kW swd
kW pred swd
SD1 Time Left
SD1 Interval End
Event
Module Label
Use Default Label
Use Custom Label:
kW swd
Modify...
OK
Cancel

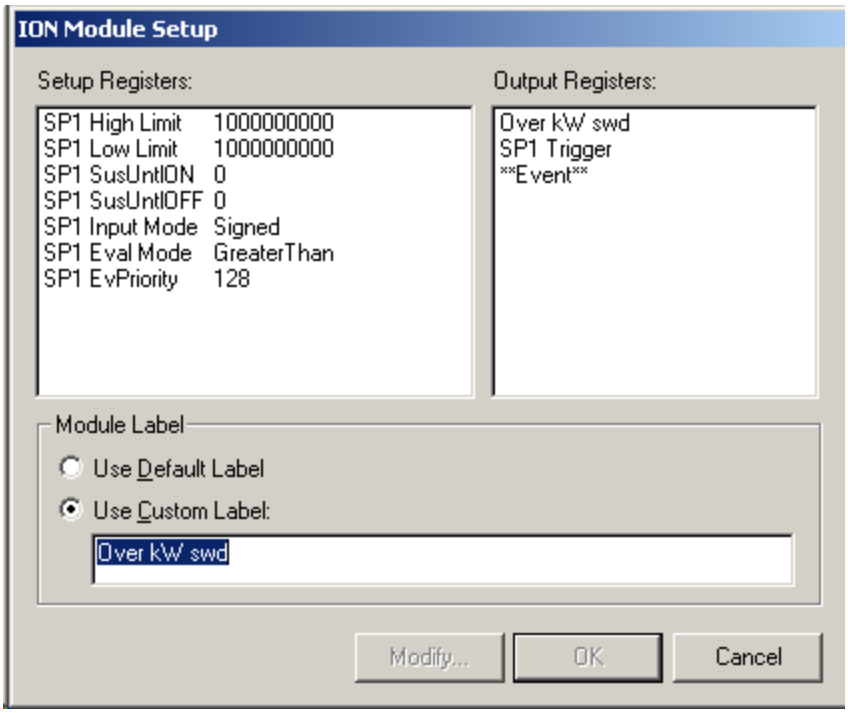

ION Module Setup
Setup Registers:
SD2 Sub Intvl 900
SD2 #SubIntvls 1
SD2 Pred Resp 70
Output Registers:
kVAR swd
kVAR pred swd
SD2 Time Left
SD2 Interval End
Event
Module Label
Use Default Label
Use Custom Label:
kVAR swd
Modify...
OK
Cancel

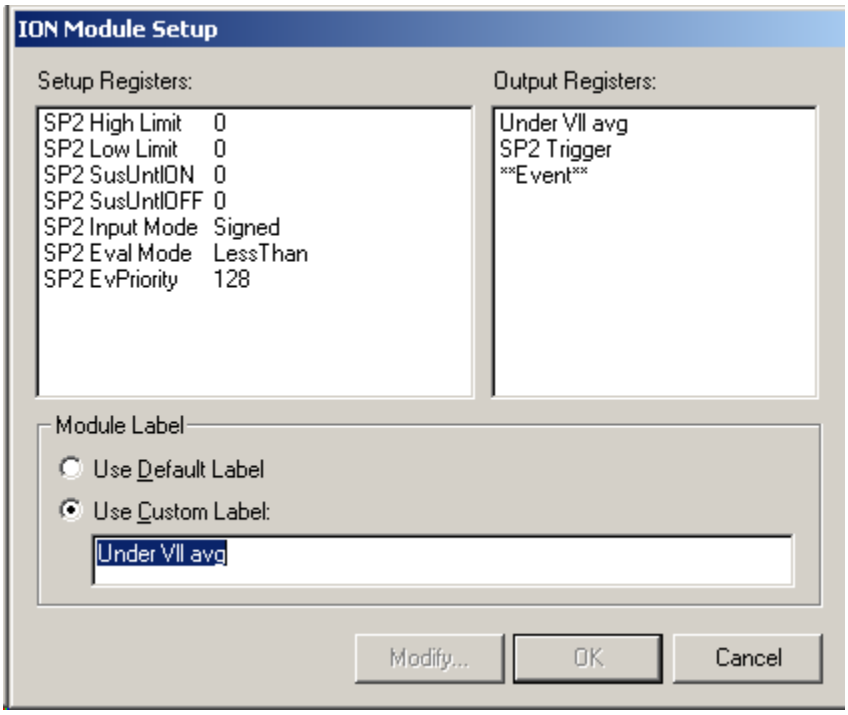

ION Module Setup
Setup Registers:
SD3 Sub Intvl 900
SD3 #SubIntvls 1
SD3 Pred Resp 70
Output Registers:
kVA swd
kVA pred swd
SD3 Time Left
SD3 Interval End
Event
Module Label
Use Default Label
Use Custom Label:
kVA swd
Modify...
OK
Cancel

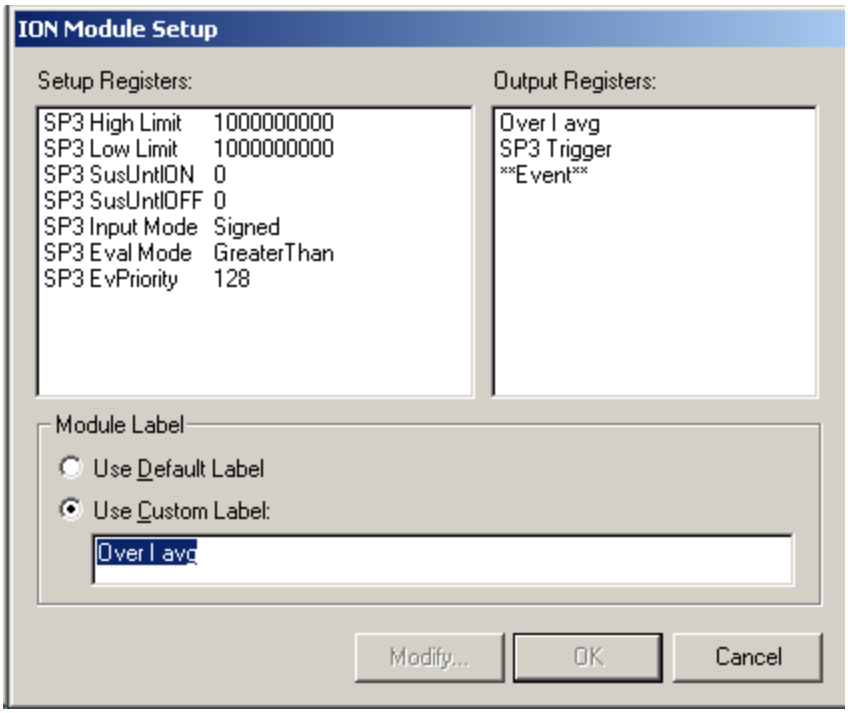

ION Module Setup
Setup Registers:
SD4 Sub Intvl 900
SD4 #SubIntvls 1
SD4 Pred Resp 70
Output Registers:
I avg swd
I avg pred swd
SD4 Time Left
SD4 Interval End
Event
Module Label
Use Default Label
Use Custom Label:
I avg swd
Modify...
OK
Cancel

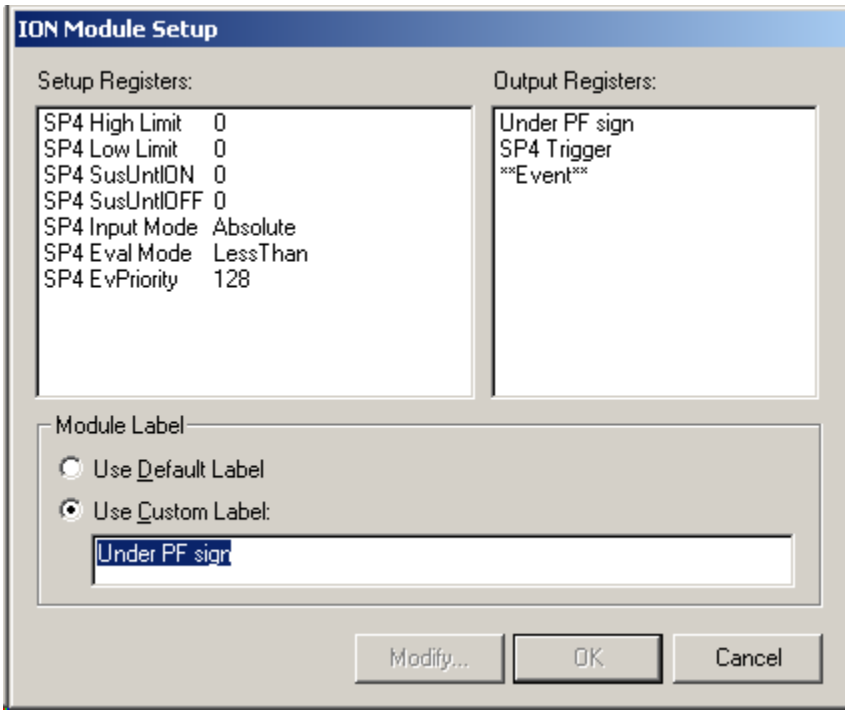

ION Module Setup
Setup Registers:
CL1 TZ Offset -28800
CL1 DST Start 1205028000
CL1 DST End 1225591200
CL1 DST Offset 3600
CL1 Time Sync Source COM1
CL1 Time Sync Type UTC
CL1 Clock Source Internal
Output Registers:
CL1 UnivTime
CL1 LocalTime
CL1 DSTFlag
CL1 Year
CL1 Month
CL1 Day
CL1 Hour
CL1 Minute
CL1 Second
CL1 Day Of Week
CL1 New Year
Module Label
Use Default Label
Use Custom Label:
Clock 1
Quick Setup...
Modify...
OK
Cancel

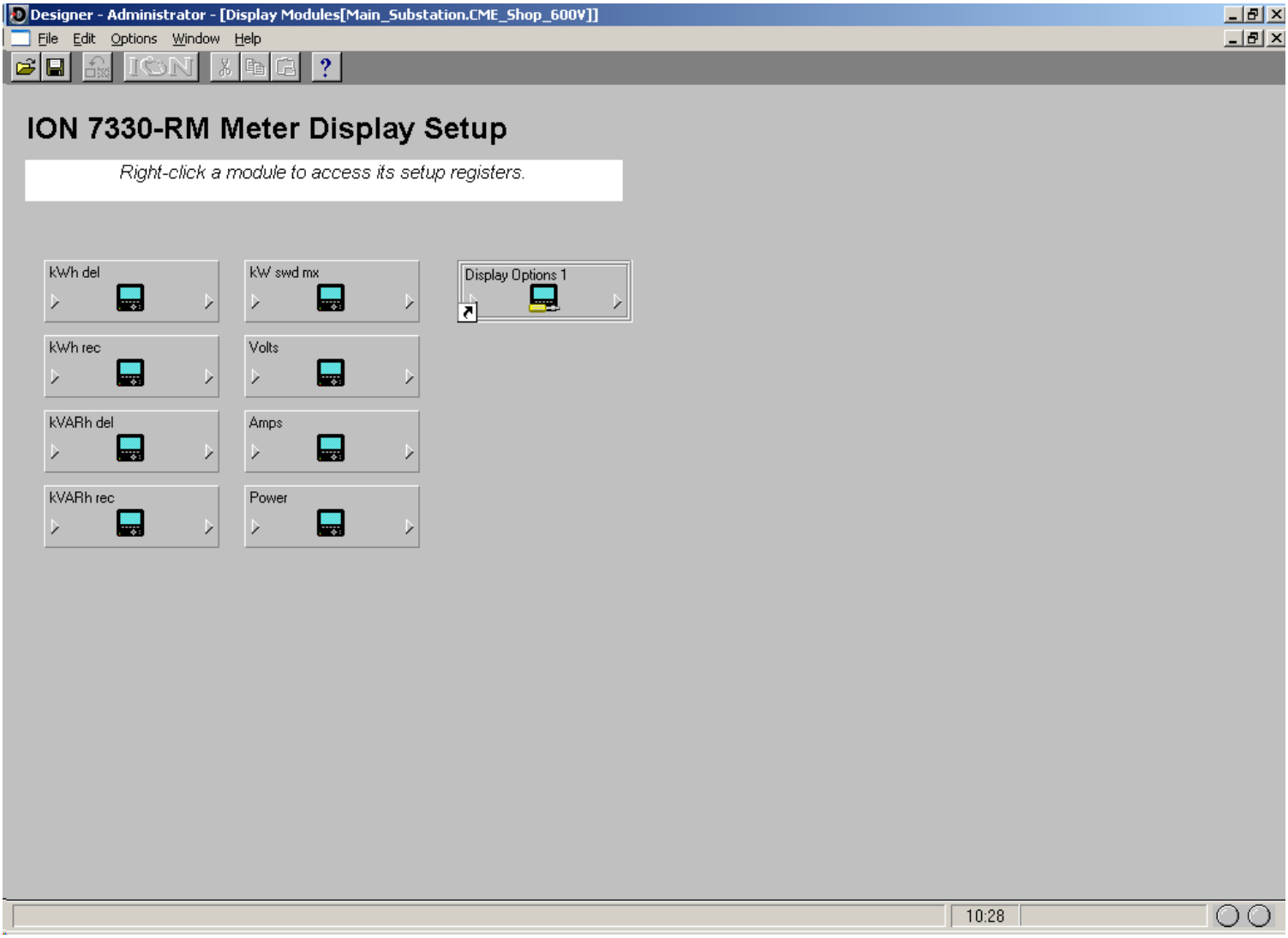

Designer - Administrator - [Setpoint Modules[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Setpoint Setup
Right-click a module to access its setup registers.
Over kW swd
Under Vll avg
Over I avg
Under PF sign
10:26

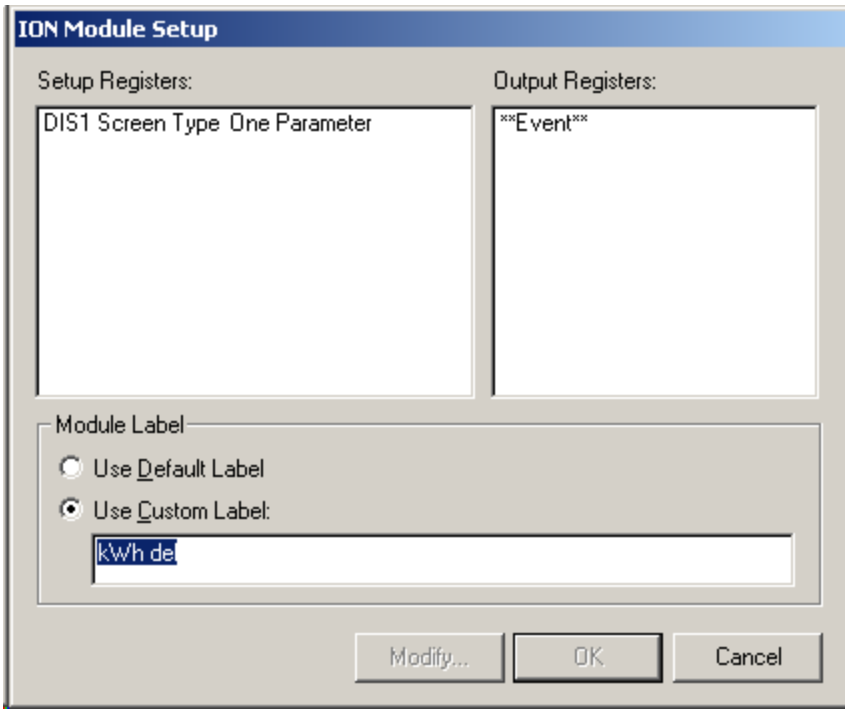

ION Module Setup
Setup Registers:
SP1 High Limit 1000000000
SP1 Low Limit 1000000000
SP1 SusUntlON 0
SP1 SusUntlOFF 0
SP1 Input Mode Signed
SP1 Eval Mode GreaterThan
SP1 EvPriority 128
Output Registers:
Over kW swd
SP1 Trigger
Event
Module Label
Use Default Label
Use Custom Label:
Over kW swd
Modify...
OK
Cancel

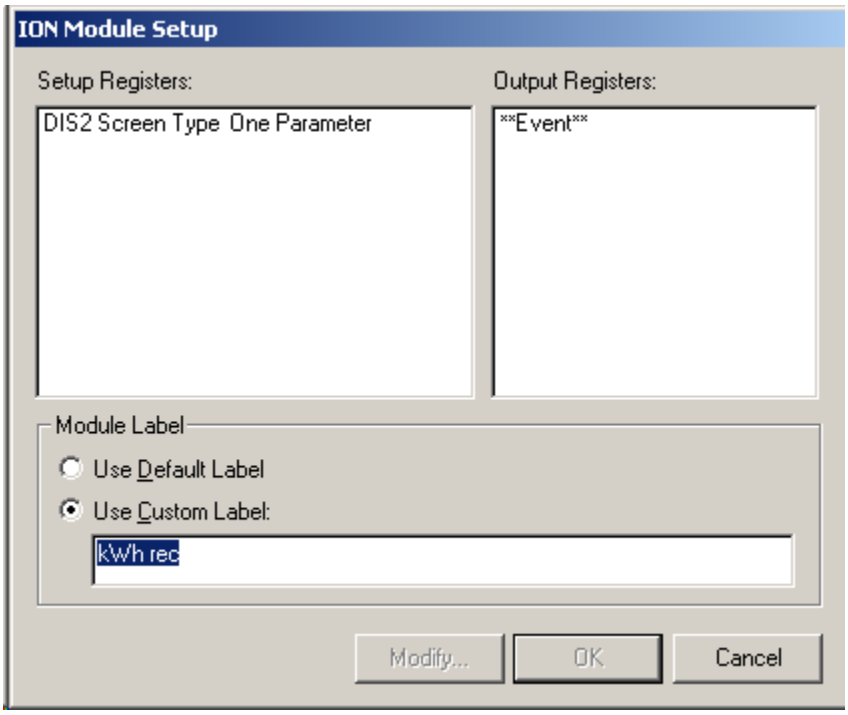

ION Module Setup
Setup Registers:
SP2 High Limit 0
SP2 Low Limit 0
SP2 SusUntlON 0
SP2 SusUntlOFF 0
SP2 Input Mode Signed
SP2 Eval Mode LessThan
SP2 EvPriority 128
Output Registers:
Under Vll avg
SP2 Trigger
Event
Module Label
Use Default Label
Use Custom Label:
Under Vll avg
Modify...
OK
Cancel

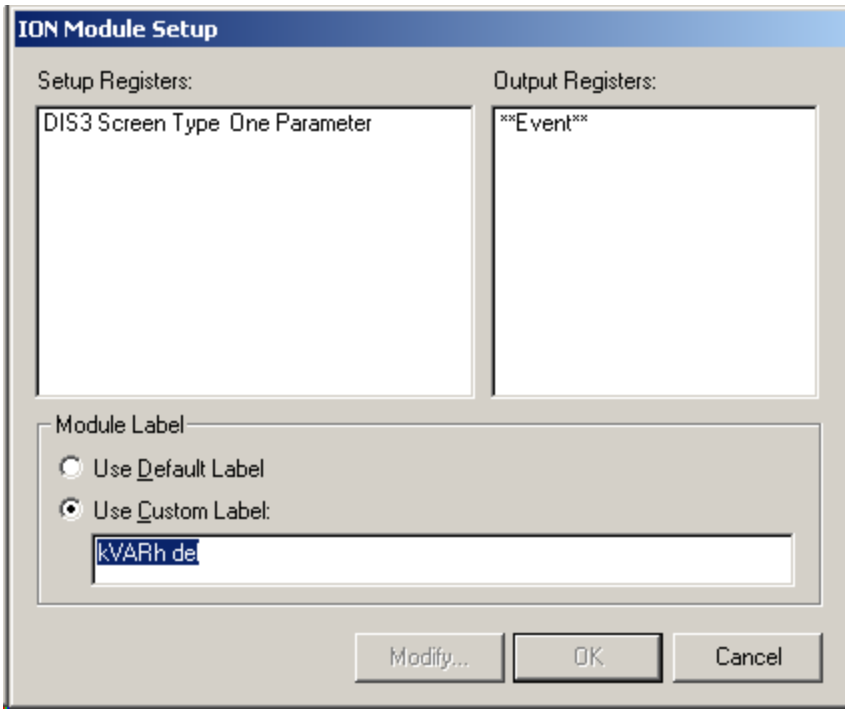

ION Module Setup
Setup Registers:
SP3 High Limit 1000000000
SP3 Low Limit 1000000000
SP3 SusUntlON 0
SP3 SusUntlOFF 0
SP3 Input Mode Signed
SP3 Eval Mode GreaterThan
SP3 EvPriority 128
Output Registers:
Over I avg
SP3 Trigger
Event
Module Label
Use Default Label
Use Custom Label:
Over I avg
Modify...
OK
Cancel

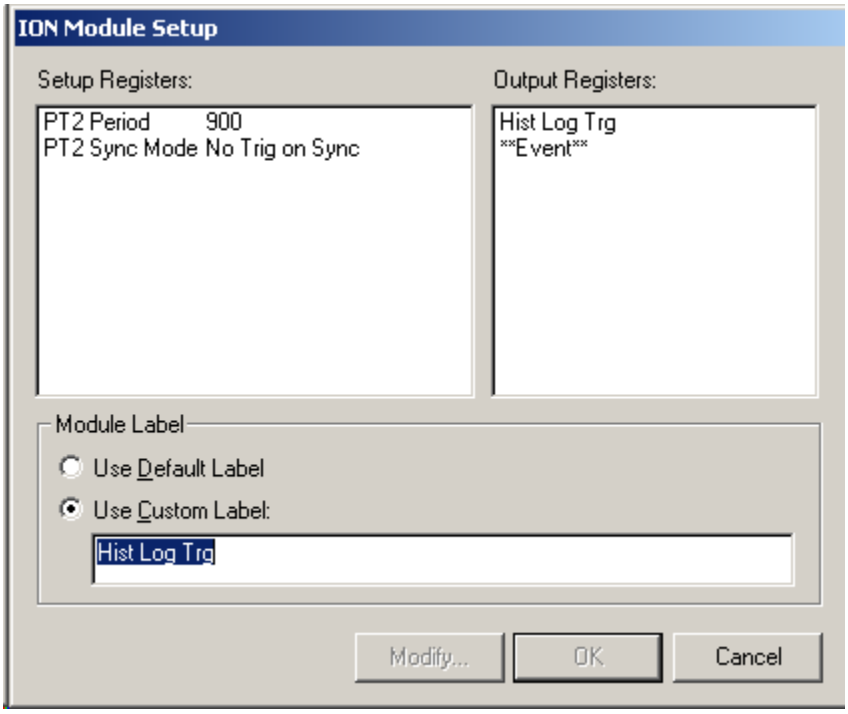

ION Module Setup
Setup Registers:
SP4 High Limit 0
SP4 Low Limit 0
SP4 SusUntlON 0
SP4 SusUntlOFF 0
SP4 Input Mode Absolute
SP4 Eval Mode LessThan
SP4 EvPriority 128
Output Registers:
Under PF sign
SP4 Trigger
Event
Module Label
Use Default Label
Use Custom Label:
Under PF sign
Modify...
OK
Cancel

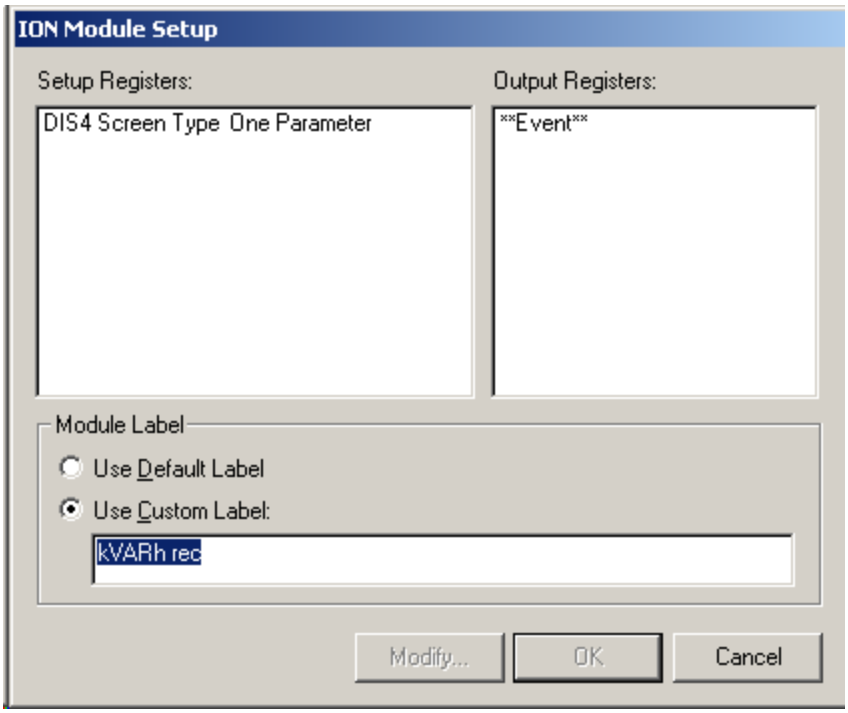

Designer - Administrator - [Display Modules[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Meter Display Setup
Right-click a module to access its setup registers.
kWh del
kW swd mx
Display Options 1
kWh rec
Volts
kVARh del
Amps
kVARh rec
Power
10:28

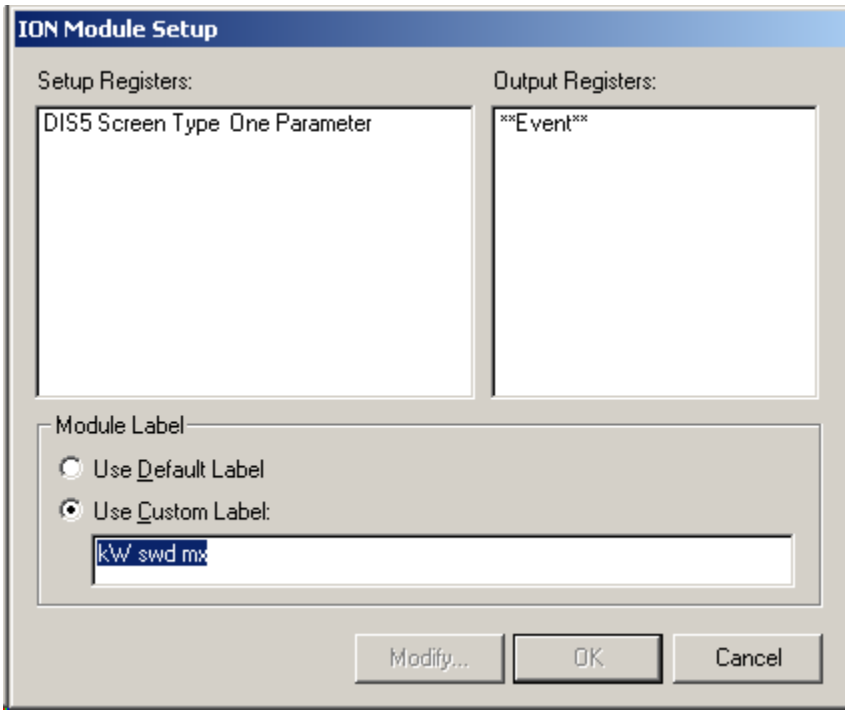

ION Module Setup
Setup Registers:
DIS1 Screen Type One Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
kWh de
Modify...
OK
Cancel

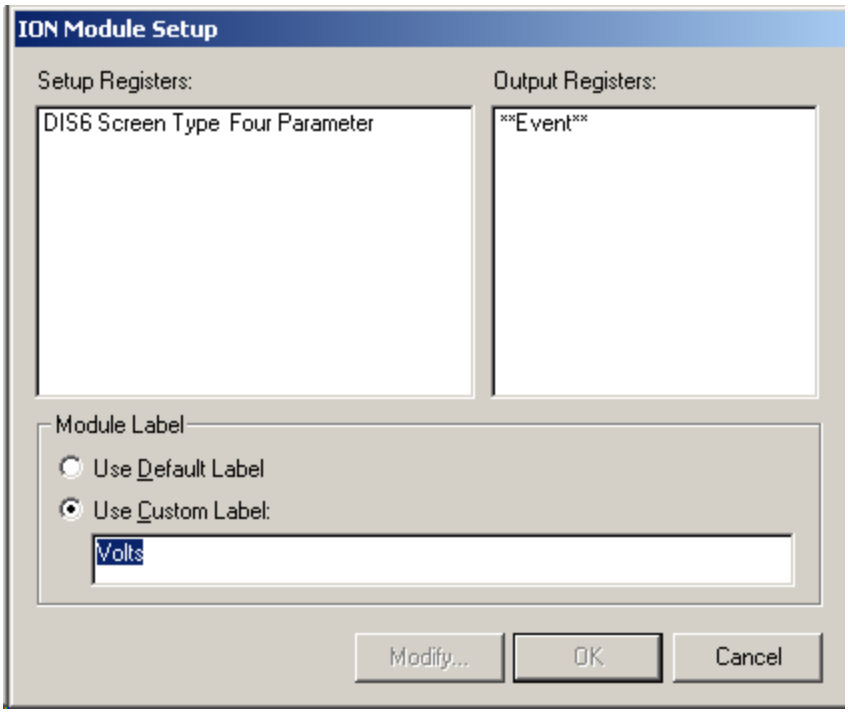

ION Module Setup
Setup Registers:
DIS2 Screen Type One Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
kWh rec
Modify...
OK
Cancel

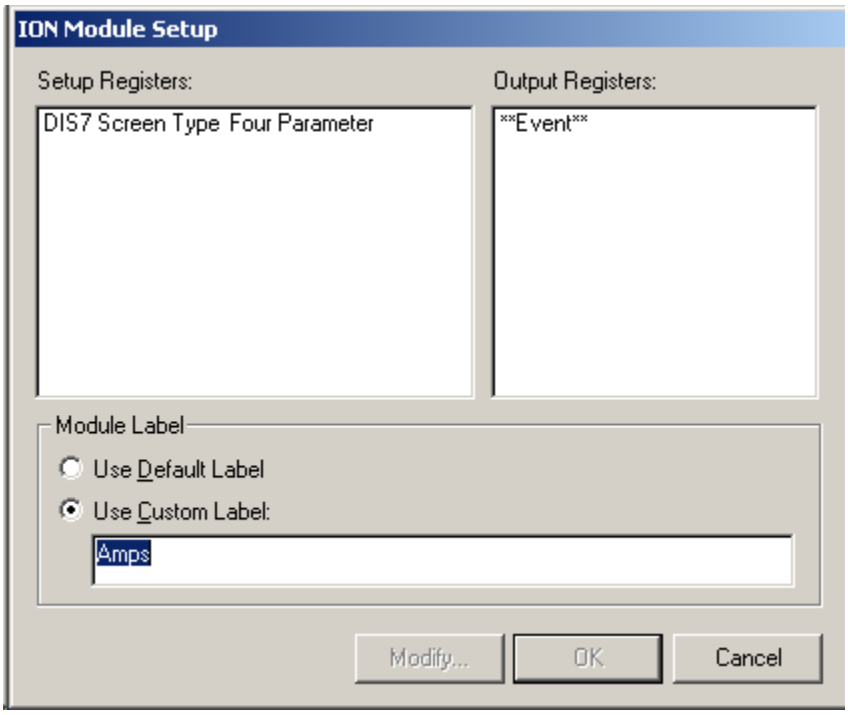

ION Module Setup
Setup Registers:
DIS3 Screen Type One Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
kVARh del
Modify...
OK
Cancel

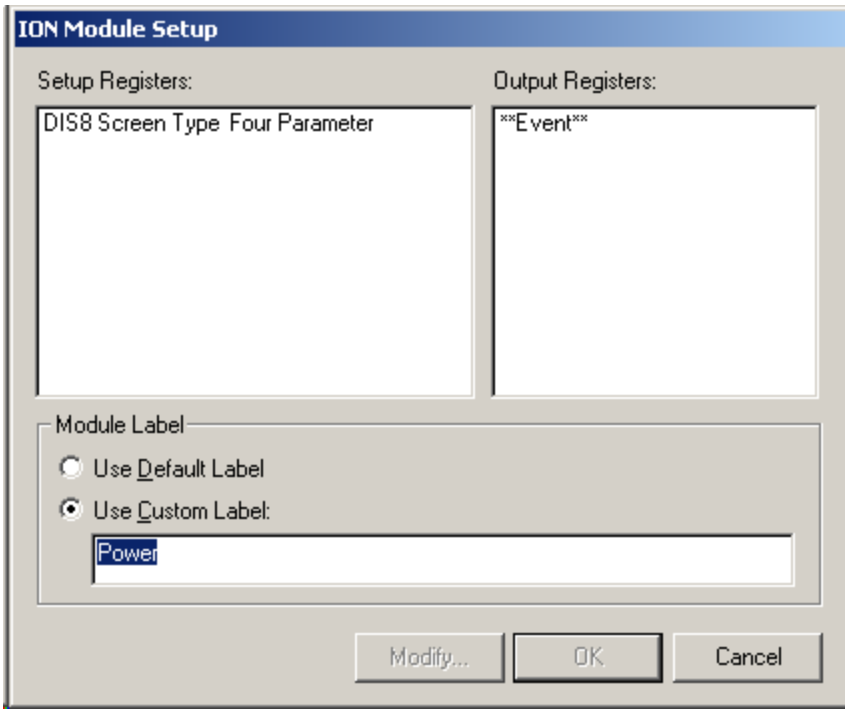

ION Module Setup
Setup Registers:
PT2 Period 900
PT2 Sync Mode No Trig on Sync
Output Registers:
Hist Log Trg
Event
Module Label
Use Default Label
Use Custom Label:
Hist Log Trg
Modify...
OK
Cancel

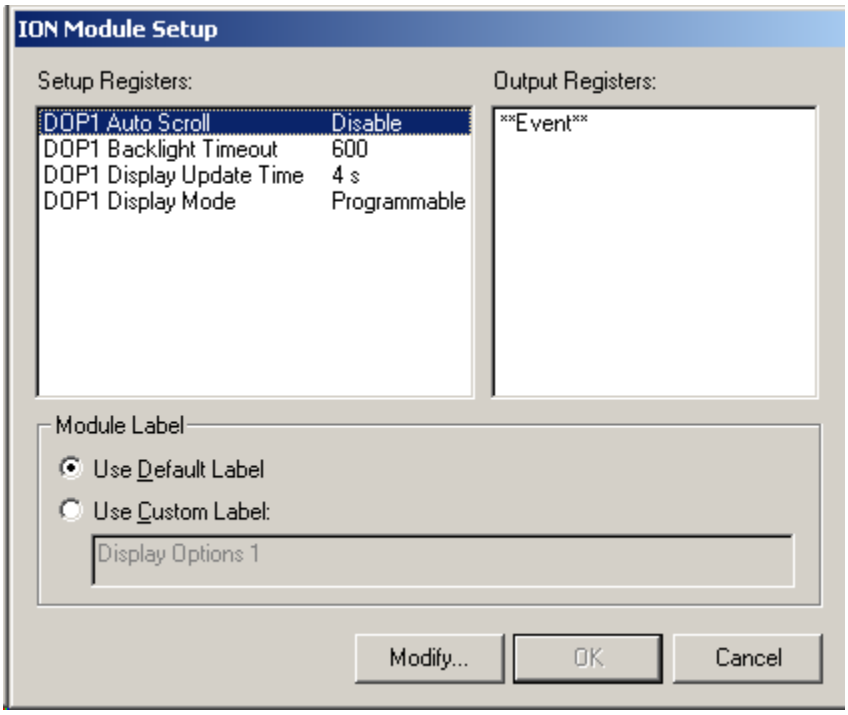

ION Module Setup
Setup Registers:
DIS4 Screen Type One Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
kVARh rec
Modify...
OK
Cancel

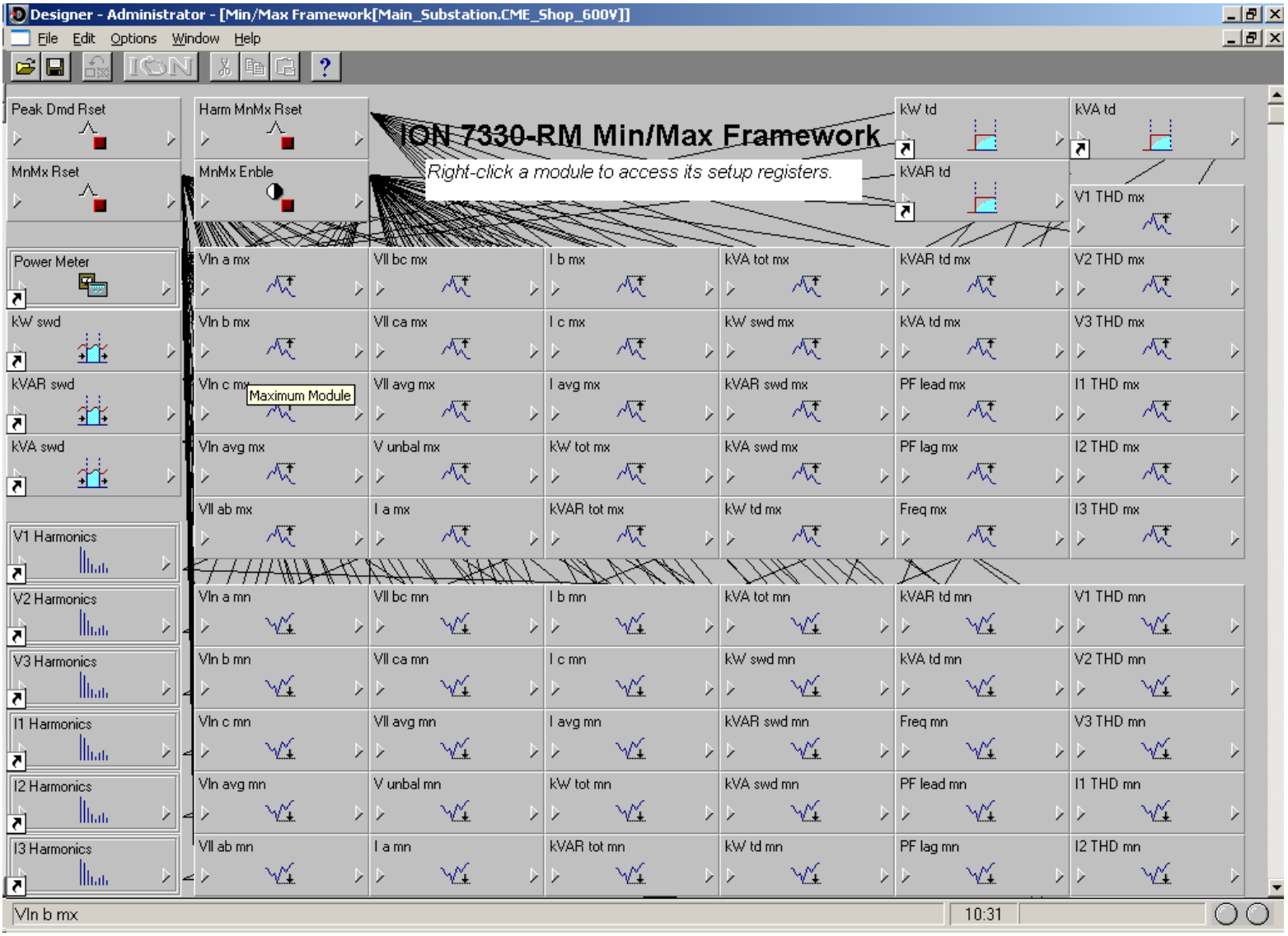

ION Module Setup
Setup Registers:
DIS5 Screen Type One Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
kW swd mx
Modify...
OK
Cancel

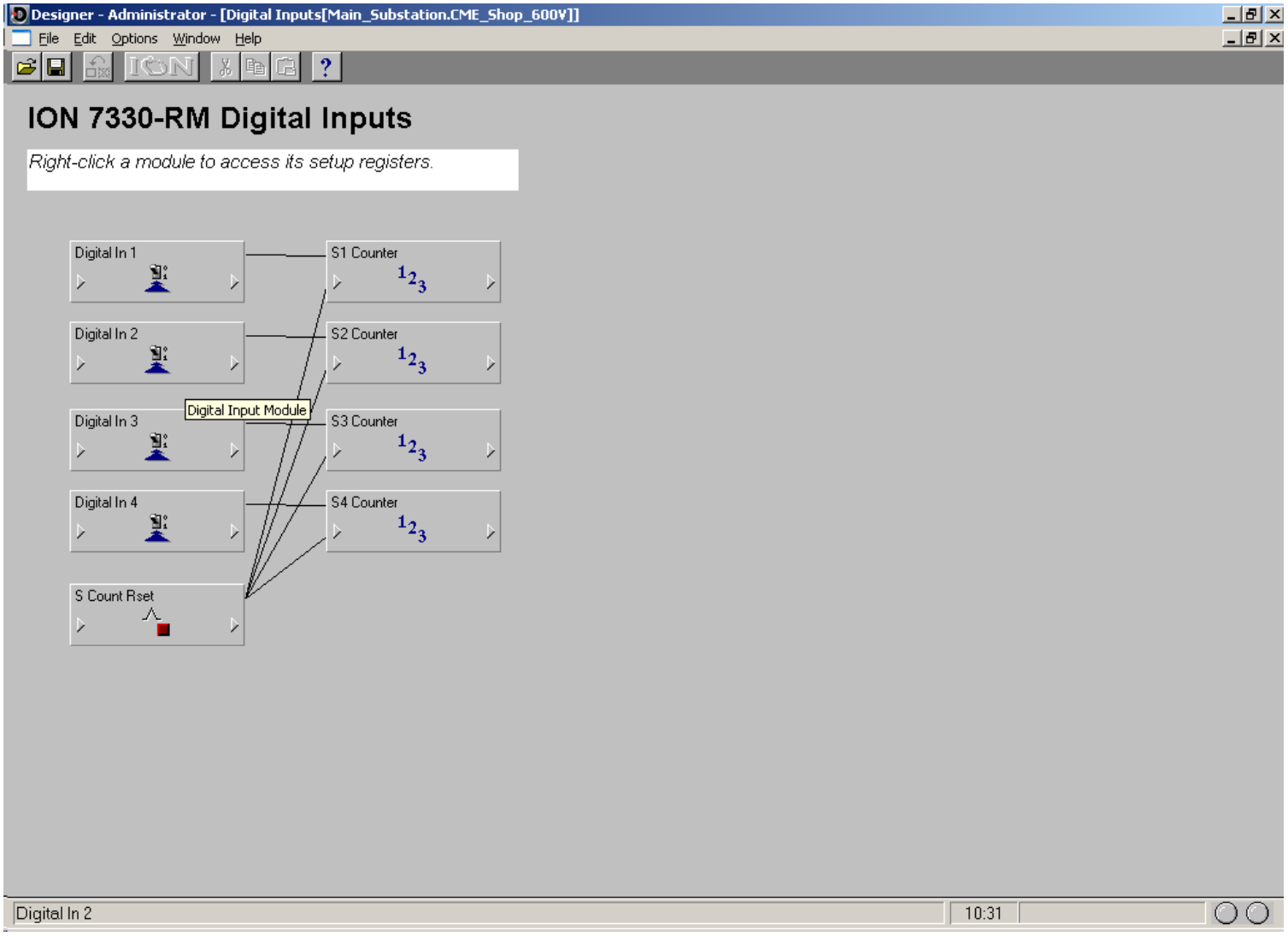

ION Module Setup
Setup Registers:
DIS6 Screen Type Four Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
Volts
Modify...
OK
Cancel

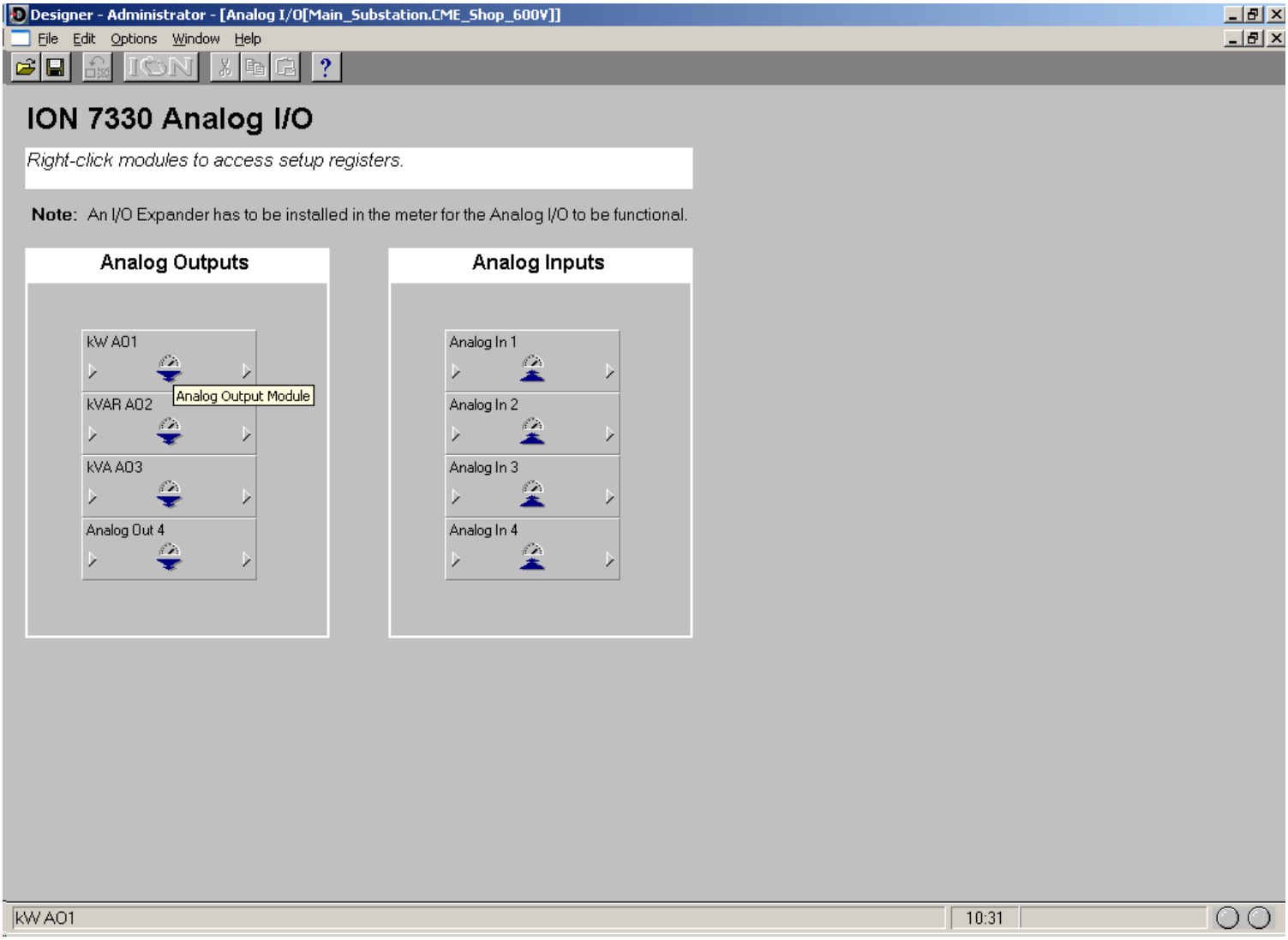

ION Module Setup
Setup Registers:
DIS7 Screen Type Four Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
Amps
Modify...
OK
Cancel

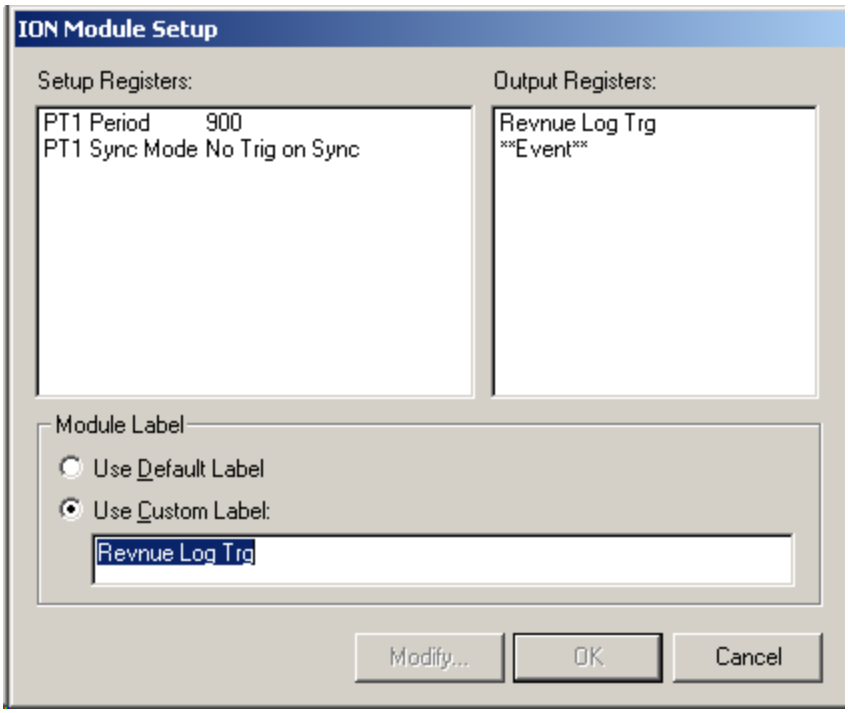

ION Module Setup
Setup Registers:
DIS8 Screen Type Four Parameter
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
Power
Modify...
OK
Cancel

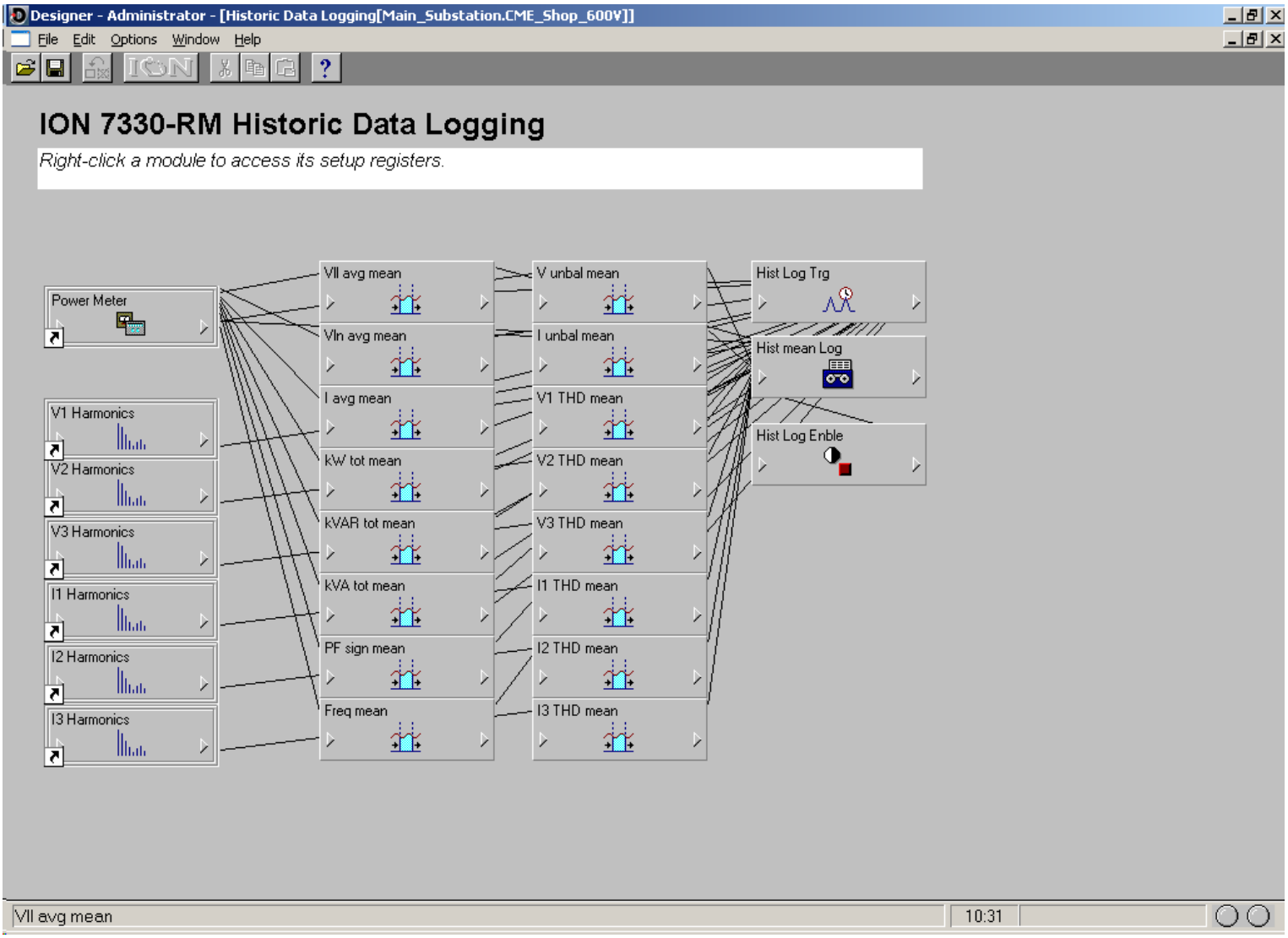

ION Module Setup
Setup Registers:
DOP1 Auto Scroll Disable
DOP1 Backlight Timeout 600
DOP1 Display Update Time 4 s
DOP1 Display Mode Programmable
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
Display Options 1
Modify...
OK
Cancel

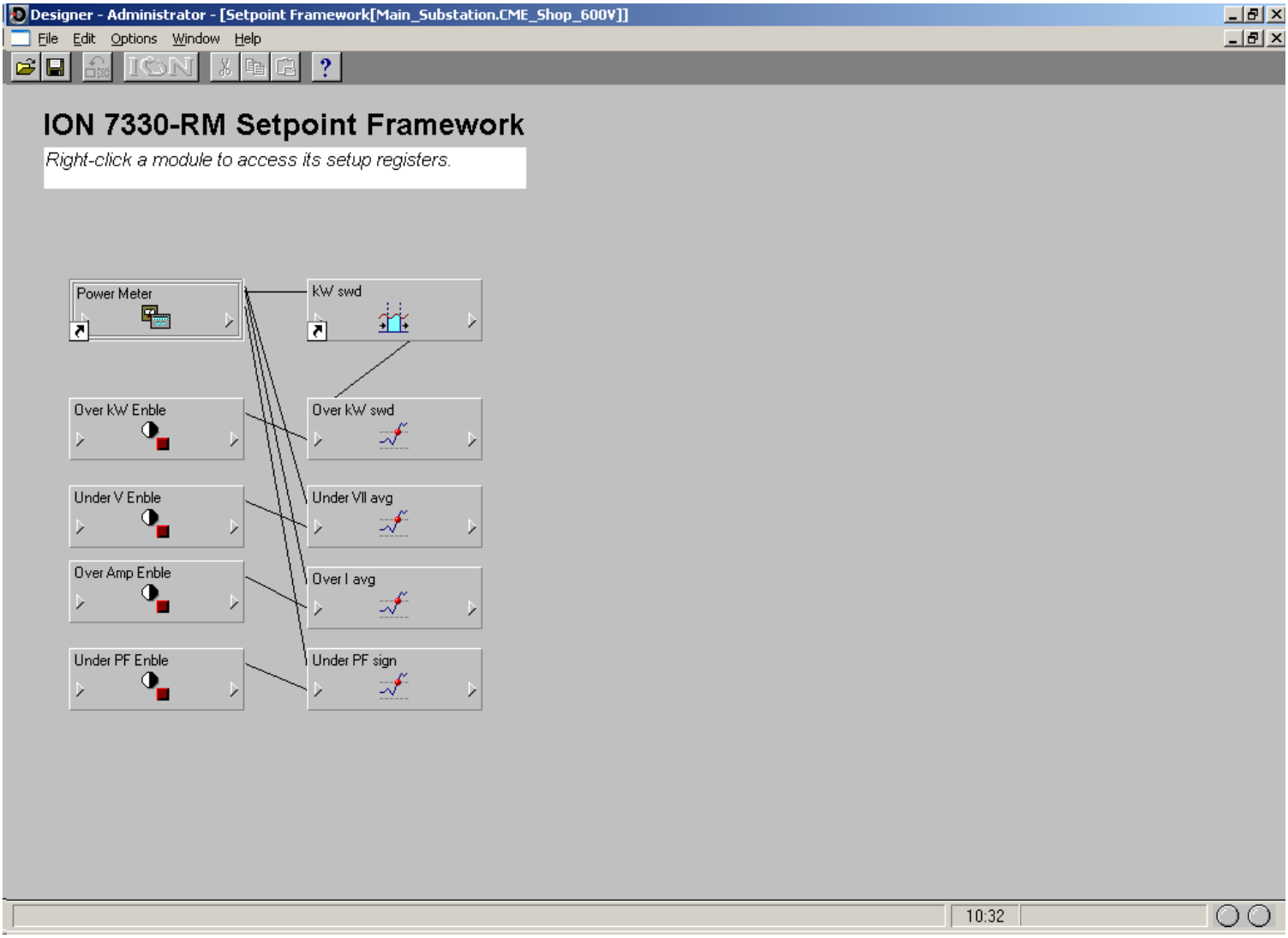

Designer - Administrator - [Min/Max Framework[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Min/Max Framework
Right-click a module to access its setup registers.
Peak Dmd Rset
Harm MnMx Rset
MnMx Rset
MnMx Enble
kW td
kVA td
kVAR td
V1 THD mx
Power Meter
Vln a mx
Vll bc mx
I b mx
kVA tot mx
kVAR td mx
V2 THD mx
kW swd
Vln b mx
Vll ca mx
I c mx
kW swd mx
kVA td mx
V3 THD mx
kVAR swd
Vln c mx
Maximum Module
Vll avg mx
I avg mx
kVAR swd mx
PF lead mx
I1 THD mx
kVA swd
Vln avg mx
V unbal mx
kW tot mx
kVA swd mx
PF lag mx
I2 THD mx
Vll ab mx
I a mx
kVAR tot mx
kW td mx
Freq mx
I3 THD mx
V1 Harmonics
V2 Harmonics
V3 Harmonics
I1 Harmonics
I2 Harmonics
I3 Harmonics
Vln a mn
Vll bc mn
I b mn
kVA tot mn
kVAR td mn
V1 THD mn
Vln b mn
Vll ca mn
I c mn
kW swd mn
kVA td mn
V2 THD mn
Vln c mn
Vll avg mn
I avg mn
kVAR swd mn
Freq mn
V3 THD mn
Vln avg mn
V unbal mn
kW tot mn
kVA swd mn
PF lead mn
I1 THD mn
Vll ab mn
I a mn
kVAR tot mn
kW td mn
PF lag mn
I2 THD mn
Vln b mx
10:31

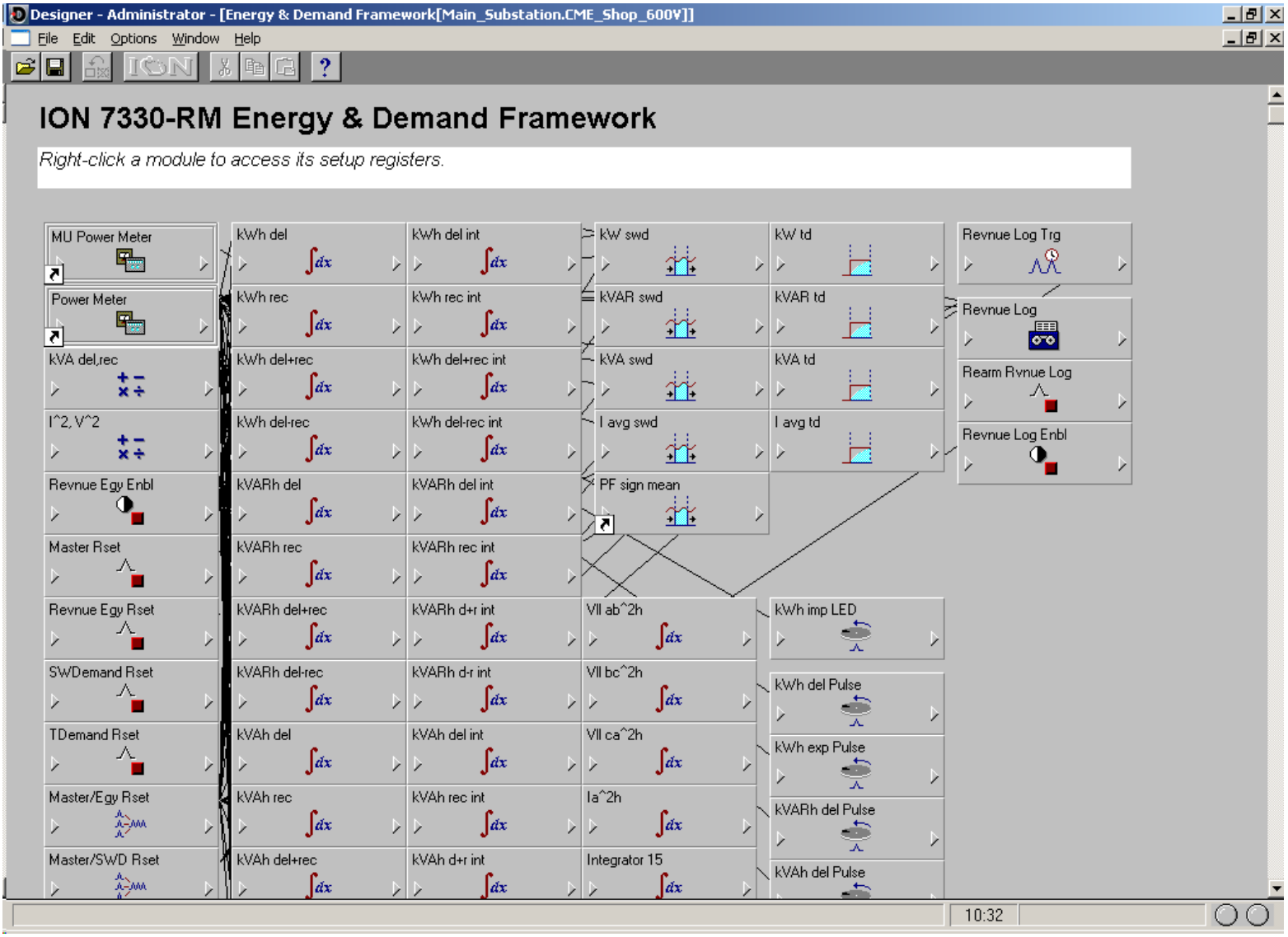

Designer - Administrator - [Digital Inputs[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Digital Inputs
Right-click a module to access its setup registers.
Digital In 1
Digital In 2
Digital In 3
Digital In 4
S Count Rset
S1 Counter
S2 Counter
S3 Counter
S4 Counter
Digital Input Module
Digital In 2
10:31

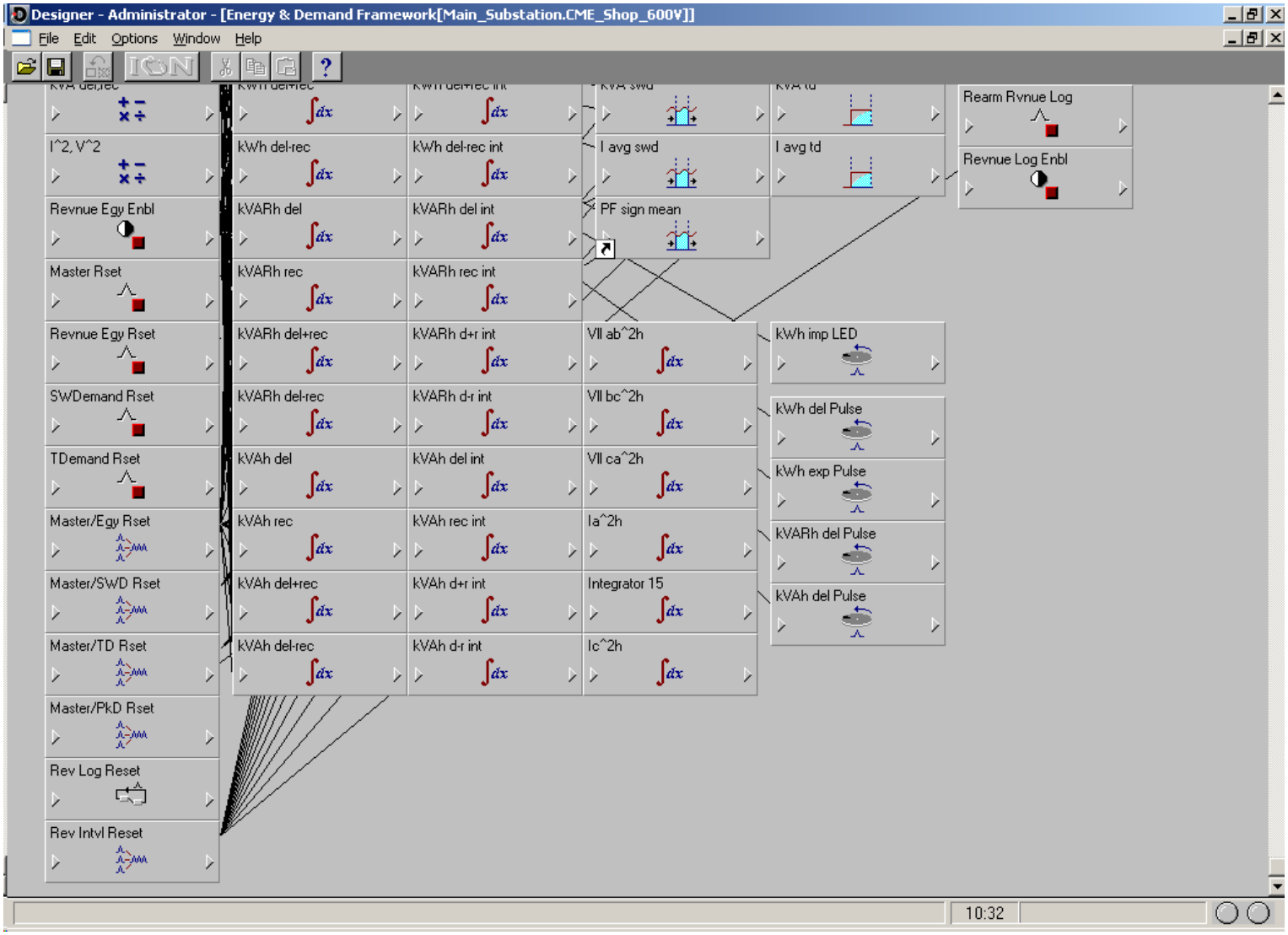

Designer - Administrator - [Analog I/O[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330 Analog I/O
Right-click modules to access setup registers.
Note: An I/O Expander has to be installed in the meter for the Analog I/O to be functional.
Analog Outputs
kW AO1
Analog Output Module
kVAR AO2
kVA AO3
Analog Out 4
Analog Inputs
Analog In 1
Analog In 2
Analog In 3
Analog In 4
kW AO1
10:31

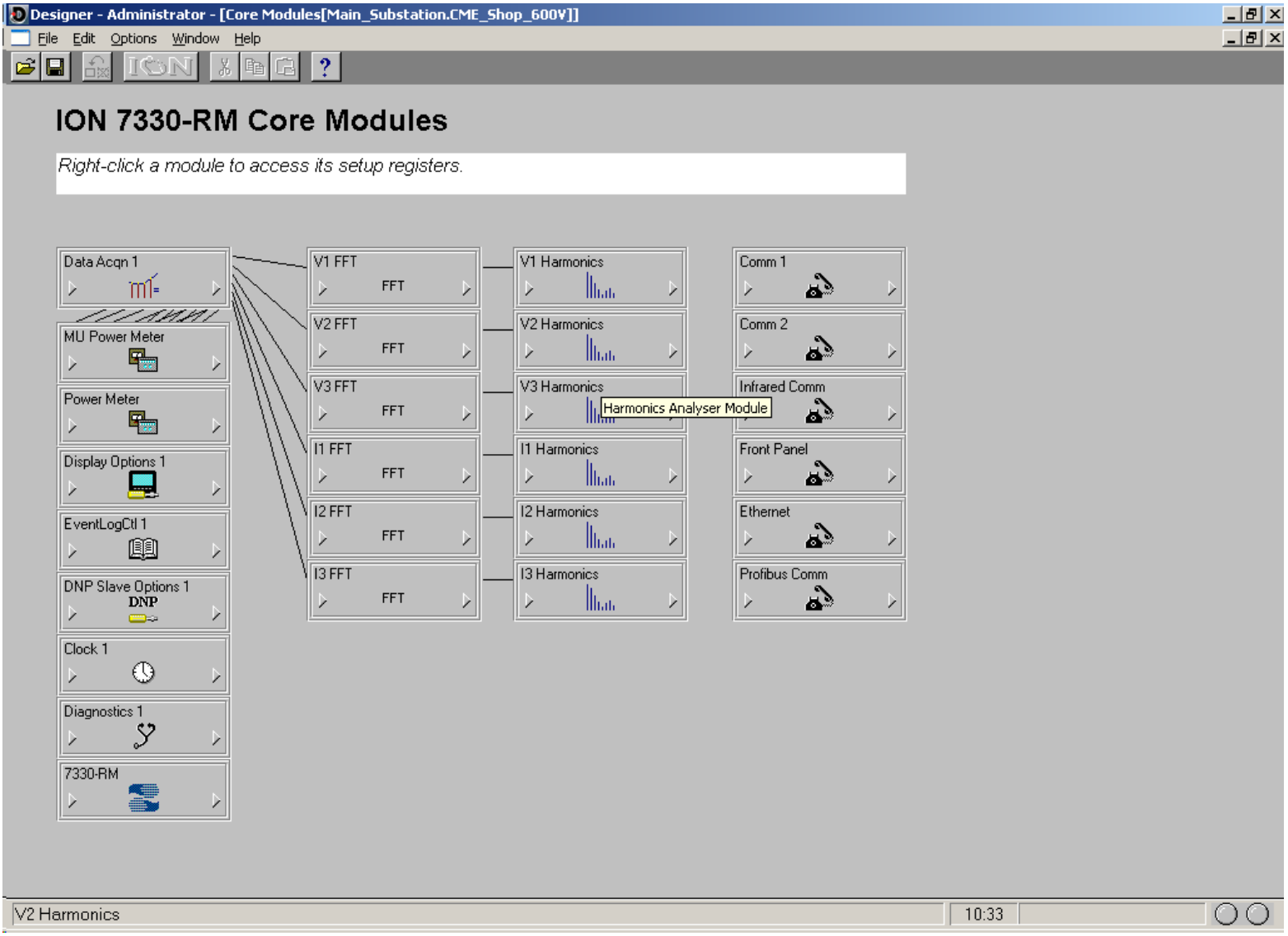

ION Module Setup
Setup Registers:
PT1 Period 900
PT1 Sync Mode No Trig on Sync
Output Registers:
Revnue Log Trg
Event
Module Label
Use Default Label
Use Custom Label:
Revnue Log Trg
Modify...
OK
Cancel

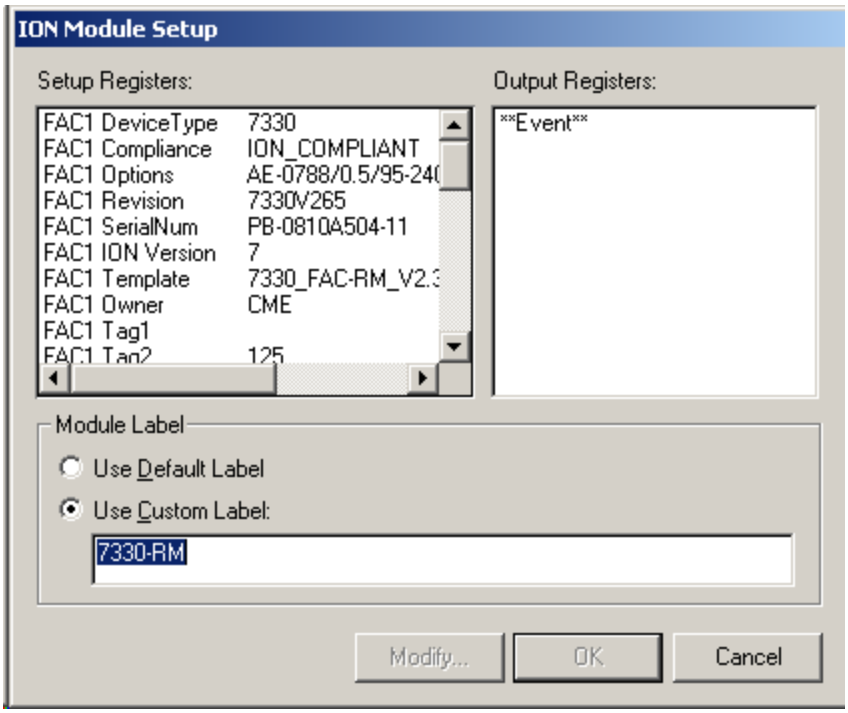

Designer - Administrator - [Historic Data Logging[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Historic Data Logging
Right-click a module to access its setup registers.
Power Meter
V1 Harmonics
V2 Harmonics
V3 Harmonics
I1 Harmonics
I2 Harmonics
I3 Harmonics
Vll avg mean
Vln avg mean
I avg mean
kW tot mean
kVAR tot mean
kVA tot mean
PF sign mean
Freq mean
V unbal mean
I unbal mean
V1 THD mean
V2 THD mean
V3 THD mean
I1 THD mean
I2 THD mean
I3 THD mean
Hist Log Trg
Hist mean Log
Hist Log Enble
Vll avg mean
10:31

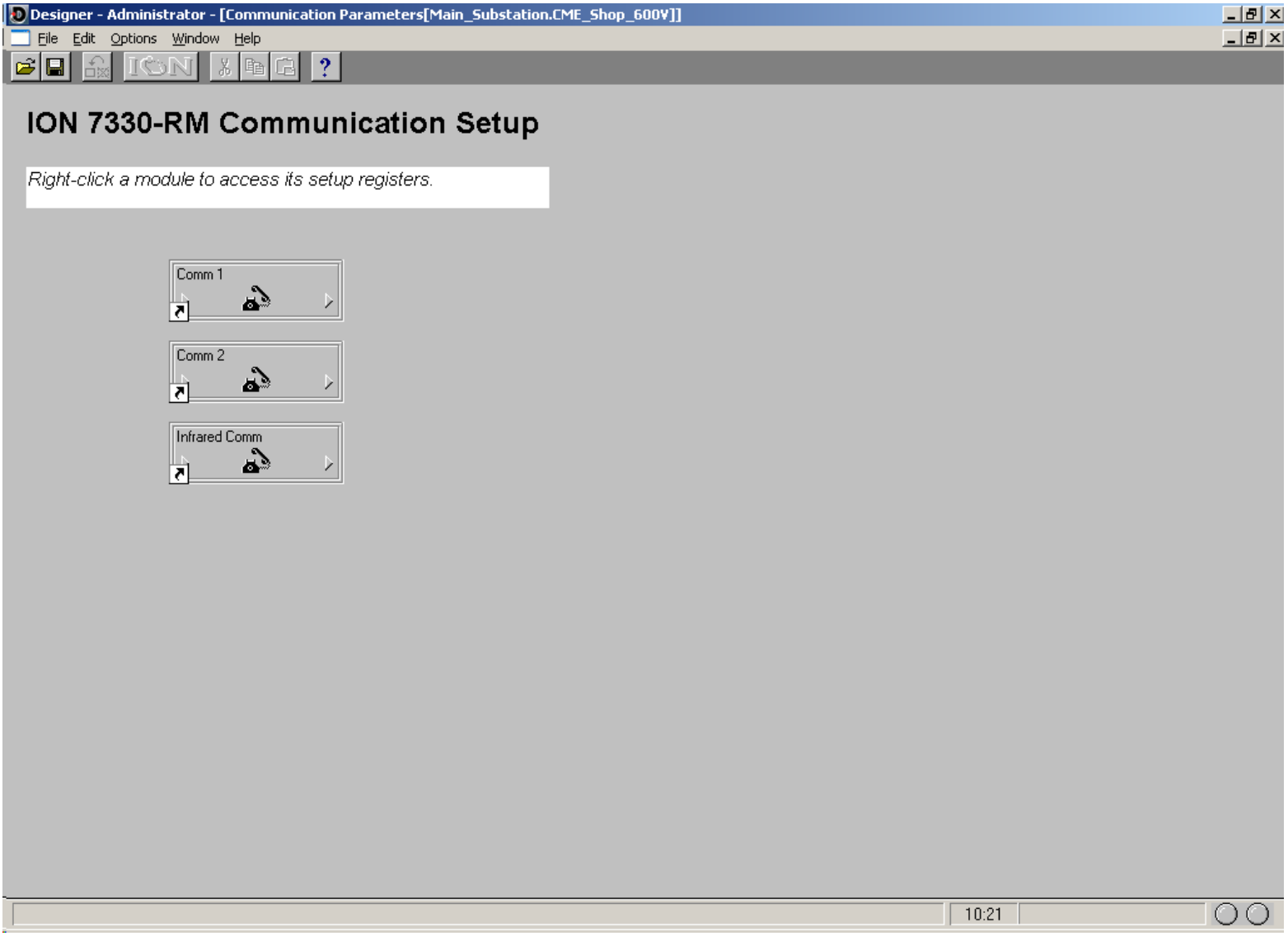

Designer - Administrator - [Setpoint Framework[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Setpoint Framework
Right-click a module to access its setup registers.
Power Meter
kW swd
Over kW Enble
Over kW swd
Under V Enble
Under VII avg
Over Amp Enble
Over I avg
Under PF Enble
Under PF sign
10:32

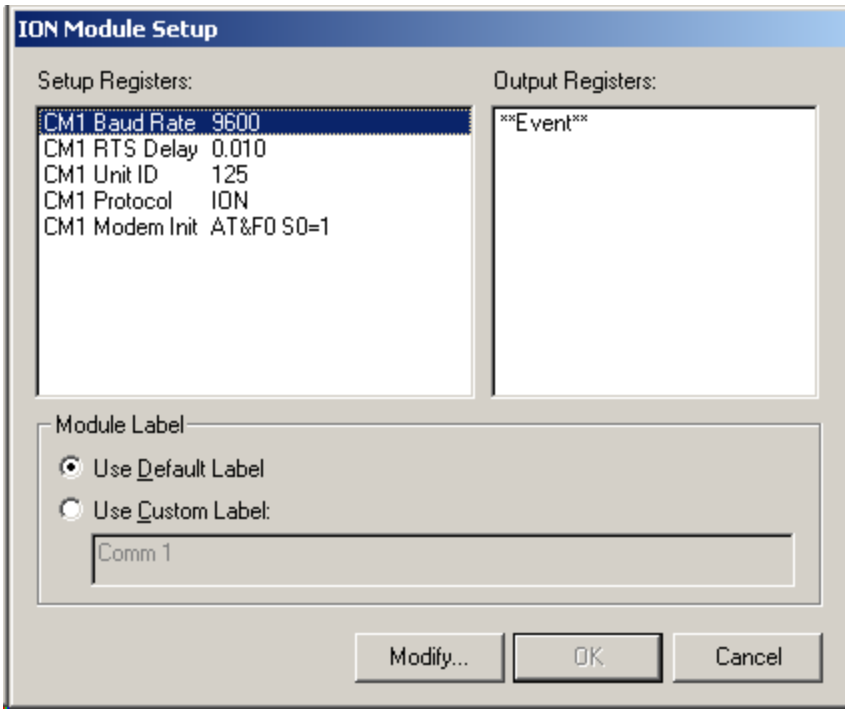

Designer - Administrator - [Energy & Demand Framework[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Energy & Demand Framework
Right-click a module to access its setup registers.
MU Power Meter
Power Meter
kVA del,rec
I^2, V^2
Revnue Egy Enbl
Master Rset
Revnue Egy Rset
SWDemand Rset
TDemand Rset
Master/Egy Rset
Master/SWD Rset
kWh del
kWh rec
kWh del+rec
kWh del-rec
kVARh del
kVARh rec
kVARh del+rec
kVARh del-rec
kVAh del
kVAh rec
kVAh del+rec
kWh del int
kWh rec int
kWh del+rec int
kWh del-rec int
kVARh del int
kVARh rec int
kVARh d+r int
kVARh d-r int
kVAh del int
kVAh rec int
kVAh d+r int
kW swd
kVAR swd
kVA swd
I avg swd
PF sign mean
Vll ab^2h
Vll bc^2h
Vll ca^2h
Ia^2h
Integrator 15
kW td
kVAR td
kVA td
I avg td
kWh imp LED
kWh del Pulse
kWh exp Pulse
kVARh del Pulse
kVAh del Pulse
Revnue Log Trg
Revnue Log
Rearm Rvnue Log
Revnue Log Enbl
10:32

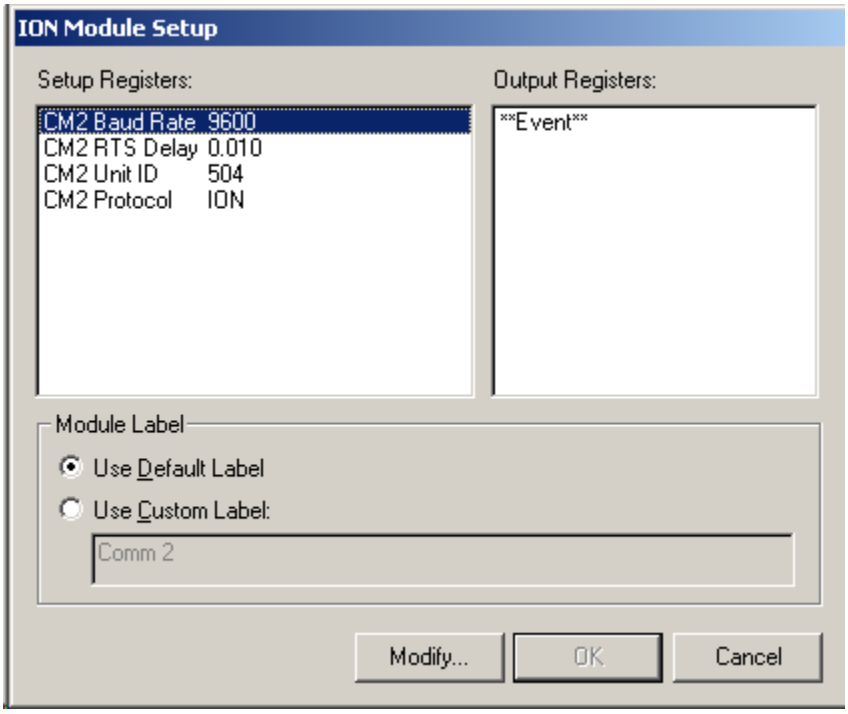

Designer - Administrator - [Energy & Demand Framework[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
I^2, V^2
Revnue Egy Enbl
Master Rset
Revnue Egy Rset
SWDemand Rset
TDemand Rset
Master/Egy Rset
Master/SWD Rset
Master/TD Rset
Master/PkD Rset
Rev Log Reset
Rev Intvl Reset
kWh del-rec
kWh del-rec int
kVARh del
kVARh del int
kVARh rec
kVARh rec int
kVARh del+rec
kVARh d+r int
kVARh del-rec
kVARh d-r int
kVAh del
kVAh del int
kVAh rec
kVAh rec int
kVAh del+rec
kVAh d+r int
kVAh del-rec
kVAh d-r int
I avg swd
I avg td
PF sign mean
Vll ab^2h
Vll bc^2h
Vll ca^2h
Ia^2h
Integrator 15
Ic^2h
kWh imp LED
kWh del Pulse
kWh exp Pulse
kVARh del Pulse
kVAh del Pulse
Rearm Rvnue Log
Revnue Log Enbl
10:32

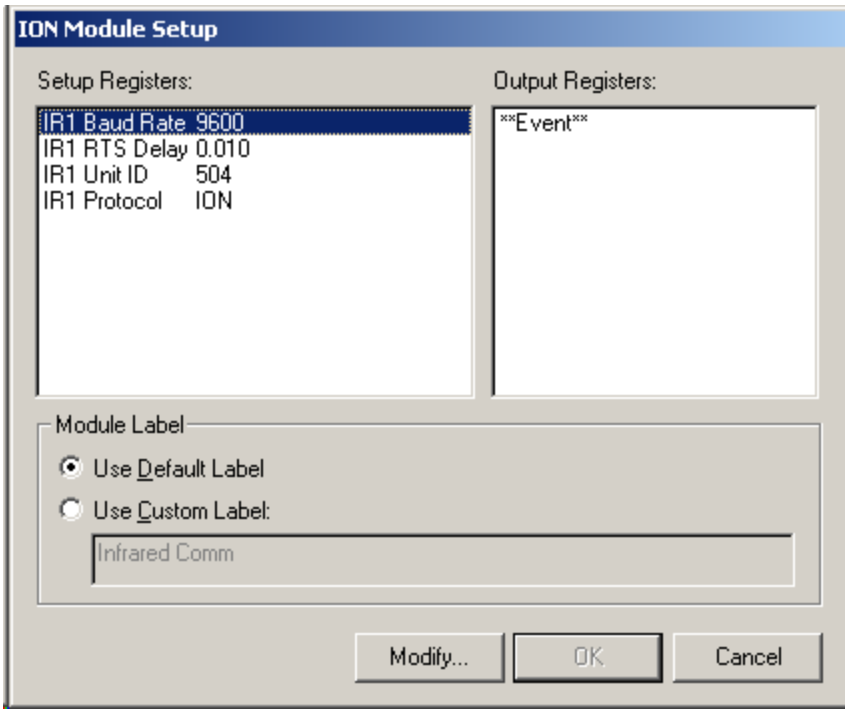

Designer - Administrator - [Core Modules[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Core Modules
Right-click a module to access its setup registers.
Data Acqn 1
MU Power Meter
Power Meter
Display Options 1
EventLogCtl 1
DNP Slave Options 1
DNP
Clock 1
Diagnostics 1
7330-RM
V1 FFT
V2 FFT
V3 FFT
I1 FFT
I2 FFT
I3 FFT
FFT
V1 Harmonics
V2 Harmonics
V3 Harmonics
I1 Harmonics
I2 Harmonics
I3 Harmonics
Harmonics Analyser Module
Comm 1
Comm 2
Infrared Comm
Front Panel
Ethernet
Profibus Comm
V2 Harmonics
10:33

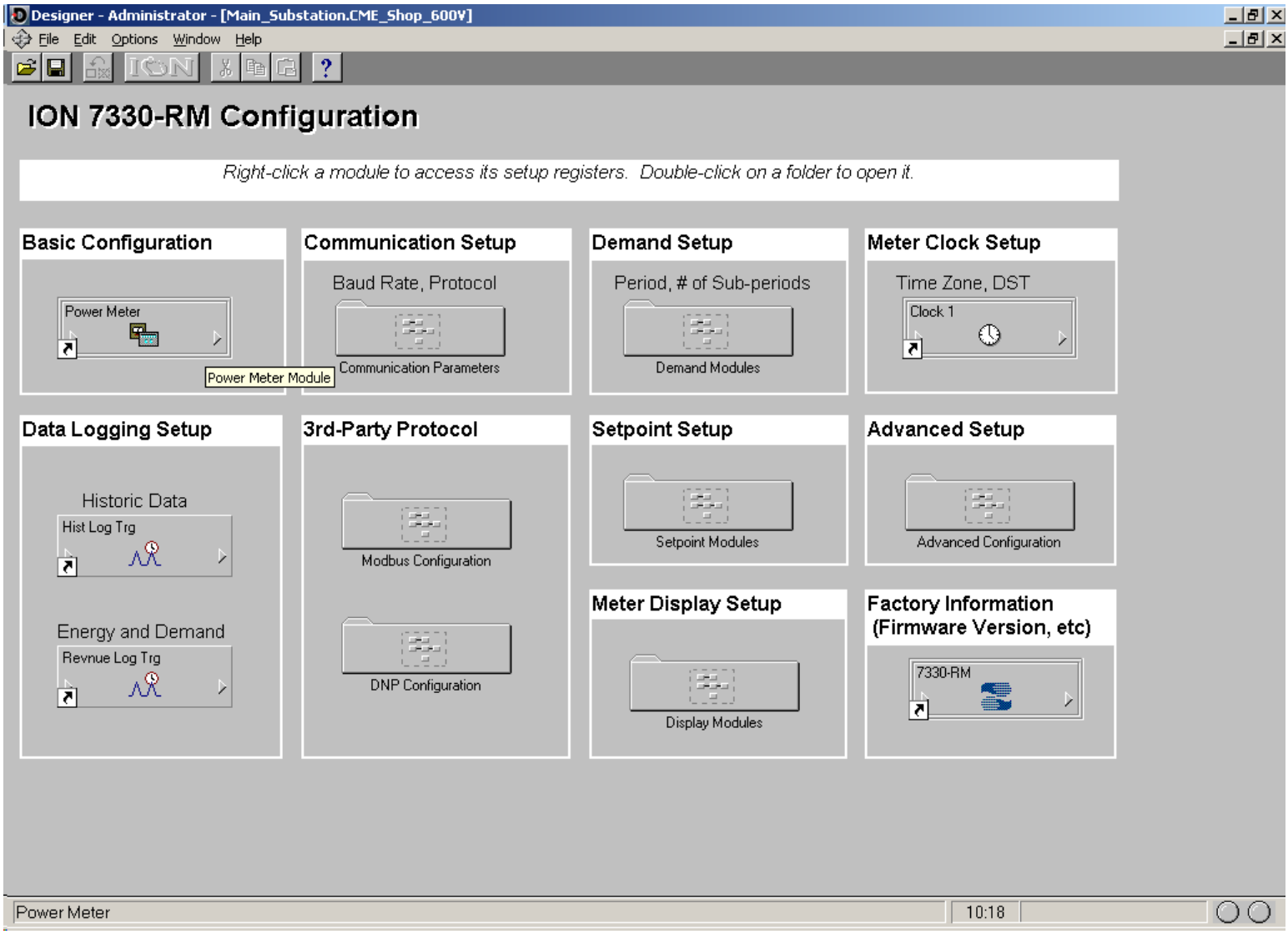

ION Module Setup
Setup Registers:
FAC1 DeviceType 7330
FAC1 Compliance ION_COMPLIANT
FAC1 Options AE-0788/0.5/95-24(
FAC1 Revision 7330V265
FAC1 SerialNum PB-0810A504-11
FAC1 ION Version 7
FAC1 Template 7330_FAC-RM_V2.3
FAC1 Owner CME
FAC1 Tag1
FAC1 Tag2 125
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
7330-RM
Modify...
OK
Cancel


Designer - Administrator - [Communication Parameters[Main_Substation.CME_Shop_600V]]
File Edit Options Window Help
ION 7330-RM Communication Setup
Right-click a module to access its setup registers.
Comm 1
Comm 2
Infrared Comm
10:21


ION Module Setup
Setup Registers:
CM1 Baud Rate 9600
CM1 RTS Delay 0.010
CM1 Unit ID 125
CM1 Protocol ION
CM1 Modem Init AT&F0 S0=1
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
Comm 1
Modify...
OK
Cancel


ION Module Setup
Setup Registers:
CM2 Baud Rate 9600
CM2 RTS Delay 0.010
CM2 Unit ID 504
CM2 Protocol ION
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
Comm 2
Modify...
OK
Cancel


ION Module Setup
Setup Registers:
IR1 Baud Rate 9600
IR1 RTS Delay 0.010
IR1 Unit ID 504
IR1 Protocol ION
Output Registers:
Event
Module Label
Use Default Label
Use Custom Label:
Infrared Comm
Modify...
OK
Cancel


Designer - Administrator - [Main_Substation.CME_Shop_600V]
File Edit Options Window Help
ION 7330-RM Configuration
Right-click a module to access its setup registers. Double-click on a folder to open it.
Basic Configuration
Power Meter
Power Meter Module
Communication Setup
Baud Rate, Protocol
Communication Parameters
Demand Setup
Period, # of Sub-periods
Demand Modules
Meter Clock Setup
Time Zone, DST
Clock 1
Data Logging Setup
Historic Data
Hist Log Trg
Energy and Demand
Revnue Log Trg
3rd-Party Protocol
Modbus Configuration
DNP Configuration
Setpoint Setup
Setpoint Modules
Advanced Setup
Advanced Configuration
Meter Display Setup
Display Modules
Factory Information (Firmware Version, etc)
7330-RM
Power Meter
10:18