



Public Works and Government Services Canada

Requisition No: EZ108-19-2389

DRAWINGS & SPECIFICATIONS
for
ESQUIMALT GRAVING DOCK (EGD)
REPLACE MAIN DISTRIBUTION LINE (RMDL)
BC HYDRO POINT OF DELIVERY (POD) SWITCHGEAR
825 Admirals Road, Victoria, B.C.

APPROVED BY:


Regional Manager, AES

2018-12-13
Date


Construction Safety Coordinator


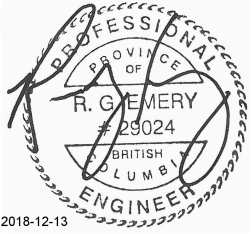
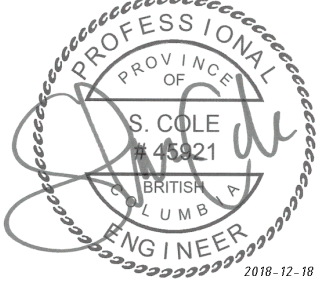
2018-12-12
Date

TENDER:


Project Manager

2018-12-14
Date

CONSULTANTS – SEAL & SIGNATURE

<u>Discipline</u>	<u>Seal / Signature / Date</u>
Electrical (Prime)	 <p>2018-12-13</p>
Structural	 <p>2018-12-13</p>
Civil	 <p>2018-12-18</p>

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END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 All Sections listed in Table of Contents.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Scope of this contract comprises all civil, structural, electrical construction, and all associated work required to receive 16 MVA at 12.5 kV (future 25 kV) of electrical power from two new BC Hydro feeders at the EGD Admirals Road property line, and the acceptance that power by BC Hydro at the new EGD POD Switchgear and the distribution of that electrical power to the existing EGD SES switchgear, including but not limited to:
 - 1. Connections to/from BC Hydro plant, interior and exterior to the POD switchgear, not including cabling from BCH offsite to switchgear;
 - 2. Connections to/from the existing EGD system;
 - 3. Revised EGD electrical plant locations, settings, and equipment in the existing EGD SES;
 - 4. Removal of all resultant obsolete equipment;
 - 5. Provision of all testing and commissioning reports, including engineering sealed seismic and electrical grounding reports to Departmental Representative;
 - 6. Coordination of work, site shutdowns, and communication with BC Hydro, PSPC and EGD personnel, and Departmental Representative.
- .2 General site address is Esquimalt Graving Dock, 825 Admirals Road, Victoria, B.C.
- .3 All shop drawings and BC Hydro approvals of POD switchgear; procurement, delivery, installation, commissioning of POD switchgear; including test energization of SES main HV breakers, tie breaker, HV bus, and closed transition test of EGD standby generation to prove system operation shall be completed by mid-September, 2019.
- .4 POD switchgear and grounding system shall physically fit within the EGD property line boundaries as shown on drawings. No encroachment on other property shall be allowed.

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. Any work impacting road access to EGD will require fulltime traffic control in the form of

qualified flaggers to maintain continuous access to EGD. Refer to Section 01 55 00 Traffic Control, Vehicle, Access, and Parking.

- .4 Maintain fire access/control as shown in Appendix J of the specifications.
- .5 Existing adjacent site sign, propeller, anchor, and associated pedestals at EGD will be removed by EGD prior to handover of the project worksite to the contractor.

1.6 CONTRACTOR USE OF PREMISES

- .1 Co-ordinate use of premises under direction of Department 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 DEPARTMENT REPRESENTATIVE OCCUPANCY

- .1 During the entire construction period, the Departmental Representative will have access to adjacent areas 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 Departmental Representative usage of adjacent areas. In the event of a conflict the contractor will accommodate changes to their operations to minimize interference with Department Representative operations.

1.8 DEPARTMENTAL REPRESENTATIVE AND CONTRACTOR RESPONSIBILITIES

- .1 Departmental Representative 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 8

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

PART 1 GENERAL

1.1 CODES, BYLAWS, STANDARDS

- .1 Perform work in accordance with the National Building Code of Canada (NBCC) 2015; the Canadian Electrical Code 2018 (CEC); the most recent version of the BC Hydro Distribution Standards for Civil work and for Electrical work; the most recent version of the BC Hydro Primary Guide; 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 EGD's new B.C. Hydro (BCH) Point of Delivery (POD) Switchgear including all associated on-site work in various locations 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 the timelines specified in Section 01 32 16.

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 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 Completion date within the time period required by the Contract documents.

- .2 Contractor to limit disruptions to site vehicle traffic as required for the installation of duct banks on EGD property at the Admirals Road entrance.
 - .1 Contractor to submit to Departmental Representative for review and approval a detailed work plan a minimum of 2 weeks in advance of duct bank construction identifying:
 - .1 Work zones for duct bank construction.
 - .2 Planned construction sequence including start date, duration and end dates.
 - .3 Measures to maintain minimum 3.5m wide vehicle access lane and 1.5m temporary pedestrian walkway including traffic control measures for safe passage of vehicles and pedestrians.
- .3 Contractor to restore completed zones to finished surface state as indicated on project drawings prior to turn over of area to PWGSC for use.
- .4 Do not change approved Schedule without notifying the Departmental Representative.
- .5 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 one 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 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 2015.
 - .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.

1.9 REGULATORY REQUIREMENTS

- .1 Building Permit
 - .1 Obtain and pay for Building Permit, Occupancy Permit, Certificates, Licenses and other permits required by Township of Esquimalt, 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.

1.10 CONTRACTOR'S USE OF SITE

- .1 Use of site:
 - .1 Exclusive and complete for execution of work within the limits defined on the Contract Documents and as permitted by PWGSC.
 - .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 Esquimalt 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.

1.11 EXAMINATION

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

1.12 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.
- .4 Contractor to undertake and pay for underground utility pre-locate program as outlined in Section 01 71 00 Examination and Preparation

1.13 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.

1.14 CUTTING AND PATCHING

- .1 Cut existing surfaces as required to accommodate new work.
- .2 Remove items 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 entire surface to the next change in plane.

1.15 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.

1.16 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.

1.17 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 2015 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.

1.18 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 particular close attention to overhead work above ceilings and within or near to building structural elements.
 - .2 Identify on coordination drawings, building elements, service 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.

1.19 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 Approval of POD switchgear shop drawing by B.C. Hydro.
 - .4 Review of re-submission.
 - .5 Ordering of approved material and/or products. Refer to individual technical sections of specifications.

1.20 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 – Quality Control.
- .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 electrical equipment and systems.
 - .1 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.
- .4 Contractor to retain and pay for services of professional engineer registered in the Province of B.C. for design and review of temporary works related to underpinning and bracing of existing structures where required and excavations.
- .5 Contractor to retain and pay for services of professional engineer registered in the Province of B.C. for review and testing of rock anchor/bolts where required to stabilize bedrock faces.
- .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 1.20.2.
- .5 Contractor to retain and pay for services of geotechnical testing company acceptable to the Departmental Representative for testing of concrete materials.
- .6 Contractor to retain and pay for services of geotechnical testing company acceptable to the Departmental Representative for testing of granular materials
- .7 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.
- .8 Contractor shall furnish labour and facilities to carry out specified testing and notify Departmental Representative in advance of planned testing.
- .9 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.
- .10 Pay costs for uncovering and making good work that is covered before required inspection or testing is completed and approved by Departmental Representative.
- .11 Provide Departmental Representative with digital copy of testing laboratory reports as soon as they are available.

1.21 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 Contractor to review Appendix H Esquimalt Graving Dock Environmental Best Practices regarding archaeological consideration located on site.
- .3 Give immediate notice to Departmental Representative if evidence of archaeological discoveries is encountered during excavation/construction, and await Departmental Representative's written instructions before proceeding with work in this area.

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

1.23 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 Appendix F – EGD Standards for Survey.

1.24 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.

1.25 CLEANING

- .1 Refer to Section 01 74 11 - Cleaning.

1.26 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.

1.27 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 – EGD Environmental Best Management Practices - for site specific environmental requirements and risk management procedures.

1.28 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.

- .2 Refer to Section 01 78 00 – Closeout Submittals

1.29 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.

1.30 BUILDING SMOKING ENVIRONMENT

- .1 Smoking within any 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.

1.31 SYSTEM OF MEASUREMENT

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

1.32 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.

1.33 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.

1.34 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.

1.35 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

PART 1 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 J – Fire Safety Map – of this specification for emergency access route to be maintained.
- .4 Contractor to transport excavated material from site to Lot 203 as outlined in Section 31 23 33.01 Excavating, Trenching, and Backfilling.

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. Project site work shall be managed such that EGD operational requirements remain paramount. Contractor is advised to review Appendix G - Esquimalt Graving Dock (EGD) Dock Booking Summary which provides details on vessels scheduled to be in the Dock during the construction period
- .2 Where security is reduced by work, provide temporary means to maintain security as per Departmental Representatives direction.
- .3 Closures: protect work temporarily until permanent enclosures are completed.
- .4 The entire dockyard will be occupied by the public, government staff, other PWGSC construction contractors and other dock lease operations during construction period.

- .5 Coordinate with Departmental Representative in scheduling operations to minimize conflict and to facilitate use of space.
- .6 All tracked equipment to have rubber track pads as outlined in Section 31 23 33.01 Excavating, Trenching, and Backfilling.

1.4 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 8 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 The Contractor shall give priority to the installation, testing, and commissioning of the new plant in such a way as to minimize, mitigate or eliminate site-wide shutdowns during this project.
 - .2 Refer to Section 01 91 13 General Commissioning CX Requirements and Section 26 08 00 Commissioning and Instruction
 - .3 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.
 - .4 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.
 - .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 2 weeks 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.

1.5 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 discretion of the Director of EGD and Departmental Representative.

1.6 NOISE CONTROL

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

1.7 CONSTRUCTION PHASING

- .1 To maintain Esquimalt Graving Dock operational during construction is of the highest priority. To achieve this goal, excavation across any existing roadway must be implemented after working hours or during weekends. All excavated areas at the roadway must be provided with a minimum of one lane for vehicle traffic during normal working hours.

1.8 PARALLEL PROJECTS

- .1 Additional projects will be underway at the Esquimalt Graving Dock during completion of this project. The contractor shall work around and coordinate access, material deliveries, etc., with other projects to ensure traffic congestion or delays do not occur.
- .2 Any additional delays, coordination or other costs shall be included by the contractor as part of this project.
- .3 Major projects expected on the site during this project include (but are not limited to):
 - .1 RMSNS –Replace Main Substation North Substation.
 - .2 NLWSR – North Landing Wharf Substation Replacement
 - .3 South Jetty Reconstruction.

END OF SECTION

PART 1 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 Departmental Representative's Work.
- .6 Record drawings in accordance with Section 01 78 00 - Closeout Submittals.
- .7 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
- .8 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
- .9 Monthly progress claims, administrative procedures, photographs, hold backs.

- .10 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 two (2) 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 Structural
 - .2 Electrical
 - .3 Civil
 - .10 Change order log review.
 - .11 Review submittal schedule.
 - .12 Review updated as built.
 - .13 Review and resolve site issues.
 - .14 New business.

END OF SECTION

PART 1 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 the 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 10 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.
- 2. Make necessary changes to proposed schedule within 5 days.
- 3. Submit letter ensuring the schedule has been prepared in coordination with major subcontractors and suppliers.
- 4. Promptly provide additional information to validate practicability of schedule as required by Departmental Representative.
- 5. 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

PART 1 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 manufacturer's 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 (CentralCollab) 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

PART 1 - GENERAL

1.1 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.

1.2 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. See Section 31 23 33.01 Excavating, Trenching, and Backfilling
 - .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.

1.3 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.

1.4 SEQUENCING AND SCHEDULING

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

1.5 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.

1.6 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.

1.7 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.

1.8 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.

1.9 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.

1.10 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.

1.11 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.
- .9 Departmental Representative will have the right to require additional decontamination to be completed if deemed necessary.
- .10 Take appropriate measures necessary to minimize drift of mist and spray during decontamination including provision of wind screens.
- .11 Collect decontamination wastewaters and sediments which accumulate on equipment decontamination area. Transfer wastewaters to designated wastewater storage tank.
- .12 Furnish and equip personnel engaged in equipment decontamination with protective equipment including suitable disposable clothing, respiratory protection, and face shields.
- .13 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.

1.12 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.

1.13 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.

1.14 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.

1.15 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.

1.16 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.

1.17 REMOVAL AND DISPOSAL

- .1 Remove surplus materials and temporary facilities from site.
- .2 Dispose of non-contaminated waste materials, litter, debris, and rubbish offsite 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.

1.18 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

PART 1 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 2015):
 - .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 National Fire Code of Canada 2010 (as amended):
 - .1 Part 5 – Hazardous Processes and Operations and Division B as applicable and required.
- .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 The Canadian Electrical Code (as amended)
- .8 EGD Environmental Best Management Practices in Appendix H.

1.2 RELATED SECTIONS

- .1 Section 01 11 55 - General Instructions
- .2 Section 01 32 16 - Construction Progress Schedule Bar (GANTT) Chart
- .3 Section 01 33 00 - Submittal Procedures
- .4 Section 01 35 13 - Special Procedures for Contaminated Sites
- .5 Section 01 35 43 - Environmental Procedures
- .6 Section 01 51 00 - Temporary Utilities
- .7 Section 01 56 00 - Temporary Barriers Enclosures

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

- .8 PSPC may terminate the Contract without liability to PSPC 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.

- .9 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 – Submittal Procedures.
- .2 Work effected by submittal shall not proceed until review is complete.
- .3 Submit the following:
 - .1 Site Specific 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 Site Specific 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 D 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 Site Specific Health and Safety Plan by Public Service and Procurement Canada (PSPC) shall not relieve the Contractor of responsibility for errors or omissions in final Site Specific 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 3300. In conjunction with Departmental Representative, schedule to carry out work during "off hours" when Esquimalt Graving Dock Staff have left the building.
 - .2 Provide 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.
- .3 Portable gas and diesel fuel tanks are not permitted on most federal work sites. Approval from the DR is required prior to any gas or diesel tank being brought onto the work site

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 Site Specific 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

PART 1 GENERAL

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 projectsite.
 - .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.
- .3 Site is a known archaeological area. Under supervision of Archaeological Consultant excavate and remove materials to an area next to the Commissionaire's building and stockpile on tarps for further evaluation. Upon conclusion of further evaluation and under direction, move materials to final location at the head of the dock above the lock-block wall and distribute evenly. See Section 31 23 35.01.

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 onsite.
 - .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.

PROJECT # R.090408.001
ESQUIMALT GRAVING DOCK (EGD)
REPLACE MAIN DISTRIBUTION LINE (RMDL)
BC HYDRO (BCH) POINT OF DELIVERY (POD) SWITCHGEAR
825 Admirals Road, Victoria, B.C.

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ENVIRONMENTAL PROCEDURES
Page 4 of 4

END OF SECTION

PART 1 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 according to 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 All electrical test equipment shall be calibrated up to date according to NETA standards and have certificates of calibration submitted during submission of test results.
- .4 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .5 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 assembly plants, and storage facilities.
- .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 requested in specifications, 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 Promptly make good all Contractor's work damaged by removals/ replacements.
- .3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Departmental Representative 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 copies 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 work to proceed in a timely manner.
- .2 Provide copies of work being inspected or tested, or the fabricator or the manufacturer of the material being inspected or tested, to the subcontractor.

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.
- .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 a reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

1.9 EQUIPMENT AND SYSTEMS

- .1 Submit adjustment and balancing reports for electrical and building equipment systems.
- .2 Refer to other Divisions for definitive requirements.

END OF SECTION

PART 1 - GENERAL

1.1 ACCESS AND DELIVERY

- .1 Only the designated entrance may be used for access to the site, with the exception of the EGD back gate which will be usable to dump trucks moving soil to Lot 203. 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.
- .5 The contractor's work site is to be used for loading and unloading purposes.
- .6 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.
- .7 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. Site services, including electricity, will be supplied free of charge to contractor where services are readily available
- .2 Contractor will be charged power at a standard BC hydro rate typical for this servicesize (BC Hydro Schedule 1220).

1.5 AIR

- .1 Site services, including compressed air, will be supplied free of charge to contractor, where services are readily available. Contractor to supply their own compressed air for

the duration of the contract where site provided air is not available.

1.6 WATER SUPPLY

- .1 Water supply is available at existing site and is provided, where services are readily available, to the contractor free of charge.

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 TEMPORARY HEATING AND VENTILIATION

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be non flameless type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.
- .5 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
 - .4 Ventilate storage spaces containing hazardous or volatile materials.
 - .5 Ventilate temporary sanitary facilities.
 - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.

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.
- .3 Site services, including crane services, will be supplied free of charge to contractor, where services are readily available.

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.
- .3 Site office may be accommodated in an area designated by EGD.

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. Dispose offsite on completion 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

PART 1 GENERAL**1.1 GENERAL**

- .1 This Section addresses general requirements for temporary vehicle movement, site access and parking not incorporated into the final or permanent work, as well as traffic control during construction. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 During progress of the Work, make adequate provision to accommodate normal traffic along onsite roads immediately adjacent to or crossing the Works so as to minimize inconvenience to site operations.
- .3 Give minimum 48 h notice or as otherwise required by Departmental Representative to local police, fire departments, emergency services, and site operations staff prior to beginning construction on roadways and comply in all respects with their requirements.
- .4 Inform Departmental Representative and tenants where access is affected at least 24 hours in advance of proposed road and/or sidewalk closures.
- .5 When active operations, including trucks, excavators, concrete trucks, and cranes, impact traffic flow to EGD, traffic control in the form of qualified flaggers, provided by the contractor, will be present at all times activities occur. See Section 1.5
- .6 Contractor to provide written notification with traffic control plans to EGD a minimum of 48 hours in advance for review and approval of all disruptive traffic activities.

1.2 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Contractor to submit traffic control plan to Departmental Representative for review and approval prior to construction.

1.3 TEMPORARY ACCESS ROADS

- .1 Provide and maintain temporary access roads at locations approved by the Departmental Representative.

1.4 TEMPORARY PARKING AREAS

- .1 Parking will be permitted on site in the location(s) designated by the Departmental Representative provided it does not disrupt the performance of the work or production operations.

1.5 TRAFFIC CONTROL

- .1 Comply with requirements of the "Traffic Control Manual for Work on Roadways", published by the British Columbia Ministry of Transportation, for regulation of vehicle and pedestrian traffic or use of roadways upon or over which it is necessary to carry out work or haul materials or equipment.
- .2 Regulate traffic in general accordance with Esquimalt Graving Dock requirements for uninterrupted access to all parts of this site except where specified otherwise and in compliance with specific requirements stipulated herein. Specific to this requirement, note that the Main Entry: Pedestrian and vehicle gates, and Area around the SES and the dive way to "Parking Lot B". These areas must stay open at all times. The contractor shall stage his work to allow for at least one-way alternating traffic through this area at all times.

- .3 Provide and maintain access to corridors specified on Contract Drawings.
- .4 Provide and maintain reasonable road access and egress to tenants fronting along or in vicinity of work under contract unless approved otherwise by Departmental Representative.
- .5 One way alternating traffic will generally be permitted during work involving road crossings. Do not close any lanes of road or highway without prior approval of the Departmental Representative. Before re-routing traffic erect suitable signs and devices as approved by the Departmental Representative. Provide sufficient crushed gravel to ensure a smooth riding surface during work. Replace surface asphalt within one week of completing the trench backfilling.
- .6 Keep travelled way well graded, free of pot holes and of sufficient width that required number of lanes of traffic may pass.
- .7 When directed by Departmental Representative, provide well graded, graveled detours or temporary roads to facilitate passage of traffic around restricted construction area. Provide and maintain signs and lights and maintain roadway.
- .8 When working on travelled way:
 - .1 Place equipment in such position as to present a minimum of interference and hazard to the travelling public.
 - .2 Keep equipment units as close together as working conditions will permit and preferably on same side of travelled way.
 - .3 Do not leave equipment on travelled way overnight.
- .9 Traffic Control Informational and Warning Devices
 - .1 Meet with Departmental Representative prior to commencement of work to prepare list of signs and other devices required for project.
 - .2 Provide and maintain signs and other devices required to indicate construction activities or other temporary and unusual conditions resulting from project work which may require road user response.
 - .3 Supply and erect signs, delineators, barricades and other miscellaneous warning devices in accordance with Departmental Representative requirements.
 - .4 Place signs and other devices in additional locations as appropriate or as directed by the Departmental Representative.
 - .5 Continually maintain traffic control devices in use by:
 - .1 Checking signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.
 - .2 Removing or covering signs which do not apply to conditions existing from day to day.
- .10 Control of Traffic Using Flaggers
 - .1 Provide flag persons, trained and properly equipped for the following situations:
 - .1 When graving dock traffic is required to pass working vehicles or equipment which may block all or part of travelled roadway.
 - .2 When it is necessary to institute one-way traffic system through construction area or other blockage where traffic signal system is not in use.
 - .3 When workers or equipment are employed on travelled way.
 - .4 Where temporary protection is required while other traffic control devices are being erected or taken down.
 - .5 For emergency protection when other traffic control devices are not readily available.
 - .6 In situations where complete protection for workers, working equipment and public traffic is not provided by other traffic control devices.

- .11 Provide and maintain suitable detours or temporary access routes for pedestrian traffic, complete with suitable warning and advisory signs.
- .12 Maintain existing conditions for traffic throughout period of contract expect that, when required for construction under contract and when measures have been taken as specified herein and approved by Departmental Representative to protect and control public traffic, existing conditions for traffic may be restricted.

END OF SECTION

PART 1 GENERAL

1.1 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'.

1.2 INSTALLATION AND REMOVAL

- .1 Provide temporary controls in order to execute Work expeditiously.
- .2 Remove from site all such work after use.

1.3 HOARDING

- .1 Refer to Section 01 51 00 Temporary Utilities.

1.4 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.

1.5 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.

1.6 ACCESS TO SITE

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

1.7 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.

1.8 FIRE ROUTES

- .1 Maintain access to property including overhead clearances for use by emergency response vehicles.
- .2 Maintain clearance for all egress routes.

1.9 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 - Waste Management and Disposal.

END OF SECTION

PART 1 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 one 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 Product approvals, procurement, delivery, installation, and commissioning shall meet the project energization date of September 15, 2019.
- .2 Products are specified by "Prescriptive" specifications: select any product meeting or exceeding specifications.
- .3 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.
- .4 Products specified by performance and referenced standard: select any product meeting or exceeding the referenced standard.
- .5 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".
- .6 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 from B.C. Hydro and from 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

PART 1 GENERAL

1.1 REFERENCES

- .1 Departmental Representative's identification of existing survey control points and property limits.

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 SURVEY REFERENCE POINTS

- .1 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.
- .3 Make no changes or relocations without prior written notice to Departmental Representative.
- .4 Report to Departmental Representative when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- .5 Require surveyor to replace control points in accordance with original survey control.

1.4 SURVEY REQUIREMENTS

- .1 Establish two permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.
- .2 Establish lines and levels, locate and lay out, by instrumentation.
- .3 Stake for grading, fill and topsoil placement and landscaping features.
- .4 Stake slopes.
- .5 Establish pipe invert elevations.
- .6 Stake batter boards for foundations.
- .7 Establish foundation and floor elevations.
- .8 Establish lines and levels for mechanical and electrical work.

1.5 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 undertake GPR Survey of existing services within work zone as required to verify existing underground condition prior to excavation.
- .3 Contractor to retain and pay for the services of a hydrovactor excavation company to complete hydrovactor work in areas noted on the drawings.

1.6 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.

1.7 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.

1.8 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.
- .4 Contractor to submit to Departmental Representative for review and approval a pre-locate work plan for Hydrovactor work outlining location, date of work, duration, description of impacted areas, temporary restoration details, and impact to site (eg. Crane, traffic, etc). A sample Notification Form is provided in APPENDIX L – Sample Contractor Submittals - for reference purposes.
- .5 Upon completion of GPR and Hydrovactor pre-locate work, Contractor to submit results of investigation on Contract drawings to Departmental Representative for review. Submission to include horizontal and vertical information of located existing services as measured by topographic survey related to project elevation datum.

1.9 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.

1.8 EXECUTION

- .1 Undertake hydrovactor excavation utility pre-locate program upon approval of plan by Departmental Representative.
- 2 PWGSC will allow Hydrovactor slurry to be deposited in the containment cell located on Lot 203 off Maplebank Road for settling upon which:
 - .1 PWGSC's Soil Management Consultant (SMC) will complete the task of sampling the settlement and water (at the expense of PWGSC) and provide the characterization reports to the Contractor for timely disposal of materials to an approved facility for disposal based on characterization report. Turnaround time for sample characterization is minimum 5 days.
 - .2 Contractor to submit to Departmental Representative for review and approval of the location of proposed disposal facility prior to disposal of any material.
 - .3 Payment disposal (including loading and hauling costs) of characterized material will be paid as a negotiated change order to the contract. Contractor must provide PWGSC will all disposal records including weigh bills, disposal receipts and chain of custody documentation.

- .3 Restoration of hydrovactor excavation trenches is required to provide access to tenant spaces. Use of steel road plates across hydrovactor excavations or temporary restoration with concrete to permit travel of forklifts to tenant spaces is acceptable.

END OF SECTION

PART 1 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 Departmental Representative 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 Departmental Representative 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, 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

PART 1 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 Departmental Representative 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 Departmental Representative 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

PART 1 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 waste.
- .2 Cost/Revenue Analysis Workplan (CRAW): based on information from Waste Reduction Workplan (WRW) and intended as financial tracking tool for determining economic status of waste management practices.
- .3 Inert Fill: inert waste - exclusively asphalt and concrete.
- .4 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.
- .5 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .6 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .7 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.
- .8 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
 - .1 Returning reusable items including pallets or unused products to vendors.
- .9 Separate Condition: refers to waste sorted into individual types.
- .10 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.
- .11 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction. Indicates quantities of reuse, recycling and landfill. Refer to Schedule A.
- .12 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .13 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 Materials Source Separation Program (MSSP) description.

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 Location.
 - .3 Security.
 - .4 Protection.
 - .5 Clear labelling of storage areas.
 - .6 Details on materials handling and removal procedures.
 - .7 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 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.

1.8 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 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.

1.9 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.

1.10 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.

1.11 SCHEDULING

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

PART 2 PRODUCTS

2.1 NOT USED

PART 3 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 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT

.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

END OF SECTION

PART 1 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 Departmental Representative'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

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 11 55 – General Instructions
- .2 Section 01 45 00 – Quality Control
- .3 Section 01 71 00 – Examination and Preparation
- .4 Section 01 77 00 – Closeout Procedures
- .5 Section 01 79 00 – Demonstration and Training
- .6 Section 01 91 13 – General Commissioning CX Requirements

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 Spare parts, maintenance materials and special tools provided shall be new, undamaged and not defective, 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 Electrical
 - .3 Data & Communication
 - .4 Under each discipline, data shall be grouped into 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 within the document or linking to other documents for references.
 - .2 'As-Constructed' Drawings
 - .1 'As-Constructed' drawings shall be converted from the original electronic CAD or REVIT files 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 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 Instructions, 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 Colour coding chart.
 - .2 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Schedules of tasks, frequency, tools required and task time.
 - .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 list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .12 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and 01 91 13 – General Commissioning (Cx) Requirements.

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.

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 Departmental Representative'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

PART 1 GENERAL

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to Departmental Representative's personnel two weeks prior to date of substantial performance.
- .2 Departmental Representative: provide list of personnel to receive instructions, and coordinate 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 26 08 00 Commissioning and Instructions.
- .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. Allow at least 40 hours for training and allow up to 20 additional hours for repeat of certain training sessions as required for operational reasons.

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 Departmental Representative'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 Provide training and written procedures on paralleling EGD standby Generators with BC Hydro
 - .4 Review of HMI screens, trending functions, alarm operations.
 - .5 Refer to Section 26 29 23.02 for additional requirements.

END OF SECTION

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 26 05 00 – Common Work Results – Electrical
 - .4 Section 26 05 14 – Power Cables (1001V-27kV)
 - .5 Section 26 05 27 – Grounding - Primary
 - .6 Section 26 05 43.01 – Installation of Cables in Trenches and in Ducts
 - .7 Section 26 13 18 – Primary Switchgear Assembly to 27kV
 - .8 Section 26 29 05 – Protective Relays
 - .9 Section 26 29 23.01 – Digital Metering
 - .10 Section 26 29 23.02 – Power System SCADA (PSS)
 - .11 Section 27 05 14 – Structured Cabling for Communications
 - .12 Section 27 05 15 – Fibre Optic System
 - .13 Section 28 13 00 – Access Control
 - .14 Section 28 23 00 – Video Surveillance
- .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, outdoor kiosks 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 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 (GANNT 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 Circuit Breakers, High Voltage
 - .6 Instrument and Power Transformers
 - .7 Metering Devices, Microprocessor-Based
 - .8 Protection devices, Microprocessor-Based
 - .9 Motor Control, Motor Starters, Low-Voltage
 - .10 Emergency Systems, Uninterruptable Power Systems
 - .11 Emergency Systems, Automatic Transfer Switches
 - .12 Power connection system
 - .13 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 Load bank testing of power connections, with Infrared Scanning.
 - .3 Circuits originating from branch distribution panels.
 - .4 Lighting and its control.
 - .5 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .6 Systems: fire alarm system communications; copper and fibre communications; access control; CCTV systems; Digital Metering and SCADA.
 - .7 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 600-27kV 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.
 - .4 Loadbank equipment of suitable ampacity and voltage for full load testing.
 - .5 Safety barriers and control appliances.

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 Technical Safety BC.

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 DEPARTMENTAL REPRESENTATIVE'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 RELATED REQUIREMENTS

- .1 Section 03 20 00 – Concrete Reinforcing
- .2 Section 03 30 00 – Cast-in-Place Concrete

1.2 REFERENCE STANDARDS

- .1 American Concrete Institute (ACI):
 - .1 ACI 347, Guide to Formwork for Concrete.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-O86-14, Engineering Design in Wood.
 - .3 CSA O121-08 (R2013), Douglas Fir Plywood.
 - .4 CSA O325-16, Construction Sheathing.
 - .5 CSA S269.1-16, Falsework and Formwork.
- .3 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submission of shop drawings for formwork is not required.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 33 – Health and Safety Requirements.
- .4 Indicate method and schedule of construction, stripping procedures, materials, arrangement of joints, ties, and locations of temporary embedded parts. Comply with CSA S269.1, for formwork drawings.
- .5 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.
- .6 Indicate sequence of erection and removal of formwork as directed by Departmental Representative.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Store and manage hazardous materials in accordance with Section 01 35 33 – Health and Safety Requirements and Section 01 35 43 Environmental Procedures.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for recycling and reuse in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Place materials defined as hazardous or toxic in designated containers.
 - .3 Divert wood materials from landfill to a recycling, reuse, or composting facility as approved by Departmental Representative.
 - .4 Divert plastic materials from landfill to a reuse or recycling facility as approved by Departmental Representative.
 - .5 Divert unused form release material from landfill to an official hazardous material collections site as approved by the Departmental Representative.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Formwork materials:
 - .1 Use wood and wood product formwork materials to CSA-S269.1, CSA-O121, and CAN/CSA-O86.
- .2 Form ties:
 - .1 Use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
- .3 Form release agent: non-toxic, biodegradable, low VOC.
- .4 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 70 and 110s Saybolt Universal free at 40 degrees C, flashpoint minimum 150 degrees C, open cup.

PART 3 EXECUTION

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels and centres before proceeding with formwork and ensure dimensions agree with drawings.
- .2 Obtain Departmental Representative's approval for use of earth forms not indicated on drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Fabricate and erect formwork in accordance with CSA-S269.1 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
- .5 Align form joints and make watertight.
 - .1 Keep form joints to minimum.
- .6 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
- .7 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .8 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.
- .9 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

- .1 Leave formwork in place for following minimum periods of time after placing concrete.
 - .1 1 day for duct banks and slabs on grade.
- .2 Remove formwork when concrete has reached 67% of its specified concrete strength.
- .3 Re-use formwork subject to requirements of CSA-A23.1/A23.2.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 03 10 00 – Concrete Forming and Accessories
- .2 Section 03 30 00 – Cast-in-Place Concrete

1.2 REFERENCE STANDARDS

- .1 American Concrete Institute (ACI)
 - .1 SP-66-04, ACI Detailing Manual.
- .2 ASTM International
 - .1 ASTM A143/A143M-07(2014), Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - .2 ASTM A767/A767M-16 Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
 - .3 ASTM A775/A775M-16, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 - .4 ASTM A1064/A1064M-16b, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .3 CSA International
 - .1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A23.3-14, Design of Concrete Structures.
 - .3 CSA-G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement.
 - .4 CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .5 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.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare reinforcement drawings in accordance with SP-66 and RSIC Manual of Standard Practice.
- .3 Shop Drawings:
 - .1 Submittal of shop drawings is not required.
 - .1 Indicate placing of reinforcement and:
 - .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.

- .2 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated.
 - .1 Provide Class B, unless otherwise indicated.
- .4 When Chromate solution is used as replacement for galvanizing non-prestressed reinforcement, provide product description for review by Departmental Representative prior to its use.

1.4 QUALITY ASSURANCE

- .1 Submit in accordance with Section 01 45 00 - Quality Control and as described in PART 2.3 - SOURCE QUALITY CONTROL.
 - .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 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 and in accordance with manufacturer's recommendations.
 - .2 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan and Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 19 Waste Management and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.
- .3 Reinforcing steel: weldable low alloy steel deformed bars to CSA-G30.18.
- .4 Cold-drawn annealed steel wire ties: to ASTM A1064/A1064M.
- .5 Deformed steel wire for concrete reinforcement: to ASTM A1064/A1064M.
- .6 Welded steel wire fabric: to ASTM A1064/A1064M.
 - .1 Provide in flat sheets only.
- .7 Welded deformed steel wire fabric: to ASTM A1064/A1064M.
 - .1 Provide in flat sheets only.
- .8 Epoxy Coating of non-prestressed reinforcement: to ASTM A775/A775M.

- .9 Galvanizing of non-prestressed reinforcement: to ASTM A767/A767M, minimum zinc coating 610 g/m².
 - .1 Protect galvanized reinforcing steel with chromate treatment to prevent reaction with Portland cement paste.
 - .2 If chromate treatment is carried out immediately after galvanizing, soak steel in aqueous solution containing minimum 0.2% by weight sodium dichromate or 0.2% chromic acid.
 - .1 Temperature of solution equal to or greater than 32 degrees and galvanized steels immersed for minimum 20 seconds.
 - .3 If galvanized steels are at ambient temperature, add sulphuric acid as bonding agent at concentration of 0.5% to 1%.
 - .1 In this case, no restriction applies to temperature of solution.
 - .4 Chromate solution sold for this purpose may replace solution described above, provided it is of equivalent effectiveness.
 - .1 Provide product description as described in PART 1.3 - ACTION AND INFORMATIONAL SUBMITTALS.
- .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 Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada, SP-66, and CSA-A23.1/A23.2.
- .2 Obtain Departmental Representative's written 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.
 - .1 Ship epoxy coated bars in accordance with ASTM A775A/A775M.

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.

PART 3 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 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.
 - .2 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 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.

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 Waste Management: separate waste materials for recycling and reuse in accordance with 01 74 19 - Waste Management and Disposal.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 03 10 00 – Concrete Forming and Accessories
- .2 Section 03 20 00 – Concrete Reinforcing

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C260/C260M-10a(2016), Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C494/C494M-16, Standard Specification for Chemical Admixtures for Concrete.
 - .4 ASTM C1017/C1017M-13e1, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- .2 CSA International
 - .1 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A283-06(R2016), Qualification Code for Concrete Testing Laboratories.
 - .3 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.3 ABBREVIATIONS AND ACRONYMS

- .1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement.
 - .1 Type GU, GUb and GUL - General use cement.
 - .2 Type MS and MSb - Moderate sulphate-resistant cement.
 - .3 Type MH, MHb and MHL - Moderate heat of hydration cement.
 - .4 Type HE, HEb and HEL - High early-strength cement.
 - .5 Type LH, LHb and LHL - Low heat of hydration cement.
 - .6 Type HS and HSb - High sulphate-resistant cement.
- .2 Fly ash:
 - .1 Type F - with CaO content less than 15%.
 - .2 Type CI - with CaO content ranging from 15 to 20%.
 - .3 Type CH - with CaO greater than 20%.
- .3 GGBFS - Ground, granulated blast-furnace slag.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: in accordance with Section 01 32 16.07 - Construction Progress Schedule Bar (GANTT) Chart, convene pre-installation meeting one week prior to beginning concrete works.
 - .1 Ensure Site supervisor, concrete producer, testing laboratories, speciality contractor - finishing, forming, Departmental Representative, and other key personnel attend.
 - .1 Verify project requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Provide concrete mix designs for review by Departmental Representative.
- .3 Provide testing reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.
- .4 Provide adhesive anchoring system data for review by Departmental Representative. Data to include product description, testing and product evaluation certifications, and factored design resistances in both uncracked and cracked concrete.
- .5 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
- .6 Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.
- .7 Provide copy of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Provide Departmental Representative, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.
 - .1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.
- .3 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by Departmental Representative on following items:
 - .1 Formwork erection.
 - .2 Hot weather concrete.
 - .3 Cold weather concrete.
 - .4 Curing.
 - .5 Finishes.
 - .6 Formwork removal.
 - .7 Joints.
- .4 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
 - .1 Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative and concrete producer as described in CSA A23.1/A23.2.
 - .2 Deviations to be submitted for review by Departmental Representative.
 - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
- .2 Packaging Waste Management: remove for reuse and return of pallets, padding, packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

- .1 Alternative 1 - Performance: to CSA A23.1/A23.2, and as described in PART 2.4 - MIXES.

2.2 PERFORMANCE CRITERIA

- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Departmental Representative and provide verification of compliance as described in PART 1.6 - QUALITY ASSURANCE.

2.3 MATERIALS

- .1 Portland Cement: to CSA A3001, Type GU.
 - .1 Reduction in cement from Base Mix to Actual Supplementary Cementing Materials (SCMs) Mix, as percentage.
- .2 Blended hydraulic cement: Type GUB to CSA A3001.
- .3 Portland-limestone cement: Type GUL to CSA A23.1.
- .4 Supplementary cementing materials: with minimum 20% N fly ash replacement, by mass of total cementitious materials to CSA A3001.
- .5 Water: to CSA A23.1.
- .6 Aggregates: to CSA A23.1/A23.2.
- .7 Admixtures:
 - .1 Air entraining admixture: to ASTM C260.
 - .2 Chemical admixture: to ASTM C1017 and ASTM C494. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .8 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.
 - .1 Compressive strength: 50 MPa at 28 days.
- .9 Non-premixed dry pack grout: composition of non-metallic aggregate Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 50 MPa at 28 days.
- .10 Curing compound: to CSA A23.1/A23.2 and ASTM C309, Type 1-chlorinated rubber.

2.4 MIXES

- .1 Alternative 1 - Performance Method for specifying concrete: to meet Departmental Representative performance criteria to CSA A23.1/A23.2.
 - .1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.
 - .2 Provide concrete mix to meet following plastic state requirements:
 - .1 Uniformity: uniform density, air content, and slump.
 - .2 Workability: free of segregation, surface blemishes, loss of mortar, and colour variations.
 - .3 Finishability: to CSA A23.1/A23.2.
 - .3 Provide concrete mix to meet following hard state requirements:
 - .1 Mix: Type 1
 - .1 Durability and class of exposure: F-2.
 - .2 Compressive strength at 28 day age: 30 MPa minimum.

- .3 Intended application:
 - .1 Duct banks.
- .4 Aggregate size: 20mm maximum
- .2 Mix: Type 2
 - .1 Durability and class of exposure: C-1.
 - .2 Compressive strength at 28 day age: 35 MPa minimum.
 - .3 Intended application:
 - .1 Reinforced slabs on grade exposed to chlorides and freezing and thawing.
 - .2 Footings and foundation piers.
 - .3 Aggregate size: 20mm maximum
- .4 Provide quality management plan to ensure verification of concrete quality to specified performance.
- .5 Concrete supplier's certification: both batch plant and materials meet CSA A23.1 requirements.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Obtain Departmental Representative's written approval before placing concrete.
 - .1 Provide 24 hours minimum notice prior to placing of concrete.
- .2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .4 Pumping of concrete is permitted only after approval of equipment and mix.
- .5 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .6 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .7 Protect previous Work from staining.
- .8 Clean and remove stains prior to application for concrete finishes.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .10 Do not place load upon new concrete until authorized by Departmental Representative.

3.2 INSTALLATION/APPLICATION

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 Sleeves and inserts:
 - .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through slabs, except where indicated or approved by Departmental Representative.
 - .2 Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by Departmental Representative.
 - .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Departmental Representative before placing of concrete.

- .4 Confirm locations and sizes of sleeves and openings shown on drawings.
- .3 Anchor bolts:
 - .1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.
- .4 Grout under base plates and equipment using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.
- .5 Finishing and curing:
 - .1 Finish concrete to CSA A23.1/A23.2.
 - .2 Use procedures as reviewed by Departmental Representative or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.
 - .3 Use curing compounds compatible with applied finish on concrete surfaces.
 - .4 Finish concrete floor to CSA A23.1/A23.2. Class A.
 - .5 Concrete floor to have finish hardness equal to or greater than Mohs hardness to CSA A23.1/A23.2.
 - .6 Provide slab on grade with broom finish unless otherwise indicated.
 - .7 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.

3.3 SURFACE TOLERANCE

- .1 Concrete tolerance to CSA A23.1. Straightedge Method to tolerance of 8mm in 3000mm.

3.4 FIELD QUALITY CONTROL

- .1 Site tests: conduct tests as follows in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1.5 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .1 Concrete pours.
 - .2 Slump.
 - .3 Air content.
 - .4 Compressive strength at 7 and 28 days.
 - .5 Air and concrete temperature.
- .2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory approved by Departmental Representative for review to CSA A23.1/A23.2.
 - .1 Ensure testing laboratory is certified to CSA A283.
- .3 Ensure test results are distributed for review by Departmental Representative.
- .4 Contractor will retain the testing laboratory and pay for costs of tests.
- .5 Contractor will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .6 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.
- .7 Inspection or testing by Consultant will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for recycling and reuse in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Divert unused concrete materials from landfill to local facility after receipt of written approval from Departmental Representative.

- .2 No onsite washing of concrete trucks will be permitted.
- .3 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by Departmental Representative.
- .4 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.
- .5 Prevent admixtures and additive materials from entering drinking water supplies or streams.
- .6 Using appropriate safety precautions, collect liquid or solidify liquid with inert, non-combustible material and remove for disposal.
- .7 Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
- .2 CSA C22.1, 2018 Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
- .3 CAN/CSA-C22.3 No. 1, Overhead Systems.
- .4 CAN3-C235-83, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .5 CSA B651-12 Accessible Design for the Built Environment
- .6 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
- .7 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .8 Requirements for Customer-Owned Primary Services Supplied at 4kV to 35kV, Primary Guide, latest revision – BC Hydro

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 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .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 01 33 00 - Submittal Procedures.
- .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 3.7.1 - 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 3.7 - 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 - Construction Progress Schedule Bar (GANTT) Chart.
 - .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 33 - 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 19 - 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 with 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 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 1.4 – ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction.
- .2 Porcelain enamel signs, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.5 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 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. " as directed by Departmental Representative.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

2.6 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.

2.7 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

2.8 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.

2.9 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.

3.6 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 1.4 – ACTION AND INFORMATIONAL 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, 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, equipment to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders, equipment with 1000 V instrument.
 - .3 Megger 600V-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 1.4 – ACTION AND INFORMATIONAL 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 and review Work, as directed in PART 1.5 - 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 Sections 1, 3, 26, 27, 28, 31, 32, 33

1.3 SUMMARY

- .1 The following represents a suggestion of the 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 ABBREVIATIONS

- .1 BCH – B.C. Hydro
- .2 DND – Department of National Defense (Canadian Forces Base – Esquimalt)
- .3 EGD – Esquimalt Graving Dock
- .4 HV – High Voltage
- .5 POD – Point of Delivery
- .6 PSPC – Public Services Procurement Canada
- .7 PWGSC – Public Works Government Services Canada (old name of PSPC)
- .8 SES – Service Entrance Substation
- .9 VAC – Volts Alternating Current

1.5 SITE SHUTDOWNS

- .1 EGD must remain operational during the construction and commissioning of this project. To ensure EGD operations are maintained with minimal power disruptions, the following proposed Sequence of Work 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 8 weeks notice for requested shutdown dates.
- .3 Contractor shall plan for and expect all outages to occur on Saturday or Sunday, or between midnight and 5am during weekdays. No extra costs to the contract will be provided for number, duration or timing of power outages.

1.6 PROPOSED SEQUENCE OF WORK

- .1 **SITE REVIEW:** Review location of POD switchgear area, location of EGD property lines, location of ductbanks and underground conduit to be installed. Review exterior and interior area of Demarc building. Review location of disconnecting points of existing DND supply cable connections at PB 34 and SES. Review SES Communication Room, HV switchgear line-up, and EGD Standby Generation breakers, ATS and closed transition system. Review all other locations where associated apparatus will be installed, re-located, connected, adjusted, commissioned and energized for safe operating use.

- .2 COMMUNICATION and COORDINATION:
 - .1 Communicate with the B.C. Hydro team assigned to this project as necessary to provide information as well as to coordinate and arrange construction in the most expeditious manner with them.
 - .2 Communicate with the PSPC/EGD team and Departmental Representative assigned to this project as required to provide information and coordinate activities. Coordinate all construction with EGD operational activities.
- .3 SHOP DRAWINGS:
 - .1 Provide shop drawings for POD switchgear, revenue metering instrument transformers, revenue metering bases and installation locations, and protective relays, to departmental representative and to BCH for review and approval prior to procurement. Ensure that BCH review and approval time, procurement, installation, connection and commissioning times are completed within the time frames for this project.
 - .2 Provide all other shop drawings for equipment detailed on drawings and in specifications to department representative for review and approval.
- .4 TRAFFIC CONTROL: Provide traffic control plan for review and approval by PSPC/EGD and Departmental Representative.
- .5 DUCTBANKS: Excavate, construct, connect, backfill, patch, and make good all surfaces where the underground concrete encased ductbanks will be installed and connect to POD switchgear and existing and proposed ductbanks:
 - .1 Ductbank to west of proposed POD switchgear location to existing EGD HV ductbank stubbed underground;
 - .2 Ductbank to east of proposed POD switchgear location to EGD property line and connected to BCH ductbank (for BCH HV supply);
 - .3 At EGD property line coordinate construction and connection to new BC Hydro ductbank at EGD property line.
- .6 DIRECT BURIED CONDUIT: Excavate, construct, connect, backfill, patch, and make good all surfaces where underground conduit will be installed and connected:
 - .1 Conduit connecting to BCH underground conduit at EGD property line (for BCH fiber link) and to west of POD switchgear location, transitioning to overhead conduit at turnstile fence.
 - .2 Conduit connected from the BCH Metering sections of POD switchgear to the BCH Meter Cabinet outside POD station fence.
 - .3 Conduit from LV JB and COMM JB above grade at turnstile fence transitioning to underground then above ground to BCH Meter Cabinet.
 - .4 Conduit from same at turnstile fence transitioning to underground then above ground to LV JB and COMM JB at each of four corner light standards.
 - .5 Conduit from same at turnstile fence transitioning to underground then above ground to card access swipes at West swing gate, then underground to card access swipes at South slider gates.
 - .6 Other conduit necessary as per drawings.
- .7 OVERHEAD CONDUIT: Securely attach conduit to fence, Demarc building, Junction Boxes (JB) panels and racks: :
 - .1 Conduit transitioning from underground to overhead at turnstile fence, along fence and into Demarc building, and to existing EGD COMM ductbank.
 - .2 Conduit from LV panel attached to outside of Demarc building along building and fence to LV JB at turnstile fence.
 - .3 Conduit from Data Racks inside Demarc building through wall and along building and fence to COMM JB at turnstile fence.
 - .4 Conduit from LV PB on each light standard to GFI outdoor rated duplex power outlets attached to light standard.
 - .5 Other conduit necessary as per drawings.

- .8 POD SWITCHGEAR AREA: Excavate, construct, connect, backfill, patch and make good all surfaces to conform to the existing areas surrounding the outside of the fenced POD switchgear:
 - .1 Ground grid and ground electrode system, including all bond to ground cabling required for POD switchgear enclosures and adjacent metallic structures both above and below grade.
 - .2 Concrete pad supporting the POD switchgear, including rebar connections to the ground grid system as per drawings.
 - .3 Crushed stone for personnel protection, drainage and ground grid encasement.
 - .4 Asphalt covering outside station fence to property lines and as per drawings.
 - .5 Fencing, gates, barbed wire, connections to ground grid system.
 - .6 Associated card access swipes for West swing and South slider gates, padlock hasps for BCH use of East swing gate.
 - .7 All HV, safety, EGD and authorized only signage, securely attached to the station fence and switchgear.
 - .8 Miscellaneous items necessary as per drawings.
- .9 POD SWITCHGEAR: Install, connect, commission and energize for operational use:
 - .1 POD switchgear and all apparatus required for its operation as primary service entrance equipment shall be reviewed and acceptable by BCH before purchase.
 - .2 Two (2) back-to-back lineups of POD switchgear.
 - .3 Revenue metering instrument transformers for each POD switchgear set;
 - .4 Revenue meter cabinet supplied by BCH for installation by contractor;
 - .5 bases and associated works required for B.C. Hydro to install their meter in each POD switchgear;
 - .6 All other miscellaneous equipment required for a primary service entrance POD switchgear system acceptable to BCH.
 - .7 The POD switchgear shop drawings, BCH approvals, procurement and installation time shall meet the project deadlines as per Section 01 11 00 Summary of Work and Section 01 32 16 Construction Progress Schedule.
- .10 CABLES AND WIRING: Install through new and existing ductbanks as required:
 - .1 HV cable install from each POD switchgear cable exit cell bus to each of the main breakers in the SES.
 - .2 Fiber optic cable supplied by BCH and installed by contractor from the Demarc building to the SES Communications room data racks and to the appropriate protective relay in the SES switchgear.
 - .3 Security camera and card access wiring, cables for lighting and power outlets in the POD switchgear area.
 - .4 Coordinate demarcation of work and responsibilities with BCH in areas where BCH apparatus is installed.
- .11 SES ADJUSTMENTS: Install, adjust, connect, commission and energize for operational use of each incoming HV circuit and Communications network:
 - .1 HV cable installation and commissioning;
 - .2 Re-locations of instrument transformers for primary power measurements;
 - .3 Adjustment to existing protective relay settings as required;
 - .4 BCH fibre connection for main breaker status only and tie breaker tripping only;
 - .5 Installation of new relays and communications connections to existing SCADA.
- .12 REMOVAL OF EXISTING DND-EGD SUPPLY: Isolate, deenergize and remove existing HV cabling from existing DND/EGD pullbox to the existing DND incoming main breaker in the SES switchgear lineup.
 - .1 Communicate with the DND team, the PSPC/EGD team, and the BCH team assigned to this project for coordination and information.
 - .2 Make all necessary arrangements for a safe switch-over from existing DND-EGD supply to new BCH-EGD supply.

- .3 De-energize DND feeder. Safely isolate at DND overhead location and SES DND incoming main breaker.
- .4 Energize the new BCH feeders at POD switchgear and SES main incoming breakers.
- .5 After BCH Feeders have been in service, trouble free, for a minimum of 3 months, remove DND feeder from PB34 to S.E.S. and cap and make safe feeder elbows in PB34.
- .13 POST-CONSTRUCTION: Provide Operation & Maintenance manuals, EGD instruction, record drawings, and related work required for final completion of project at all areas impacted by the construction:
 - .1 POD Switchgear area to EGD property line and connection to BCH ductbank;
 - .2 SES switchgear apparatus impacted by cable and wiring installations; cable removals; fibre connections; metering measurement devices and protective relay adjustments;
 - .3 Removal of DND-EGD feeder.

PART 2 PRODUCTS

- .1 Not used

PART 3 EXECUTION

3.1 SCHEDULE

- .1 Award, start-up meeting, submission of POD switchgear shop drawing (3 weeks).
- .2 POD switchgear shop drawing review and acceptance by BCH (2 weeks).
- .3 Procurement of POD switchgear (16 weeks).
- .4 Completion of civil and structural construction by mid-August, 2019.
- .5 Delivery of POD switchgear to EGD site by mid-August, 2019.
- .6 Installation of POD switchgear and completion of all electrical construction work, and connection to BCH supply feeders by end of August, 2019.
- .7 Wait a minimum of 3 months of trouble free operation before removing DND feeder.
- .8 Commissioning of POD switchgear, including test energization of SES switchgear main bus, main breakers, tie breaker, and closed transition test of EGD standby generation to prove workability of system by mid-September, 2019. Commissioning of closed transition test arranged with BCH prior to full operational energization of EGD, to be done during an EGD shutdown (weekend) so as not to compromise EGD or BCH operations.
- .9 Operational energization from BCH feeders by mid-December 15th, 2019.
- .10 Post-construction completion by end of year 2019.

3.2 APPROVED PLAN OF CONSTRUCTION

- .1 Provide a detailed plan of construction sequence with critical path timelines for review and approval by PSPC/EGD and Departmental Representative.
- .2 Critical path shall meet the project completion deadline of 9 months from contract award.

3.3 REFERENCE SINGLE LINE DIAGRAMS

- .1 Contractor shall provide an updated single line diagram for each area affected by the project, including the outdoor POD switchgear units.

- .2 Install existing single line diagram in mounting frames (SES) and in new weatherproof laminated sheets attached to inside of POD switchgear doors.
- .3 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.
- .4 Single line diagrams, S.E.S. Thompson HMI, and SCADA single line drawing screens and controls shall be updated and submitted to the Departmental Representative for approval prior to installation.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Division 01 - Operation and Maintenance Manuals.
- .3 Section 01 78 00 - Closeout Submittals
- .4 Section 26 05 00 - Common Work Results
- .5 Section 26 08 00 - Commissioning and Instruction

1.2 SCOPE

- .1 Electrical operations and maintenance manuals, hereinafter referred to as O&M manuals, shall be prepared by a firm specializing in this type of work.
- .2 Specialty firm to be responsible for:
 - .1 The supply and preparation of four sets of O&M manual binders and tabs as specified in the index below.
 - .2 The preparation of all written system descriptions and schematics, neatly drafted, for each tab section identified as article 1.4. Format as directed by the Departmental Representative, utilizing proportional typewritten format, with schematics in appendices at the end of each section. System description shall include an overview of basic design philosophy, description of future expansion capability, general construction of components, electrical characteristics not readily deduced from the contract documents, basic system configuration and interfaces with other systems existing or new.
 - .3 Securing and assembling all necessary literature describing operational and maintenance procedures for all equipment into the O&M manual binders, including Preventative Maintenance data as described below. Preventative maintenance data and maintenance suggestions to be compiled in tabular format in applicable section to provide a comprehensive overview of maintenance procedures.
 - .4 Preparing in coordination with Electrical Divisions and equipment manufacturer's technical specialist, scheduled maintenance sheets and check lists. Scheduled maintenance sheets shall include safety in maintenance data plus detailed daily, monthly and yearly scheduled maintenance information. Format as directed by the Departmental Representative.
 - .5 Preparation of safety in maintenance suggestions and procedures.
 - .6 Summarized daily, monthly and yearly maintenance charts.
 - .7 Prestonia No. 2047-10 plastic sheet protectors for all drawings larger than 210 mm × 275 mm. Locate drawing title block on lower right-hand corner.
- .3 Division 26 shall be responsible for:
 - .1 Supply four copies of all information as described below:
 - .1 Final shop drawings.
 - .2 All wiring diagrams.
 - .3 List all major trades, sub-trades and suppliers including names of equipment supplied and by whom, addresses, phone numbers, facsimile numbers and contact persons.

- .4 Obtaining all data necessary to compile a complete comprehensive Preventative Maintenance program. Data gathered shall be neatly handwritten on forms provided by the Departmental Representative. Data to be collected for all systems described in the index below.
- .5 Spare/replacement parts lists for all of the above. Copies of the electrical contractor's data collection sheets available during tendering period when requested.
- .6 Test results as outlined in other sections of this specification.

1.3 ELECTRONIC FORMAT

- .1 In addition to the specified hardcopy, provide an electronic copy in pdf format. Electronic copy to be produced on a CD-ROM in the latest version of Acrobat.
- .2 CD-ROM to be reproducible by Departmental Representative as required to carry out his duties.
- .3 Electronic copy to consist of a single pdf file divided into chapters to allow a quick and easy access to the different sections of the manual.
- .4 All log sheet, maintenance tables, and preventative maintenance sheets intended to be completed by the Departmental Representative are to be completely interactive, allowing the Departmental Representative to complete all pertinent information and save, print or modify these forms as required.
- .5 Provide a proposed layout to the construction for approval prior to the construction.
- .6 Electrical contractor to submit complete system description and schematics by 50% complete stage of construction. O&M manuals to be submitted to the Departmental Representative 90% complete three (3) months prior to substantial completion review.
- .7 Electrical O&M manuals to be assembled in 210 mm × 275 mm capacity, expanding spine catalogue binders complete with plated piano hinges, bound in heavy fabric, hot stamped lettering on front and spine. Electrical contractor to provide sufficient quantity to allow all binders to hold system data while in full closed position (not expanded).
- .8 Electrical contractor to provide sample art work and fabric cover (before having binders constructed) to the Departmental Representative.
- .9 In addition to the specified hardcopy, provide an electronic copy in pdf format. Electronic copy to be produced on a CD-ROM in the latest version of Acrobat.
 - .1 CD-ROM to be reproducible by Departmental Representative as required to carry out their duties.
 - .2 Electronic copy to consist of a single .pdf file divided into chapters to allow a quick and easy access to the different sections of the manual.
 - .3 All log sheet, maintenance tables preventative maintenance sheets, intended to be completed by the Departmental Representative are to be completely interactive allowing the Departmental Representative to complete all pertinent information and save, print or modify these forms as required.
 - .4 Provide a proposed layout to the Consultant for approval prior to the construction.

END OF SECTION

PART 1 GENERAL**1.1 SECTION INCLUDES**

- .1 General requirements related to changes to existing site and electrical apparatus.

1.2 RELATED SECTIONS

- .1 Section 26 05 00 Common Work Results - Electrical
- .1 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 or in 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 installations.
- .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 Departmental Representative in writing of any intended interruptions outside of these normal hours, including the time and duration of outage. Obtain permission from Departmental Representative 8 weeks for power systems, 5 working days for alarm and / or control on communication systems before partially or completely disabling any of the systems. The Departmental Representative 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 HV power, low voltage power, communications services or apparatus within the existing EGD building, the wiring or apparatus 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, or to enclose the work), concealing may not be possible. In such cases, special wiring methods or enclosures shall be used, provided that approval 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.

1.6 SALVAGE

- .1 All surplus electrical equipment, devices, and light fixtures shall be considered Departmental Representative's property. Determine from the Departmental Representative which materials they wish to keep and transport, and store such items at a location as directed by the Departmental Representative. 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 Departmental Representative and provide a copy of same to the Departmental Representative.

PART 2 PRODUCTS

- .1 Not used

PART 3 EXECUTION

- .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 133% voltage level, with concentrically served copper wire shield over semi-conducting insulation shielding layer, separator tape over shield, XLPE jacket rated -40 degrees C and FT4 rated.
- .3 Single copper conductor: to ICEA S-93-639/NEMA WC74 size as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install power cable in ducts and manholes as indicated and in accordance with manufacturer's instructions.

- .2 Install power cable in trenches as indicated.
- .3 Provide supports and accessories for installation of high voltage power cable.
- .4 Install stress cones, terminations and splices in accordance with manufacturer's instructions
- .5 Install grounding in accordance with local inspection authority having jurisdiction.
- .6 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 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 Materials and installation for wire and box connectors.

1.2 RELATED SECTIONS

- .1 Section 01 74 19 - Waste Management and Disposal.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .2 CSA C22.2No.65, Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2, 1961 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 sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for copper conductors.
 - .2 Clamp for copper conductors.
 - .3 Clamp for conductors.
 - .4 Stud clamp bolts.
 - .5 Bolts for copper conductors.
 - .6 Bolts for aluminum conductors.
 - .7 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable 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 with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.

- .3 Install fixture type connectors and tighten. Replace insulating cap.
- .4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Refer to Division 27 & 28 for particular Communications, Electronic Safety & Security wiring systems and types.

1.2 TERMS OF REFERENCE

- .1 Typically use insulated 98% conductivity copper conductor wiring enclosed in EMT (steel) conduit for the general wiring systems unless otherwise indicated. Refer to "Site Services" Section for allowable site conduits as an alternative to steel.
- .2 Refer to Equipment Schedule(s) for detailed responsibilities.
- .3 Non-metallic sheathed, AC-90 and Teck cables are not to be used on this project.

1.3 PRODUCT DATA

- .1 Provide product data in accordance with Division 01

PART 2 PRODUCTS

2.1 WIRING & CABLES – GENERAL

- .1 Conductors: stranded for 10 AWG and larger. Minimum size #12 AWG.
- .2 Insulation to be 600 Volt RW90 XLPE (X link) for general wiring in conduit.
- .3 Use RWU90 XLPE for underground installations.
- .4 Site services sub-circuits, including site lighting, to be minimum #10 AWG for power and #12 AWG 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.
- .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.
- .6 TBS75 #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
- .7 Conductors to be colour-coded. Conductors #10 AWG and smaller shall have colour impregnated into insulation. Conductors size #8 AWG 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 shall not be painted.

2.2 WIRE & BOX CONNECTORS

- .1 Pressure type wire connector current carrying parts to be copper and sized to fit conductors used.

- .2 Fixture type splicing connector current carrying parts to be copper sized to fit conductors 10 AWG or less.
- .3 Bushing stud connectors to EEMAC 1Y-2 and suitable for stranded copper conductors
- .4 Clamps or connectors for armoured cable, flexible conduit, as required.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Conductor length for parallel feeders to be identical. Provide permanent plastic nametag indicating load fed.
- .2 Lace or clip groups of feeder conductors at all distribution centres, pullboxes, and termination points.
- .3 Wiring in walls should drop or loop vertically from above to better facilitate future renovations. Wiring from below and horizontal wiring in walls should be avoided.
- .4 All grounding conductors and straps to be copper. All bonding conductors to have green insulation jacket.
- .5 Colour coding to be in accordance with Section 26 05 00 – Common Work Results.
- .6 Provide sleeves where cables enter or exit cast concrete or masonry.
- .7 Power wiring up to and including #6 AWG shall be spliced with nylon-insulated expandable spring-type connectors. Large conductors shall be spliced using split-bolt or other compression type connectors wrapped with cambric tape then PVC tape.
- .8 Wires shall be sized for 2% maximum voltage drop to farthest outlet on a loaded circuit. Increase home run cable size to meet these requirements.
- .9 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, common neutrals not permitted.
- .10 Install all control cables in conduit.
- .11 Provide numbered wire collars for all control wiring. Numbers to correspond to control drawing legend. Obtain wiring diagram for control wiring of other Divisions.

3.2 VOLTAGE REGULATION

- .1 The drawings are diagrammatic and indicate the general routing of conduit runs and not exact routing, either horizontally or vertically.
- .2 Branch circuit conductor sizes shall be #12 AWG or larger based on the Canadian Electrical Code CSA 22.1 Section 8, which allows a maximum 3% voltage drop for branch circuits.

3.3 WIRE & BOX CONNECTORS

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65
 - .2 Install fixture type connectors and tighten. Replace insulating cap.
 - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .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.

2.2 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 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 Provide grounding study sealed by a Professional Engineer of B.C. in good standing to verify grounding system design ensures step and touch potentials in the POD switchgear area including adjacent non-electric metallic structures (fencing, underground piping, lighting standards, anchor, etc.) are within the limits specified by the Canadian Electrical Code.
- .3 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .4 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, and 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, 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 and size of
- .10 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.
- .11 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, including 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 RELATED WORK**

- .1 This Section of the Specification is to be read, coordinated and implemented in conjunction with all other parts of the Contract Documents.

PART 2 PRODUCTS**2.1 SUPPORT CHANNELS**

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted, suspended or set in poured concrete walls and ceilings.

PART 3 EXECUTION**3.1 INSTALLATION**

- .1 Secure equipment to hollow and solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .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 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

- .11 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.
- .12 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 This Section of the Specification is to be read, coordinated and implemented in conjunction with all other parts of the Contract Documents.

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 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.
- .1 Expansion-deflection fittings for metal conduits crossing building expansion or seismic joints.
- .2 Security bridles: Minimum #16 ASWG stranded stainless steel aircraft cable.
- .3 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.
- .1 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.
- .2 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.
 - .3 Resiliently-mounted major equipment such as standby generators, pad mounted high voltage switchgear, 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.
 - .4 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.
 - .5 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).
 - .6 Provide transverse and axial restraints within **4m** of a vertical bend.
 - .7 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.
 - .8 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.
 - .9 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.
 - .10 Provide custom fabricated flexible sections allowing horizontal and vertical movement of cable trays at building expansion or seismic joint.
 - .11 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.

- .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 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 00 – Common Work Results – Electrical.

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, connection bars 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 [1"] minimum extension all around, for flush-mounted pull and junction boxes.

2.3 CABINETS

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle and catch, for surface mountings.
- .2 Type T: sheet steel cabinet, with full length hinged door, latch, lock, 2 keys, containing 19 mm G1S fir plywood backboard for surface or flush mounting as appropriate.
- .3 Include filtered vents and/or fan-cooling when enclosed equipment is heat producing.

2.4 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00.

PART 3 EXECUTION

3.1 SPLITTER INSTALLATION

- .1 Install splitters as indicated 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 spaces.

- .2 Only main junction and pull boxes are indicated. Provide pull boxes so as not to exceed 30 m of conduit run between pull boxes.
- .3 Provide pull boxes and junction boxes in locations shown on the drawings and as required to suit job conditions.
- .4 Locate pull boxes and junction boxes above removable ceilings, in electrical rooms, utility rooms or storage areas.
- .5 Junction boxes, when used, to be installed in areas that are accessible through luminaire openings, and/or access panels.
- .6 Where pull boxes are flush mounted, provide overlapping covers with flush head cover retaining screws, prime coated and painted to match wall or ceiling finish.
- .7 Where cast corrosion resistant boxes are used, covers to be of matching type and gasketed.
- .8 For special (not 100mm [4"] square or octagonal) pull boxes and/or junction boxes, paint identification for the system and provide lamicoïd nametags to box covers with a size 2 nameplate 5mm [0.25"] lettering identifying system.
- .9 Interior of all pull boxes and junction boxes for each system to be spray painted with colour as specified in Section 26 05 00 – Common Work Results – Electrical
- .10 All pull boxes, junction boxes and cabinets to be supported directly from building structure using one or a combination of galvanized screws, galvanized bolts, galvanized rods, and approved box clip.
- .11 Support of pull boxes, junction boxes by conduit fittings or wire is not acceptable.

3.3 CABINETS INSTALLATION

- .1 Mount cabinets with top not higher than 2 m [6'] above finished floor.
- .2 Cabinets shall be flush mounted in finished areas where depth can be accommodated in the walls. Provide flush trim to suit.
- .3 Provide fit up in Type T cabinets as indicated.

3.4 IDENTIFICATION

- .1 Install size 2 identification labels indicating system name, voltage and phase in accordance with Section 26 05 00 – Common Work Results – Electrical

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

PART 2 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES IN GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 10 mm [4"] 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 347V outlet boxes for 347V switching devices.
- .6 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 [3" x 2" x 1.5"] or as indicated. Larger 102 mm square x 54 mm deep [4" x 2"] 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, telephones to be 100 mm square No. 52151 or 52171 with Taylor 8300 series covers.
- .4 Lighting fixture outlets: 102 mm [4"] square outlet boxes (No 52151, 52171 or 72171) or octagonal outlet boxes (No 54151 or 54171).
- .5 103 mm [4"] 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 FLOOR BOXES

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with flanged cover assemblies and faceplate. Device mounting plate to accommodate short or long ear receptacles. Minimum depth: 28 mm [1.1"] for receptacles; 73 mm [2.9"] for communication equipment.

- .2 Cover assemblies to be die-cast aluminum, provide barriers between the power and low voltage sections. A minimum of two (2) gangs for power and two (2) gangs for communications devices.
- .3 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 16 mm [0.5"] and 21 mm [0.75"] conduit. Minimum size: 73 mm [2.9"] deep

2.6 SURFACE CONDUIT BOXES

- .1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

2.7 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 [1.25"]. 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 - Common Work Results – Electrical, 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 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm [0.25"] of opening.
- .5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not to be used.
- .6 All outlet boxes to be flush mounted in all areas, excluding mechanical rooms, electrical rooms, and above removable ceilings.
- .7 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.
- .8 No sectional or handy boxes to be installed.
- .9 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.
- .10 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.
- .11 Outlets installed back to back in party stud walls to be off-set by one stud space.

- .12 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.
- .13 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.
- .14 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 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 SCOPE

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.
- .2 Conceal all conduits where possible in finished areas. Conduits may be surface mounted only where indicated or in service areas accessible only to authorized personnel.
- .3 If a finished area is concrete (existing) or concealment is not practical, obtain ruling from Consultant where exposed wiremold may be substituted.
- .4 Note particular requirements for routing of conduits where detailed.
- .5 Minimum Size of all conduits to be 21mm [3/4"].
- .6 Provide polypropylene pull cord in all "empty" conduits.

PART 2 PRODUCTS

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No.45 Galvanized Steel.
- .2 Epoxy coated conduit: to CSA C22.2 No.45 with zinc coating and corrosion resistant epoxy finish inside and outside.
- .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: to CSA C22.2 No.56 liquid-tight flexible metal conduit.

2.2 CONDUIT FASTENINGS

- .1 One-hole steel straps to secure surface conduits 41mm [1.5"] and smaller. Use two-hole steel straps to conduits larger than 41mm [1.5"].
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .4 10mm [3/8"] threaded rods to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings manufactured for use with conduits specified. Coating same as conduit.
- .2 Provide factory "ells" where 90-degree bends are required for 27mm [1"] and larger conduits.
- .3 EMT couplings and connectors shall be steel, or Regal Die-cast zinc alloy. Couplings used on conduit containing fire-rated cable shall be steel. Regular die-cast alloy fittings and couplings are not acceptable. Provide plastic bushings (insulated throat) for all

connectors unless there is no chance of burrs. Provide water-tight connectors in damp or wet locations and for surface equipment (e.g. Panelboards, MCC's, etc.) in rooms that are fire sprinkler protected.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable linear expansion.
- .2 Water-tight expansion fittings: with integral bonding jumper, suitable for linear expansion and 21mm [3/4"] deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel as required.

2.5 RIGID P.V.C. CONDUIT

- .1 Conduit: rigid non-metallic conduit of unplasticized polyvinyl chloride as manufactured C.G.E. "Sceptre".
- .2 Fittings: threaded male or female solvent weld connectors and solvent weld couplings, as supplied by conduit manufacturer.
- .3 Solvent: as recommended by conduit manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- .1 Generally, use electrical metallic tubing (EMT) in the building interior and in above grade slabs except where subject to mechanical injury or where otherwise indicated.
- .2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. Set out the work and coordinate with other services prior to installation. Maintain access to junction and pull boxes.
- .3 Where practical conceal conduits.
- .4 Any exposed conduit in finished areas to be free of unnecessary labels and trademarks.
- .5 All conduit ends to be reamed to ensure a smooth interior finish that will not damage the insulation of the wiring.
- .6 Ensure grounding continuity in all conduit systems.
- .7 Surface conduits are acceptable in mechanical and electrical service rooms and in unfinished areas or where indicated.
- .8 Use rigid galvanized steel (RGS) threaded conduit where the installation is subject to mechanical injury. In any event, use RGS conduit for surface installations up to 1.5m [5'] above the finished floor.
- .9 Field threads on rigid conduit shall be sufficient length to draw conduits ends together.
- .10 Unless otherwise noted and where practical, all conduits to be routed through the ceiling space rather than in, or below, slabs or floor structures to facilitate future changes.
- .11 Conduits in walls should typically drop (or loop) vertically from above to better facilitate future renovations. Generally, conduits from below and horizontal conduits in walls and concrete structures should be avoided unless indicated.
- .12 All home-run branch circuit conduit and communication/data conduits to be minimum 21 mm [3/4"] diameter unless otherwise indicated.

- .13 Generally use Rigid PVC conduits in or below ground level slab unless otherwise noted. Transition to RGS conduit in exposed locations: eg where conduits emerge from ground level slab.
- .14 Conduits are not permitted in terrazzo or concrete toppings.
- .15 Cap turned up conduits to prevent the entrance of dirt or moisture during construction.
- .16 Locate conduits more than 75mm [3"] parallel to steam or hot water lines with a minimum of 25mm [1"] at crossovers.
- .17 Bend conduits cold, so that conduit at any point is not flattened more than 1/10th of its original diameter. Conduits bent more than this or kinked to be replaced.
- .18 Provide polypropylene pull cord in empty conduits to facilitate pulling wiring in future.
- .19 Where conduits become blocked, the use of corrosive agents is prohibited. Remove and replace blocked section.
- .20 Damaged conduits to be repaired or replaced.
- .21 Dry conduits out thoroughly before installing wiring. Swab out conduit and thoroughly clean internally before wires and cables are pulled.
- .22 Conduits shall not pass through structural members except as indicated.
- .23 Conduit sizes indicated on drawings are minimum only. Increase sizes as required to suit alternative wiring types or to comply with Code.
- .24 Conduits and ducts crossing building expansion joints shall have approved conduit expansion fittings to suit the type of conduit used.
- .25 Seal conduits with approved sealant where conduits are run between heated and unheated areas.
- .26 Seal openings with approved sealant where conduits, cables, or cable trays pierce fire separations.
- .27 Where conduits pass through walls, they shall be grouped and installed through openings. After all conduits are installed, wall openings shall be closed with material compatible with the wall construction and/or to meet any fire separation integrity.
- .28 Where drawings show conduit designations, these conduits shall be identified at each point of termination with Thomas & Betts "Ty-Rap" No. TY532M labels.
- .29 Use "Condulet" fittings for power and telephone type conduit terminations in lieu of standard boxes where box support is not provided.
- .30 Provide necessary roof jacks or flashing where conduits pass through roof or watertight membranes. Apply approved sealant to maintain membrane integrity.
- .31 Use flexible metal conduit for connection to recessed incandescent fixtures without a prewired outlet box and connection to recessed fluorescent fixtures.
- .32 Use liquid tight flexible metal conduit for connection to motors, and other vibrating equipment and transformers.
- .33 Use explosion proof flexible connection for connection to explosion proof motors.
- .34 Install conduit-sealing fittings in hazardous areas, isolation rooms and clean rooms. Fill with compound.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with minimum 1.5m [5'] clearance.
- .3 Conduits to be run in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended and/or surface channels.
- .5 Surface conduits will not be accepted in finished areas unless detailed.

3.3 SPARE CONDUITS

- .1 Provide spare conduits as indicated.
- .2 Provide 4 x 27 mm [1"] spare conduits up to ceiling space and 2 x 27 mm [1"] spare conduits down to ceiling space below from each flush panel tub. Terminate the conduits in 150 x 150 x 100 mm [6" x 6" x 4"] junction boxes in ceiling spaces or in case of an exposed concrete slab, terminate each conduit in a flush concrete box. Provide cover plates for all junction boxes.

3.4 CONDUITS IN CAST IN PLACE CONCRETE

- .1 Locate conduits to suit reinforcing steel. Install in centre third of slab.
- .2 Do not place conduit in concrete slabs in which slab thickness is less than four times conduit diameter. Place conduits larger than this size under the floor or slab. Conduits to have minimum 25 mm concrete cover. Conduits to be completely encased in concrete
- .3 Organize conduit in slabs to minimize crossovers. Obtain approval and minimum concrete cover required from structural engineer prior to installing conduits in slabs.
- .4 Protect conduits from damage where they stub out of concrete.
- .5 Tie down conduit to prevent shifting. All joints are to be made up tight to ensure ground continuity. To prevent concrete entry, seal EMT set screw fittings with tape, pack outlet boxes and cap conduit terminations both in boxes and stub-ups. Apply Polykin #940 tape to the conduit 150 mm [6"] at the point of leaving slab.
- .6 Carefully check and mark out set-backs of conduit(s) to be installed in floor slabs and to be stubbed up to equipment or motors. Verify conduit size and stub-up locations for mechanical and equipment from shop drawings or detail drawings. Brace all stub-ups. Stub-ups shall be RGS.
- .7 Install sleeves in advance of concrete pour where conduits pass through slab or wall.
- .8 Where conduits pass through waterproof membrane provide oversized sleeve before membrane installation. Use cold mastic between sleeve and conduit.

3.5 CONDUITS IN POURED SLABS ON GRADE

- .1 Use Rigid PVC conduit in the gravel or select fill base below concrete slabs. Provide mechanical protection around exposed stub-ups through slab and extend up to 150 mm [6"] beyond concrete. Transition to RGS conduit immediately above the slab.
- .2 In the event that rigid steel conduit is installed in contact with earth it shall be protected by Polykin #940 tape. Extend taping 300 mm above finished grade.
- .3 Conduits 27mm and larger to be run below slab and encased in 75mm concrete envelope. Provide 50mm of sand over concrete envelope below floor slab.

3.6 EXPANSION JOINT CONDUIT FITTINGS

- .1 Provide conduit expansion joint fittings at concrete expansion joint.

3.7 RIGID P.V.C. CONDUIT

- .1 Use in accordance with the Canadian Electrical Code and Building Codes and as noted below:
- .2 Use as raceways for following applications
 - .1 In poured slab on grade concrete floors and walls and for underground runs exterior to the buildings unless otherwise noted.
 - .2 Wiring installed in areas subject to intermittent or continuous moisture but not surface mounted.
 - .3 Rigid PVC conduit shall not be surface mounted or exposed within buildings.
- .3 Do not use in return air plenums or for exit light circuits and emergency lighting.
- .4 Provide insulated ground wire in all rigid PVC conduits in accordance with the Canadian Electrical Code.
- .5 Where rigid PVC conduit is set in poured concrete, solvent joints must be completed and allowed to set as per manufacturer's instructions before pour.
- .6 Bend rigid conduit in strict accordance with manufacturer's directions. Distorted bends will not be accepted.

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 RELATED SECTIONS**

- .1 Section 26 05 00 Common Work Results - Electrical
- .2 Section 26 05 14 Power Cables (1001V – 27kV)

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.
 - .2 Store and protect cables from nicks, scratches, and blemishes.
 - .3 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 There shall be no splices in cables or wiring 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 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 01 91 13 - General Commissioning (CX) Requirements
- .3 Section 26 05 00 - Common Work Results - Electrical

1.2 SCOPE

- .1 Provide demonstration and instruction sessions to familiarize the Departmental Representatives operation and maintenance personnel with electrical systems that have been extended into the new area and their operation and maintenance.

1.3 MANUFACTURER'S SITE SERVICES

- .1 Arrange and pay for appropriately qualified manufacturer's representatives to provide or assist in providing electrical equipment and systems demonstration and instruction seminars for systems specified in this Section.

1.4 DEMONSTRATION AND INSTRUCTION SEMINARS

- .1 Assist the Departmental Representative to present Operator Training Seminar(s) including content specified by Division 01 - General Requirements.

1.5 SYSTEM TESTING, EQUIPMENT DEMONSTRATIONS, AND INSTRUCTIONAL SEMINARS

- .1 Provide demonstration and instruction seminars for the following equipment and systems identified. Include in demonstrations and instruction seminars the information specified for each piece of equipment and system.
- .2 Some systems may require two independent seminars, one for the maintenance staff and one seminar for the user groups. Accommodate split seminars as required.
- .3 Normal Power Distribution:
 - .1 Panelboards:
 - .1 Types and sizes of breakers.
 - .2 Spare capacity.
 - .3 Visual maintenance inspections.
 - .4 Maintenance procedures.
 - .5 Testing requirements and procedures
 - .6 Spare parts.
 - .2 Branch Circuits:
 - .1 Power receptacle system
 - .2 Miscellaneous wiring devices
 - .3 Miscellaneous equipment
 - .4 Heat tracing.
- .4 HV Switchgear:
 - .1 Torquing procedures and values
 - .2 Circuit breaker or disconnect switch operation

- .3 Protective features on breakers
 - .4 Kirk key interlocks
 - .5 Protective relaying - calibration and operation
 - .6 Metering - calibration and operation
 - .7 Safety procedures
 - .8 Troubleshooting procedures
 - .9 Visual maintenance inspections
 - .10 Maintenance procedures
 - .11 Testing requirements and procedures
 - .12 Spare parts.
- .5 Communication and CCTV:
- .1 Communication:
 - .1 Head-end equipment.
 - .2 Patch panel locations.
 - .3 Troubleshooting procedures
 - .4 Maintenance procedures
 - .2 CCTV
 - .1 Head-end equipment.
 - .2 Patch panel locations.
 - .3 Troubleshooting procedures
 - .4 Maintenance procedures
- 1.6 SITE TOURS**
- .1 Provide a series of walkthrough Contractor guided tours of new areas to allow operators to familiarize themselves with the buildings electrical systems.
 - .2 Coordinate timing of tours with the Consultant. Allow for tours at approximately the following times:
 - .1 90% completion stage. Three weeks prior to Interim Acceptance of the work.
 - .2 At Interim Acceptance of the Work

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 Luminaire mounting.
- .2 Capable of switching 1000 W of lighting at 120V.
- .3 Voltage variation: plus or minus 10%.
- .4 Temperature range negative 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. 500 mm long.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install photoelectric controls in accordance with manufacturer's instructions.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 26 05 00 – Common Work Results - Electrical.

1.3 COORDINATION OF PROTECTIVE DEVICES AND SHORT CIRCUIT STUDY

- .1 This contract includes an addition to an existing power system. The coordination documents shall include all existing power devices downstream to this installation.
- .2 Include all associated costs in this Division for the preparation of a complete system study that shall include Protective Coordination, Short Circuit, Ground Fault, and Arc Flash analysis. The base and system short circuit study values, electrical coordination curves, and breaker settings to be based on the Utility and Manufacturers information.
- .3 The arc flash study shall analyze the Flash Boundary Distance and the range of incident energy based on the calculated available fault current range at each device. The arc flash analysis, short circuit and coordination study shall meet the calculation requirements of IEEE Std 1584a, NFPA 70E, ANSI C.37, and IEEE Std. 399.
- .4 The Arc Flash Study, Coordination Study, and Curves to be sealed by a practicing professional engineer P. Eng. registered and in good standing with the Engineers and Geophysicists of British Columbia (EGBC).
- .5 Documentation to include the following:
 - .1 Available symmetrical fault current including Utility and large motor contribution.
 - .2 Symmetrical withstand current rating for bussing.
 - .3 Transformer damage curves and in-rush for the main power transformers and major distribution transformers.
 - .4 Large Motor starting and damage curves.
 - .5 Breaker interrupting capacities including any cascade arrangements.
 - .6 Transfer switch interrupting or withstand capacity as appropriate.
 - .7 Relay information, manufacturer and type, sensor ratings and tap setting, relay pickup and delay settings.
 - .8 Settings for all breakers having adjustable solid-state trips or thermal magnetic trips.
 - .9 Single line of system illustrated on curves. All curves to be justified using upstream and downstream conditions. Provide alternative scenarios where applicable.
 - .10 Submit with the main distribution switchgear and secondary distribution switchboard general arrangement drawings a complete set of coordination curves. Coordination curves to be submitted prior to selection of primary fuses, main and secondary air circuit breaker trip settings and ground fault relay pick-up and time delay settings.

- .11 Coordination curves to include the main primary feeder protective devices in the utility system, the primary fuses in the main switchgear, transformer damage curves, all main and secondary air circuit breakers.
- .12 Coordination curves to be plotted on log-log graph paper and shall be accomplished by individual time current trip curves of each device.
- .6 The review will not eliminate the responsibility of this Division to provide system coordination and protection.
- .7 Circuit protective devices such as overcurrent trips, relays and fuses to be set into the required values and settings. Prior to final review, arrange for the switchgear manufacturer, or the (coordination agency) to visit the site to check all settings to ensure they are in accordance with coordination study values.
- .8 Arc Flash Analysis
 - .1 Perform an arc flash analysis study in conjunction with the previous specified short circuit and protective device coordination study. This arc flash analysis study to be performed in accordance with IEEE Std 1584a.
 - .2 The study shall be calculated by means of a digital computer, using the latest version of applicable software. Pertinent data and the rational employed in developing the calculations shall be incorporated in the introductory remarks of the student.
 - .3 Determine the following for each bus analyzed:
 - .1 Flash Hazard Protection Boundary
 - .2 Available Incident Energy
 - .3 Required Personal Protective Equipment Category
 - .4 Type of Fire Rated Clothing
 - .5 Limited Approach Boundary
 - .6 Restricted Approach Boundary
 - .7 Prohibited Approach Boundary

PART 2 PRODUCTS

2.1 WARNING LABELS

- .1 Produce an Arc Flash Warning label for each piece of electrical equipment with a specific equipment ID. Specifically, the POD Switchgear and immediate downstream SES main and tie breakers, and the SES main bus. Also include the system operating voltage and date of issue. Labels shall be printed in colour on adhesive backed nylon labels.

PART 3 EXECUTION

3.1 ANALYSIS OF SHORT CIRCUIT CALCULATIONS

- .1 Analyze the short circuit calculations, protective device coordination, and arc flash calculations, and highlight any equipment that is determined to be underrated as specified or cause abnormally high incident energy levels. Propose approaches to effectively protect the underrated equipment and to reduce the energy levels. Provide minor modifications to conform with the study (Examples of minor modifications are trip sizes within the same frame, the time curve characteristics of induction relays, CT ranges, etc.). After developing the coordination curves, highlight areas lacking coordination. Present a technical evaluation with a discussion of the logical compromises

for best coordination. Proposed major corrective modifications will be taken under advisement by the Departmental Representative, and the Contractor will be given further instructions.

3.2 ARC FLASH ANALYSIS STUDY

.1 Present the data determined by the Arc Flash Analysis Study in a tabular format summary sheet. Include the following for each bus analyzed:

- .1 Flash Bus Name
- .2 Protective Device Name
- .3 Bus Operating Voltage
- .4 Bus Bolted Fault Current
- .5 Protective Device Bolted Fault Current
- .6 Protective Device Arcing Fault Current
- .7 Trip/Delay Time (Sec)
- .8 Breaker Opening Time (Sec)
- .9 Ground
- .10 Equipment Type
- .11 Gap (mm)
- .12 Arc Flash Boundary (in)
- .13 Working Distance (in)
- .14 Incident Energy (cal/cm²)
- .15 Required Protective FR Clothing Category

3.3 FINAL WRITTEN REPORT

- .1 The results of the power system study shall be summarized in a final written report. The report shall include the following sections:
- .1 Introduction, executive summary, recommendations, and assumptions
 - .2 Electrical One-Line(s) with previously identified specific data values
 - .3 Tabulations of equipment ratings versus calculated short circuit values and X/R ratios, arc flash values
 - .4 Protective device time versus coordination curves, tabulations of relay and circuit breaker trip settings and fuse selection with commentary
 - .5 Engineering analysis, commentary, and recommendations
 - .6 The report is to be stamped by a professional engineer.
 - .7 Submit a digital (soft) copy with the Final Report of all computer files used during the arc flash study to use as reference for future Arc Flash Studies.

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)
- .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

1.2 GENERAL REQUIREMENTS

- .1 The EGD POD Switchgear:
 - .1 Shall be approved for operational use by B.C. Hydro;
 - .2 Shall be installed and commissioned by September 19, 2019;
 - .3 Shall be energized for operational use by December 15, 2019.
- .2 The EGD POD Switchgear procurement process shall be as follows:
 - .1 Shop drawings submitted for approval within 3 weeks of contract award;
 - .2 Shop drawings approved by B.C. Hydro within 2 weeks after submission;
 - .3 Procurement immediately after approval;
 - .4 Delivery, installation, and commissioning by September 19, 2019.
- .3 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.
- .4 Fully coordinate the design, manufacturing, and commissioning of the switchgear and the existing computerized monitoring (SCADA) system. Provide detailed design of switchgear control and protection system.
- .5 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.
- .6 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 12.5 kV utility operating voltages. Each graph shall also include 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.

- .7 Provide a complete and fully integrated high voltage switchgear system mounted on the point of delivery vault as per the contract drawings:
 - .1 25kV Service Entrance rated metal clad switchgear, designed to meet BCH requirements for Dead Front Terminations – advisory No. 2015-030 R1
 - .2 25kV Vacuum Fault Interrupter (VFI) Vault-Mounted Switchgear (27 kV, 125 kV BIL)
 - .3 Envirotemp E200 Fluid (Environmentally Friendly)
 - .4 900 Amp Copper Deadbreak Bushings (as per BCH's Standards)
 - .5 25 kV/12.5 kV CTs (initial use at 12.5 kV supply)
 - .1 CTs for protective relays to protective accuracy class.
 - .6 All protective relays and related wiring.
 - .7 All BCH revenue metering and related wiring.
 - .1 25 kV/12.5 kV CTs (initial use at 12.5 kV supply)
 - .1 CTs for protective relays to protective accuracy class.
 - .2 CTs for BCH metering to revenue measurement accuracy class.
 - .2 25 kV/12.5 kV PTs (initial use at 12.5 kV supply)
 - .1 PTs for BCH metering to revenue measurement accuracy class
 - .8 Lightning/surge arresters for use at initial 12.5 kV supply voltage installed, arresters for use at future 25 kV provided as spares. Switchgear must accommodate size of future 25 kV arresters.
 - .9 Live line indicators, lamacoid labels, ground bus with ground balls and isolated neutral bus.

1.3 APPLICATION

- .1 The switchgear will be installed outdoors at the main service entrance to EGD. 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 14.4/25 kV, 3-phase 4-wire, 60 Hz, solidly grounded neutral.
 - .2 Commissioned at 7.2/12.5 kV, 3-phase 4-wire, 60 Hz, solidly grounded neutral.
 - .3 Maximum symmetrical interrupting: 12.5 kA
- .3 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 BC Hydro Primary Guide.
- .7 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 $V_p = v \cdot I \cdot S_p \cdot W_p$ where V_p 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 $S_p = C_p A_r A_x$ in accordance with Code Clause 4.1.9.1 (17) and Table 4.1.9.E. Minimum S_p 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 W_p = 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 Consultant 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 Consultant for review.
 - .9 Other standards as specified in individual Specification items.
- .8 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.
- .9 Equipment shall be built in accordance with "B.C. Hydro Requirements for Customer's Primary Substations Supplied at 15 kV and 25 kV."

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 3 Phase Vacuum Fault Interrupter
 - .3 Busbar.
 - .4 Envirotemp E200 Fluid (Environmentally Friendly)
 - .5 Supply Authority Metering
 - .6 Infrared Viewing Windows.
 - .7 Visible Break - 3 Position (Open/Close/Ground) Visible Break Window
 - .8 Grounding Studs with insulating boots.
 - .9 Distribution class arresters. Make provisions for 12.5 kV arresters to be replaced in the future with 25kV arresters.
 - .10 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 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 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 in service 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 Metering and Metering Compartment to BC Metering Guide 4 – 35kV.
- .3 Steel for cubicles: to CSA G40.21.
- .4 Insulators: to CSA C22.2 No.58

2.2 CONFIGURATION

- .1 Provide 25 kV rated switchgear assemblies for POD Service Entrance Switchgear, configured as shown on the Drawings and generally as follows:
 - .1 Service Entrance rated, designed to meet BCH requirements for Dead Front Terminations – advisory No. 2015-030 R1

- .2 Dead-front service entrance cubicles with incoming cable terminal pads, cable support clamps.
 - .1 900 Amp Copper Deadbreak Bushings (as per BCH's Standards)
 - .3 Switch Mounting; Operation Style Front Mount, Front Operated
 - .4 VFI control compartment
 - .1 Electronic Trip Control
 - .1 Tri-phase control (50/51 phase)
 - .2 Ground trip (50/51 ground)
 - .2 Phase Time Current Curve – TCC:
 - .1 EF Curve – Phase
 - .2 EF Curve - Ground
 - .5 VFI and isolation switch compartment
 - .1 One three position 400 amp under oil switch interlocked with a Vacuum Fault interrupter complete with phase and ground overcurrent protection, service entrance rated by CSA and BCH.
 - .2 Visible Break 3 Position (Open/Close/Ground) Visible Break Window on All Tap Ways, c/w padlock provisions to prevent inadvertent operation by the Departmental Representative to the grounded position.
 - .3 Viewing Window, Operation Handle, Control Box on Source Bushing Side of unit
 - .4 Cabinet to Cover Visible Break Window & Operating Handle Sized to accommodate phase and ground overcurrent protection.
 - .6 Surge Arrestors
 - .7 BCH metering Compartment
 - .1 PTs for protection and metering.
 - .2 CTs for protection and metering.
 - .3 Key Interlocks
 - .4 BCH Revenue Meter on outdoor meter base.
 - .8 Outgoing cable cubicle, cable termination, cable support blocks, and grounding ball access (with a hot-stick).
 - .9 All steelwork.
 - .10 Integral heater.
 - .11 Neutral Bus.
 - .12 Ground Bus.
- .2 Accessories:
 - .1 Provide accessory equipment as recommended by the manufacturer for the equipment provided.

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: 14.4/25 kV, 3-phase, 4-wire
 - Voltage, maximum design:.....27.6 kV rms
 - Insulation level, low frequency withstand: 25 kV rms
 - Insulation level, BIL, impulse: 125 kV crest
 - Rated voltage range factor:..... 1.30
 - Amperage, main bus, continuous: 600 A, 60 Hz
 - Rated short circuit current at rated max. kV: 12.5 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 VFI 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, pad-mounted, dead front, outdoor tamper-proof, non-walk-in CSA Enclosure NEMA 3R cubicle unit with drip hood extending out from top front of switchboards, 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 VFI compartment, incoming cables, and VFI controls, Metering Compartment, outgoing cable compartment. Size: as indicated.
- .3 Enclosures shall incorporate the following wiring features:
 - .1 Bottom entry of HV cables.
 - .2 Bottom entry of protection, control, wiring
 - .3 Metering wiring in rigid steel conduit through the enclosure to accept a minimum of one 35 mm conduits for each metering cubicle.
 - .4 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 Use non-corrosive bolts and hardware.
- .6 Access from front, sides and rear.
- .7 100 mm steel channel sills for base mounting.
- .8 Full height outer doors, gasketed, 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.
- .9 Hinge doors on same side.
- .10 Gaskets on removable covers.
- .11 Inner door: hinged and bolted mesh steel screens to prevent inadvertent contact with exposed live parts, to open at least 90 degrees.
- .12 Metal pocket with weatherproof envelope and 1 set of drawings and diagram prints on inside surface of door.
- .13 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.

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 Brace busbar system including ground bus to withstand stresses resulting from short circuit currents specified.
- .5 Tin surfaced joints, secured with non-corrosive bolts and washers, tightened with torque wrench in accordance with manufacturer's recommendations.
- .6 Identify phases of busbars by suitable marking.
- .7 Include full capacity neutral as indicated.
- .8 Maximum symmetrical interrupting: 12.5 kA.

2.6 GROUNDING

- .1 Copper ground bus not smaller than 50 mm x 6 mm 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.
- .6 Grounding connectors must be CSA and IEEE 837 station class approved.

2.7 VACUUM FAULT INTERRUPTERS

- .1 The switchgear shall incorporate a vacuum fault interrupter for overcurrent protection.
 - .1 The device shall interrupt all fault currents up to its maximum rated current of 12,500 RMS amperes symmetrical.
 - .2 The interrupter shall be manually resettable, with no consumable parts (i.e. fuses).
 - .3 The maximum interrupting time from issuance of a trip signal from the electronic control shall be 2 cycles.
 - .4 To maximize safety to the operator, the interrupter shall incorporate a trip-free mechanism to prevent the possibility of holding the interrupter mechanism closed under a faulted circuit condition.
- .2 The vacuum fault interrupter shall act as a three-phase gang operated circuit breaker. The trip mechanisms for each phase shall be mechanically linked and the electronic control shall be set so that an overcurrent condition on any one phase shall simultaneously trip all three phases.
 - .1 A single operating handle shall be provided for manual opening, reset, and closing.
 - .2 The operating handle(s) shall be mounted on the front plate of the tank in close relation to the VFI being controlled and shall have three distinct operating positions corresponding to the vacuum fault interrupter positions of closed, open, or tripped.
 - .3 A pointer attached to the handle shall be provided for ready identification of the handle's position. The handle shall be designed for operation with a lineman's hotstick and have a push to close / pull to open / pull to reset operation requiring

no more than 75 lbs. of force and 60 degrees of movement for complete operation.

- .4 Operating handle shall be 90 degrees of the switch.

2.8 SURGE ARRESTERS

.1 25 kV Arrester Characteristics

- .1 Surge Arrester in Transition Section of POD Switchgear, shipped loose for future installation.
 - .1 Metal Oxide Surge Arrester to ANSI/IEEE C62.11.
 - .2 System highest voltage line to line: 15 kV.
 - .3 Metal oxide varistor in series with non-linear resistance graded gap structure. 25 kV Class
 - .4 Three elbow style 15.3 kV MCOV lightning arresters.
 - .5 Duty Cycle Voltage rating: 12.5 kV.

.2 12.5 kV Arrester Characteristics

- .1 Surge Arrester installed in Service Entrance Substation.
 - .1 Distribution class arrester.
 - .2 System highest voltage line to line: 15 kV.
 - .3 MCOV (maximum continuous operating voltage): 15 kV.
 - .4 Three elbow style 7.65 kV MCOV lightning arresters.
 - .5 Indoor type. Radio influence voltage: maximum at 250 microVolts x MCOV.

2.9 ELECTRONIC TRIP CONTROL

- .1 Overcurrent sensing shall be accomplished with an electronic trip.
- .2 The control shall use internally mounted 1000:1 bushing current transformers (CTs) to sense line current and shall also provide the control operating power, eliminating the effects of system voltage conditions. The control shall be self-contained and includes the following:
 - .1 Meet the specified time-current curve immediately upon energization.
 - .2 No "warm-up", initialization, or arming time delays adjustments shall be necessary.
 - .3 No minimum load requirement or battery back-up device shall be necessary to meet the specified time-current characteristics.
 - .4 The control shall have a minimum operating temperature range of -30 °C to +65 °C with no more than a ±5% variation in time-current response characteristics from its response at +25 °C.
 - .5 The standard control shall provide minimum phase overcurrent trip settings that are field selectable, in 10 Amp increments, from 20 Amps to 1290 Amps. Trip settings may be changed while the transformer is energized so service is not interrupted. An instantaneous trip feature shall be provided as a standard feature of the control. Instantaneous trip shall be a field selectable multiple of 1X, 3X, 5X....15X times the phase overcurrent trip settings or it may be selected to be disabled. The instantaneous trip feature shall provide a fixed 0.025-second response time characteristic.
- .3 A single time-current curve shall be provided that is common to all three phases. Time-current trip curves shall be changeable via plug-in TCC modules. The time-current curve

provided shall be equal to Type EF fuse and shall emulate the time-current characteristics of its associated fuse type.

- .4 The control and its enclosure shall be mounted in an enclosure on the outside of switchgear in proximity to the VFI tap compartment. The control enclosures shall be stainless steel and vented in design to prevent trapping of moisture within the control.
- .5 TPG Ground Trip Element: The minimum trip selection for each phase element and for ground element shall be independently settable. Minimum ground trip settings shall be selectable from 10 to 640 amps, in 10 Amp increments. A separate instantaneous trip feature shall be provided for ground as a standard feature that shall provide a selection of 1X, 3X, 5X....15X the ground minimum trip setting for the instantaneous trip pick-up or it may be disabled. The instantaneous trip feature shall provide a fixed 0.025-second response time characteristic.
 - .1 The overcurrent trip response time for ground trip shall be governed by a separate time-current curve plug-in module.
 - .2 The ground trip sensing portion of the control shall be capable of being de-activated via a ground trip block switch.

2.10 VISIBLE BREAK WINDOW

- .1 The contacts of the visible break switch will be clearly visible through a 103 mm x 280 mm view window manufactured of a clear material with a high impact strength rating.

2.11 HIGH VOLTAGE BUSHINGS

- .1 Bushings shall be deadfront type for use with bolted elbow connectors conforming to IEEE Std 386™-2006 standard and ANSI Standard C119.2. The main incoming shall have a continuous current rating of 900 ampere Copper deadbreak Bushings (as per BCH's Standards).

2.12 INSULATING LIQUID

- .1 Insulating liquid: Environmentally friendly dielectric liquid shall be Envirotemp E200 Fluid.

2.13 DIGITAL METERING

- .1 Fully integrate digital metering into existing downstream switchgear assembly in the SES, 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 which it measures.

2.14 BC HYDRO REVENUE METERING CELL

- .1 Metering cell built to and conform to BC Hydro requirements set in the latest edition of BC Hydro "Requirements for Complex Revenue Metering" and CSA C22.2 NO.31.

2.15 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.

2.16 LOCKOUT PROVISIONS

- .1 Provide cabinets with integral lock out means where possible. Reduce the need for separate lock out devices as much as possible.

2.17 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results- Electrical.
- .2 Cubicle exteriors: Grey ANSI #61
- .3 Cubicle interiors: Grey ANSI #61.
- .4 Supply 2 spray cans touch up paint.

2.18 MIMIC DIAGRAMS

- .1 Provide a mimic diagram on the front face of each 25 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.

2.19 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.

2.20 WARNING SIGNS

- .1 Include warning signs in accordance with Section 26 05 00 - Common Work Results - Electrical.

2.21 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.

2.22 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.

2.23 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.

2.24 MANUFACTURERS

- .1 Acceptable manufacturers:
 - .1 Eaton Cooper Power Systems
 - .2 Schneider Electric
 - .3 Prime Engineering

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 switchgear assembly 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 system ground.
- .4 Render entire assembly rodent and insect proof by means of plates, screens and grouting.
- .5 Check factory made connections for mechanical security and electrical continuity.
- .6 Check VFI and TTC settings against shop drawings.

3.3 FIELD QUALITY CONTROL

- .1 Switchgear shall be commissioned by a trained and certified field technician, from the equipment manufacturer to travel to site, shall as per contract specifications and NETA standards.
- .2 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .3 As per specifications and NETA standards, provide start up commissioning services on the high voltage switch and associated ground fault overcurrent relays.

- .4 Provide a system coordination study from the largest downstream device to the utility fusing.
 - .1 Coordination graphs will be included, showing phase overcurrent and ground fault protection for primary devices, main transformer, secondary breaker, and switchgear through the largest breakers.
 - .2 Graphs will be submitted on time versus current log graph paper, and the study will be done by a professional engineer registered in BC.
- .5 BCH Primary connection forms for connection to the utility sign and sealed by a professional engineer registered in BC.
- .6 Provide step and touch ground report to be signed and sealed by a professional engineer registered in BC. The following data will be used in a digital program to determine, under worst case conditions, whether initial at 12.5 kV or with future voltage at 25 kV, what the step and touch voltages are, and in a complete report, their adherence to CEC Table 52, and IEEE standard 80.
 - .1 Provide site soil ground resistivity measurements by the Wenner method,
 - .2 Provide system ground resistance measurements by the fall of potential method.
- .7 Operate VFI circuit breaker closing and tripping mechanisms, to verify correct functioning.
- .8 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.
- .9 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.
- .10 Check phase rotation, phasing and sequence of each feeder.
- .11 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.
- .12 Check fuses for correct type and rating.
- .13 Check for grounding and neutral continuity between station ground and system neutral.
- .14 Check alignment of circuit breakers within cubicles to assure proper connections. Adjust as required.
- .15 Set protective relays to their required settings. Perform secondary current injection tests to confirm relay operation. Record test results.
- .16 Have third party commissioning agency commission final installation and certify proper operation and installation.
- .17 Upon completion of all testing and when all systems are ready for use, submit a complete report of all testing results for review.
- .18 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 interlocks systems included for primary switchgear assembly.

1.3 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.

PART 2 PRODUCTS

2.1 INTERLOCK SYSTEMS

- .1 Kirk key interlocks, Type F for load interrupter switch and Type D for all HV switchgear cubicle doors. 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 switchgear enclosures without isolation and de-energization of upstream supply.

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.
- .2 Visually inspect substrate in presence of Departmental Representative.

- .3 Inform Departmental Representative of unacceptable conditions immediately upon discovery. 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.

3.3 PROTECTION

- .1 Protect installed products and components from damage during construction.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 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 proposed 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.

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 Separate monitoring channels per feeder, each with independent alarm, trip and time delay settings and shunt trip contact for each channel.
 - .3 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.
 - .4 RS485 or similar serial interface between all ground fault modules to allow for alarm interactions, delays and priority tripping control.
 - .5 MODbus TCP interface to SCADA system for fault indication, alarm status and real-time indication for all channels.
 - .6 Push button for testing each channel with simulated ground fault current.
 - .7 Reset button for contacts and target.
 - .8 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 where noted in single line drawings.
 - .2 Provide all required pulse measurement or similar equipment as required for correct sensing, alarming and operation of ground fault protection equipment for resistance grounded systems.
 - .3 System to constantly scan and monitor ground leakage currents and alarm and/or trip based on magnitude, time delay and priority.
 - .4 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.

2.3 ENCLOSURE

- .1 Integral to Panelboards and/or Distribution Centres.

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 ground fault detection 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.

END OF SECTION

PART 1 GENERAL

1.1 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).

1.2 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 26 05 00.
- .2 Include time-current characteristic curves for breakers with ampacity of 100A and over.

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 10 kA 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 on 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 breakers 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 where mounted in any of the main 208V, 480V, 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 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 RELATED WORK

- .1 Section 26 13 18 – Primary Switchgear Assembly to 27kV.

1.2 ACTION AND INFORMATION 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 INCOMING ELECTRICAL SERVICES

- .1 The microprocessor-based relay shall provide protection, monitoring, control, fault locating, and automation. Relay self-checking functions shall be included.
- .2 Schweitzer Engineering Laboratories

2.2 INCOMING ELECTRICAL SERVICE, FEEDER, AND TRANSFORMER DIFFERENTIAL PROTECTION

- .1 The microprocessor-based relay shall provide protection, monitoring, control, fault locating, and automation. Relay self-checking functions shall be included. Specific requirements are as follows:
- .2 Protection Control:
 - .1 Differential Protection: Six low-impedance current differential elements.
 - .2 Directional Element: Phase-comparator directional elements for each zone
 - .3 Phase-Sequence or Phase-Balance Voltage Relay (47) for supply feeder.

- .4 Phase, residual, and negative-sequence overcurrent elements (50P/50G/50Q) with optional directional control.
- .5 Phase, residual, and negative-sequence inverse time-overcurrent elements (51P/51G/51Q) with optional directional control.
- .6 Neutral overcurrent and inverse time-overcurrent elements (50N, 51N)
- .7 Breaker/contactors failure
- .8 Auto-reclosing control (79)
- .9 Arc-flash detection and arc-flash overcurrent (50PAF, 50NAF)
- .10 Over- and undervoltage (59, 59G, 59Q, 27)
- .11 Directional power elements (32)
- .12 Power factor (55)
- .13 Over- and underfrequency (81)
- .14 Rate-of-change of frequency (81R)
- .15 Loss-of-potential (60)
- .16 Synchronism check (25)
- .17 Transformer Thermal Relay (49)
- .18 AC Directional Overcurrent Relay (67)
- .19 Time Delay Starting or Closing Relay (2)
- .20 Time-Delay Stopping or Opening Relay (62)
- .21 Differential Protective Relay (87)
- .22 Fast rate-of-change of frequency (81RF) for Aurora mitigation
- .23 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.
- .24 Fault locator: The relay shall include a fault locating algorithm to calculate fault location without communications channels, special instrument transformers, or pre-fault information.
- .25 Synchrophasors: The relay shall include operation as a phasor measurement unit (PMU) following the IEEE C37.118-2005 Standard for Synchrophasors for Power Systems.
- .26 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.
- .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 Open/Close digital Status output
 - .3 Draw out status
 - .4 Overcurrent trip output
 - .5 Ground fault trip output
 - .6 Analog outputs for phase current and voltage (A, B, and C)
 - .7 Motor racking 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.
- .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 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 non-volatile, Flash memory
 - .7 Station battery monitor with two levels of detection
 - .8 Breaker wear monitoring
 - .9 Event report with arc-flash light input
 - .10 High-impedance fault event reports

2.3 BUS DIFFERENTIAL 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 Check Zone: Three dedicated check zones. Each check zone will have its own adaptive differential element and settings.
 - .4 Analog Inputs: 21 current and 3 voltage inputs.
 - .5 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.

- .6 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.
- .7 Current Transformer Alarm: The relay shall include an element in each zone to detect CT open or short-circuit conditions.
- .8 Digital Inputs: As indicated on the drawings.
- .9 Outputs: As indicated on the drawings.
- .10 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.
- .11 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.
- .12 Voltage Elements: Three phase over- and undervoltage elements as well as negative- and zero-sequence overvoltage elements.
- .13 End-Zone Protection: Provide protection for a fault between the open circuit breaker and the CT.
- .14 External Faults: Detection of an external fault and enter 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 Systems SCADA.
 - .2 Minimum 1 spare digital and 1 spare analog outputs.
 - .3 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.

2.4 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 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.

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 system 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.

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 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 26 09 23.02 - Power Systems SCADA (PSS)

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.

PART 2 PRODUCTS

2.1 DIGITAL POWER METERS

- .1 Current/Voltage Inputs
 - .1 Have no less than 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 ($\pm 10\%$)@ 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, ~-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 kV^Rh, Apparent kVAh) (Signed/Absolute)
 - .4 Reactive Energy by Quadrant

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):

 - .5 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.
 - .6 Trigonometric functions: COS, SIN, TAN, ARCCOS, ARCSIN, ARCTAN, LN, LOG10
 - .7 Logic functions: =,=>,<=,<>,<,>, AND, OR, NOT, IF
 - .8 Thermocouple linearization functions: Type J, Type K, Type R, Type RTD, Type T

- .9 Temperature conversion functions: C to F, F to C
- .5 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.
- .6 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.
- .7 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.
- .8 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 or 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% 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.
- .9 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.
- .10 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 Modem
 - .4 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 Mod bus
 - .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. Email messages sent by the PMS instruments can be received like any ordinary email 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:
 - .1 At least 1 Mb of storage for fault capture files
 - .2 The files shall be downloadable via standard ftp client
 - .3 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 LLNO and LPHD (mandatory):
 - .1 MHAI – Harmonics
 - .2 MMTR – Metering
 - .3 MMXU – Measurement
 - .4 MSQI - Sequence and imbalance
 - .5 MSTA - Metering Statistics
 - .6 GGIO - The ability to view data from and control all I/O points in the meter.
 - .7 RDRE - Disturbance recorder function
- .11 I/O Options
 - .1 Digital Meter shall be capable of having 16 digital inputs capable of % 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.
- .12 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, phaser 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 Departmental Representative, 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, THO (total, even, odd); current harmonics histogram screens display K Factor and Crest Factor.
 - .6 Phaser: Display phase information in phaser diagram format, including phase, voltage and current magnitudes; phasers that are too small in magnitude are shown as table entries only.
- .13 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.
- .14 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.
- .15 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.
- .16 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.
- .17 **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.

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 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.
 - .7 Provide power supply fusing protecting each meter independently. Fuses shall be mounted in flipopen style fuse holder that will also provide isolation means for Digital Meter. Fuse holders shall be rated for disconnecting meter power supply under load.
 - .8 When Digital Meters use 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.
 - .9 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.
 - .10 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 signaling.

PROJECT # R.090408.001
ESQUIMALT GRAVING DOCK (EGD)
REPLACE MAIN DISTRIBUTION LINE (RMDL)
BC HYDRO POINT OF DELIVERY (POD) SWITCHGEAR
825 Admirals Road, Victoria, B.C.

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END OF SECTION

PART 1 GENERAL

1.1 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.

1.2 ACTION AND INFORMATION 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 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.

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 SCADA systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.4 SCOPE OF WORK

- .1 The scope of work for this project includes new equipment and modifications to the existing SCADA system and includes but is not limited to the following:

- .1 Installation, configuration, integration and programming of all new devices indicated in these documents.
 - .2 Modifications to existing SCADA programming, HMI screens, control logic, trending and alarming to support to control schemes noted in these documents including: load shed/restore, remote operations, trending, recording, automated usage summaries, etc .
 - .3 Removal, decommissioning and associated modifications to the SCADA system for devices noted to be removed in these documents.
- .2 This SCADA system is customized and one of a kind. Extensive custom programming, frameworks, logic and integration has been performed. Any assumptions regarding the level of integration, programming, or programming in place to support future implementation is at the risk of this contractor. Where modifications to existing logical functions is indicated (load shed/restore, for example) the contractor shall assume that they will be responsible for all programming of this function to the level of operations noted in these documents. Any claims for additional costs based on assumptions of the existing SCADA or metering programming will be dismissed.

1.5 QUALIFICATIONS

- .1 The SCADA programmer/integrator shall be fully versed in the programming, maintenance, deployment and operation of the Schneider Powerlogic SCADA system in operation at EGD. The existing system uses StruxureWare Power SCADA Expert and Power Monitoring Expert. **Only contractors/integrators who are accredited under the Schneider Electric system integrator program and registered under the "Power Solution EcoXpert Label" shall be permitted to work on this SCADA system.** No alternative arrangements will be accepted regarding this qualification.

PART 2 PRODUCTS

2.1 GENERAL SYSTEM DESCRIPTION

- .1 The Power System SCADA (PSS) will be a complete removal of the existing hardware and software of the system currently installed. 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 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.
- .7 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 components, 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 devices.
- .8 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. 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.
 - .4 The PSS will be largely Ethernet based, using direct copper Cat 6 STP (shielded twisted pair) cabling to new devices. New optical fiber cabling will be used to tie into existing equipment on the site.
 - .5 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 IO Support real-time data display and control actions for multiple users for applications such as sub-metering, load monitoring / shedding, real-time pricing.
- .11 Expansion of system through distributed IO servers.

2.3 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
 - .2 The Data Log Retrieval Time from any device shall be less than one minute.
- .3 Software Components
 - .1 General
 - .2 Software shall expand on existing Powerlogic SCADA and datalogging software, including all required licensing and drivers required.
- 2.4 PSS SYSTEM – HARDWARE**
 - .1 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.
- 2.5 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 realtime 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 NL. 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 demolishing existing digital metering, networking or equipment. All transitions or phased cutovers to existing equipment must be approved by the Departmental Representative 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 Departmental Representative, 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 Departmental Representative in the current operational state that it was in, prior to removal. Any equipment determined to be surplus, as decided by the Departmental Representative, shall be disposed of by this contractor.

- .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 converters will not be accepted.
 - .4 All PSS communications equipment shall be grouped together and mounted in the Communications room 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.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results – 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 provided 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 WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCES

- .1 CAN/CSA C22.1-18, Canadian Electrical Code, Part I.
- .2 CAN/CSA C22.2 No. 9.0, General Requirements for Luminaires.
- .3 IESNA Illuminating Engineering Society of North America - Lighting Handbook - 10th Edition
- .4 ASHRAE 90.1-10 – American Society of Heating, Refrigerating and Air-Conditioning Engineers.

1.3 ADDITION OF ACCEPTABLE MANUFACTURERS

- .1 Refer to Section 26 05 00 and as noted below.
- .2 Material/products considered to satisfy the specification, but of a manufacturer other than those named may be submitted to the Consultant for consideration not later than five (5) working days prior to closing of tender or of bid depository subtrade tender whichever is earlier.
- .3 Alternate approvals will be given by written addendum only. No other substitution will be permitted after closing of tenders.
- .4 Alternate approvals granted before the closing of tenders will be limited to a manufacturer's system and/or series only. This limited approval will not preclude substitute equipment/material from complying with specific features included with equipment/material specified. Determine that the alternate product meets the specification intent before basing a tender on the product

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 00.
- .2 Submit complete photometric and heat dissipation data prepared by independent testing laboratory for proposed luminaires.

1.5 INTENT

- .1 Provide lighting fixtures and accessories for all equipment 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 Bond all lighting equipment to grounding system.
- .4 Fixtures of the same or similar type shall be supplied by the same manufacturer.
- .5 Electrical contractor shall supply and install all luminaries complete with lamps, mounting brackets, lenses, ballasts (dimming or otherwise), drivers and all necessary accessories in accordance with luminaire types shown on drawings and listed in luminaries' schedule unless otherwise noted.

- .6 Supply and install complete and proper support and hangers for all luminaires on posts where required for proper support of outlet boxes and luminaire hanger assemblies.

PART 2 PRODUCTS

2.1 LED DRIVERS

- .1 LED drivers shall be fully dimmable, Energy Star compliant, maximum THD of 20%, power factor to be greater than .95, have high voltage regulation and have internal surge protection.
- .2 LED lit luminaires shall meet the LM-79 and LM-80 test protocols (70% output at 50,000 hours), a minimum efficacy of 40 watts per lumen and shall meet or exceed ENERGY STAR SSL standards to ensure lumen and color consistency between luminaires.

2.2 WIRE GUARDS

- .1 All fixtures shall have wire guards.

2.3 FIXTURES

- .1 Provide fixtures as indicated on the drawings.
- .2 All fixtures shall comply with CSA Standard C22.2 No.9. Accessories and components shall comply with relevant CSA Standards applicable to accessory or components.
- .3 All fixture diffusers, lens panels, lens frames, etc., shall be securely and adequately supported and shall be removable without the use of tools for cleaning.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- .1 Lighting fixtures shall be installed as indicated on Electrical Drawings and per approved shop drawings.
- .2 Verify locations of lighting fixtures and notify Consultant of any variance or conflict between the plans and field conditions. Do not proceed until conflict has been resolved.
- .3 Work shall be coordinated with other trades.
- .4 All fixtures shall be supported by corner fenceposts. Provide all necessary hardware to ensure that fixtures hang true.
- .5 Lighting fixtures shall be adequately supported and braced to satisfy seismic codes. Refer to Section 26 05 30 Seismic Restraints.
- .6 Mount fixtures at elevations shown on Electrical Drawings.

3.2 INSTALLATION AND SUPPORTS

- .1 Provide complete and proper support for all fixtures, fixture hangers, outlet boxes etc.
- .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.

- .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 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.
- .5 Provide and install all conduit, boxes, wire and make emergency power connection to all units and to unit controllers. Obtain all specialty backboxes, switches, controllers, etc. from contractor and coordinate installation as required.

3.3 LIGHTING CONTROL

- .1 All lighting in the scope of this project shall be controlled with a "HAND-OFF-AUTO" (H-O-A) switch with the following control scheme:
 - .1 HAND: All fixtures in an "ON" state.
 - .2 OFF: All fixtures in an "OFF" state.
 - .3 AUTO: All fixtures controlled by a photocell.
 - .1 Photocell shall be installed locally in a northern facing direction. If installation in a northern direction is impossible, contractor to install in a western or eastern facing direction.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 REFERENCES

- .1 Canadian Electrical Code (CEC)
- .2 BICSI Telecommunications Distribution Methods Manual (TDMM), latest edition
- .3 ANSI/TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises
- .4 ANSI/TIA-568-C.1 Commercial Building Telecommunications Cabling Standard
- .5 ANSI/TIA -568-C.2 Balanced Twisted Pair Telecommunications Cabling & Components Standard
- .6 ANSI/TIA-568-C.3 Optical Fibre Cabling Components Standard
- .7 TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces
- .8 ANSI/TIA -606-A Administration Standard for Commercial Telecommunications Infrastructure.
- .9 ANSI/TIA-607-B Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

1.3 GENERAL REQUIREMENTS

- .1 System to be complete with all necessary components to provide functions required if each and every item is necessarily mentioned. System to be supplied and installed by an RCDD with an established communications contracting firm certified by the Manufacturer.
- .2 Provide fibre and copper cabling as indicated on drawings. All wiring and cabling to be installed in conduit and tray system unless otherwise specified.
- .3 All conduit, pullboxes, junction boxes and terminal panels are to be installed to provide a complete conduit system for the Structured Cabling System. All communication/data conduits to be minimum 27 mm diameter. Horizontal pathway conduits may have no more than two 90-degree bends and are may be no longer than 30.5m in distance without a pullbox.
- .4 The system, when complete, must be free of all interference from cross-talk, hum, switch and relay noise, etc.
- .5 Personnel installing communications cabling shall be trained and conversant with communications cabling practices required for this project. Proof of certification must be provided prior to commencement of work.
- .6 The system shall be certified, by a contractor designated and trained by the manufacturer of being capable to do so and shall provide written confirmation of this fact.

1.4 SYSTEM DESCRIPTION

- .1 A complete structured telecommunications wiring system consist of unshielded-twisted-pair horizontal cabling, copper and fibre backbone cabling, terminations, connectors, racks, patch panels, communication bonding system, cross-connection hardware and related equipment installed inside building for occupant's telecommunications systems, including voice (telephone), data, and image.
- .2 This Contract includes provision of a complete structured wiring system, including but not necessarily limited to:
 - .1 Fibre and Copper Backbone Cabling
 - .2 Communication Racks
 - .3 IDC Terminal Blocks
 - .4 Horizontal wiring to communications outlets.
 - .5 Outlets at all locations shown.
 - .6 Rack-mounted patch panels
 - .7 System labelling
 - .8 Testing of all communication cabling links
 - .9 Communication bonding system
 - .10 Power at all communication racks
 - .11 Conduit and cable tray (and J hooks if applicable) distribution system
- .3 This Contract includes all necessary hardware, connections and testing for a complete functional standards-compliant system. The test results shall be to the satisfaction of the Departmental Representative and the Manufacturer responsible for the System Warranty.
- .4 The communication system shall comprise all components specified, implied or otherwise necessary to constitute a fully operational system.

1.5 SUBMITTALS

- .1 Provide submittals in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Cabling System Labelling:
 - .1 The Contractor in coordination with the Consultant shall develop and submit for approval a labelling system for the cable installation based on ANSI/TIA-606-A standards. At a minimum, the labelling system shall clearly identify all components of the system: racks, cables, panels and outlets.
 - .2 The labelling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labelled to identify the location within the cabling system infrastructure. All labelling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labelling scheme.
 - .3 All label printing will be machine generated using labelling software and laser printers obtained from cabling system manufacturer. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet labels will be the manufacturer's labels made of white card stock or self-adhesive polyester where applicable.
- .3 As-built Records and Drawings:

- .1 Provide database reflecting cable installation and cross-connections.
- .2 Provide electronic drawings in AutoCAD format depicting all construction.
- .3 Provide two bound complete hard-copy sets of as-built records to the Consultant.
In addition:
 - .1 Provide and place one hard copy of as-built records for each telecommunications room in plan holder in each telecommunications room.
- .4 Test Documentation:
 - .1 Test documentation shall be provided in both a three-ring binder(s) and electronic format on appropriate media, within three weeks after the completion of the project. The binder(s) shall be clearly marked on the outside front cover and spine with the words "Test Results", the project name, and the date of completion (month and year). The binder shall be divided by major heading tabs, Horizontal and Backbone.
 - .2 Each major heading shall be further sectioned by test type. Within the horizontal and backbone sections, scanner test results (Category 6), fiber optic power meter attenuation test results, OTDR traces, and green light test results shall be segregated by tab. Test data within each section shall be presented in the sequence listed in the administration records.
 - .3 The test equipment by name, manufacturer, model number, serial number and last calibration date will also be provided at the end of the document. Unless a more frequent calibration cycle is specified by the manufacturer, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test.
 - .4 Scanner tests shall be printed on 8-1/2" x 11" paper, and in native format of the tester used. Hand written test results (attenuation results and green light results) shall be documented. Electronic native format test results shall include the test equipment manufactures software for reading and interpreting test results. OTDR test results shall be in electronic format as well as printed or attached and copied on 8-1/2" x 11" paper for inclusion in the test documentation binder.
 - .5 Provide a copy of all test results on a compact disk in PDF format.
 - .6 When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be co-located in the binder.

1.6 WARRANTY/SERVICE

- .1 A system warranty shall be provided covering the installed cabling system against defects in workmanship, components, and performance, and follow-on support after project completion.
- .2 The Contractor shall provide documentation showing proof of warranty registration to the benefit of the Departmental Representative and include the Project Warranty particulars and claim procedures in the Project Operation and Maintenance Manuals.
 - .1 Installation Warranty:

- .1 The warranty shall warrant the cabling system against defects in workmanship for a period of one year from the date of system acceptance. The warranty shall cover all labor and materials necessary to correct a failed portion of the system and to demonstrate performance within the original installation specifications after repairs are accomplished. This warranty shall be provided at no additional cost.
- .2 Service to be provided on system within 24 hours of call origination during the warranty period.

PART 2 PRODUCTS

2.1 GENERAL

- .1 All products must be from the same manufacturer and capable of being certified as a complete system under full warranty by the manufacturer. The selection of material types, fixing, and workmanship shall be to provide a robust installation with an operational life equal to or in excess of 25 years. This warranty shall be direct from the system / cabling manufacturer and supported by the local cabling Contractor.

2.2 HORIZONTAL CABLE

- .1 The cables shall meet Category 6 as minimum to the following parameters:
 - .1 4 pair UTP, #24 AWG, Category 6 Cables, 250MHz
 - .2 Physical Characteristics:
 - .1 UTP 4-pair, 24 AWG, thermoplastic insulated, solid copper conductors enclosed in a CSA FT-6 (CMP) rated thermoplastic jacket and all individual conductors to be insulated with fluorinated ethylene propylene (FEP).
 - .2 Cable Size: Nominal O.D – 7.5mm or smaller.
 - .3 Breaking strength: 40.8kg at temperature of -20°C ± 1°C without jacket or insulation cracking.
 - .3 Transmission Characteristics:
 - .1 DC resistance: less than 94Ω/km, with an unbalance between conductors in a pair of 5% maximum.
 - .2 Mutual Capacitance of any one pair: maximum of 5.6nF/100 m @ 1 MHz.
 - .4 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.
 - .5 STP and UTP cabling indicated for data communications shall be Cat 6 rated.
 - .6 All SCADA and protection/control Ethernet cabling shall be STP.
 - .7 UTP cabling indicated for telephone only shall be Cat 5e.

2.3 TERMINATION AND CROSS-CONNECTION HARDWARE FOR UTP

- .1 Horizontal distribution cables shall be terminated using a Cat 6 modular jack connector at both ends.

- .2 Connectors:
 - .1 Category 6 jacks: to TIA/EIA TSB-31, CSA Standard C22.2, No. 182.4, CAN/CSA-T529.
 - .1 Universal 8-position, non-keyed jack, IDC spring contacts, integral with jack contacts, snap in modular type, RJ-45.
 - .2 Colour: To Departmental Representative standards.
- .3 Cat 6 Patch panel, 2 rack unit height, 48 ports, rack mounted:
 - .1 Shall be made of steel frame with black powder coat finish.
 - .2 Shall be modular and of Keystone construction to allow the possibility of changing connectors type in the future without replacing the entire unit.
 - .3 Shall have identical labels on front and rear.
 - .4 Shall be made by an ISO9001 Certified Manufacturer.
 - .5 Each port equipped with factory or field installed "RJ-45" jacks, type T568A Category 6 to: TIA/EIA-568-C.2.
 - .6 Horizontal cable-management unit for every 48 ports.
- .4 Outlet Connector Faceplates
 - .1 Faceplates shall be modular and in Keystone format opening to allow the possibility of changing connector types in the future without replacing the entire unit.
 - .2 Faceplate shall be equipped with small form factor terminating connectors to fit the individual outlet's requirements (RJ45 and dual LC or CATV bulkheads).
 - .3 Each port shall be equipped with icon inserts to designate outlet function. Colour to be selected. Unused ports shall have snap-in closure plates.
 - .4 Faceplates shall be equipped with a minimum of four (4) Keystone openings. Contractors are to equip the faceplate with the required amount of blank inserts as required.
- .5 BIX / IDC Cross Connect System
 - .1 The solution shall be based on highly reliable technology using the IDC connecting block and redesigned cable management system.
 - .2 The design shall offer deeper cable mounts with more room for cable dressing, polarized connectors and colour coding on pair splitters.
 - .3 Allow termination of 24 - 26 AWG cables.
 - .4 Allow for identification field to support the ANSI/TIA-606-A standard.
 - .5 Include troughs channels for Cross-connect cable management.
 - .6 Allow the use of 4 and 5 pair connecting blocks.
 - .7 Connecting block terminals shall be constructed of phosphor bronze, plated with a minimum of 150 micro inches of tin-lead over a 50 micro-inch minimum nickel under plate.

2.4 WORK AREA MODULAR JACK & FACEPLATE

- .1 General - Eight-position modular jack ("RJ-45"), type T568A Category 6 to: ANSI/TIA-568-C.2:
 - .1 Mounted in compatible single gang faceplate, angle entry, 4 port positions per faceplate.

- .2 Blank inserts for unused port positions within the faceplate.
- .3 Each wall outlet shall accommodate a minimum of four RJ-45 connectors.
- .4 Provide surface box mounted to modular furniture base track or install in mid-span.
- .2 Furniture mounted
 - .1 Suitable for flush mounting in modular office furniture panels.
 - .2 Provide 2 port adapter, install blanks on unused ports.
 - .3 Coordinate with modular office furniture supplier.
- .3 Wiremold mounted
 - .1 For installation in wiremold.
 - .2 Decora-style faceplate.
 - .3 Provide 2 port faceplate, install blanks on unused ports.
- .4 Floor mounted boxes
 - .1 Suitable for flush mounting installation.
 - .2 Minimum 4 ports.
 - .3 Suitable for accepting snap-in type 8P/8W modular connectors.

2.5 UTP PATCH CORDS

- .1 Patch Cords shall have snag less boots, with factory-installed male plug at one end to mate with "RJ-45" jack and with factory-installed male plug at other end to mate with "RJ-45" jack Category 6, 4-pairs to: ANSI/TIA 568-C.2.
- .2 Patch cables approved by the system supplier for end-use devices shall be provided in sufficient quantity to make each device operational.
- .3 Communications Room and Closets Patch Cords
 - .1 Provide patch cords equal to the number of horizontal cables installed in Communication Room and Closets.
 - .2 Provide spare 50% cables at 1.2m length and 50% at 1.8m length.
- .4 Work Area Equipment Cords
 - .1 Provide patch cords equal to 50% of horizontal cables installed in the Work Area.
 - .2 Provide 75% at 3m length and 25% at 4.6 m length.

2.6 IDENTIFICATION AND LABELLING

- .1 Identify and label all cables, terminations, cross-connects, patch cords, patch panels, outlet jacks, racks, and any other communications cabling system components to: ANSI/TIA-606-A.
- .2 Every wall jack and patch panel jack shall be labeled with a unique label using a Brother "P Touch" labeler or similar. Handwritten labels are not acceptable. Cover plate shall be cleaned with isopropyl alcohol prior to installing label. Provide an identical label on the cable in outlet box.

2.7 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.

2.8 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.

2.9 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 TERMINATION AND CROSS-CONNECT HARDWARE

- .1 Install termination and cross-connect hardware on wall and according to manufacturers' instructions. Identify and label as indicated to: ANSI/TIA-606-A.

3.2 INSTALLATION OF COMMUNICATIONS BONDING SYSTEM

- .1 The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, raceways, and other associated hardware that has the potential for acting as a current carrying conductor. The TBB shall be installed independent of the buildings electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA-607.B Telecommunications Bonding and Grounding Standard.
- .2 All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the Communication rooms shall be grounded to the respective TGB using a minimum #6 AWG stranded copper bonding conductor and compression connectors.
- .3 Where metallic panels attached to the rack to not have sufficient metal to metal contact to provide an adequate path to ground, they shall be bonded to the rack using a minimum #14 AWG copper conductor. The copper conductor size shall be upgraded based on the largest power conductor feeding any rack mount equipment. The conductor shall be continuous; attaching all isolated components in a daisy chain fashion from top to bottom and bonded to the rack using an appropriate compression connector.

- .4 All wires used for telecommunications grounding purposes shall be identified with green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape. All cables and bus bars shall be identified and labelled in accordance with the System Documentation Section of this specification.

3.3 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES AND OUTLETS

- .1 Install horizontal cables in conduits or cable trays from telecommunication rooms to individual work-area jacks.
- .2 Terminate voice horizontal cabling on wall mounted IDC terminal blocks in the telecommunication room. Mount IDC terminal blocks adjacent to telephone demarcation.
- .3 Terminate horizontal cabling on rack mounted patch panels in the telecommunication room.
- .4 Cables shall be installed in continuous lengths from origin to destination (no splices) unless specifically addressed in this document and shall not be longer than 90m.
- .5 Harness slack cable in cabinets, racks, and wall-mounted termination and cross-connection hardware.
- .6 The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
- .7 If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of five foot intervals - at no point shall cable(s) rest on acoustic ceiling grids or panels. Velcro wrap is the only acceptable method for Securing communication cabling to support structure.
- .8 The cabling system and support hardware shall be installed so that it does not obscure any valves, boxes, or other systems or equipment.
- .9 Cables shall not be attached to ceiling grid or lighting support wires.
- .10 Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Contractor prior to final acceptance at no cost to the Contractor.
- .11 Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification.
- .12 The cable label shall be applied to the cable behind the patch panel termination no more than 150mm from the end of cable.
- .13 The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
- .14 There shall be no use of tie wraps on any network cabling. All cables shall be wrapped with Velcro-type strapping where such restraint is necessary.

3.4 FIELD QUALITY CONTROL

- .1 Test fibre and copper backbone cabling.
- .2 Test horizontal UTP cables as specified below and correct deficiencies provide record of results as hard copy and electronic record on CD.
 - .1 Perform tests for Permanent Link on installed cables, including spares:
 - .1 Category 6 using certified level III tester to: ANSI/TIA-568-C.1.
- .3 Test each communication link.

- .4 Documentation to be recorded for each test result shall include:
 - .1 Date of the test
 - .2 Description of equipment used; manufacturer model number and serial number
 - .3 Date of latest equipment calibration
 - .4 Test personnel
 - .5 Trace of the copper or fiber cabling link
 - .6 Circuit or fibre identifier with length and test results events
 - .7 Parameters indicated above.

3.5 FIRESTOP SYSTEMS

- .1 All penetrations through fire rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure).
- .2 All firestop systems shall be installed in accordance with the manufacturer's recommendations and shall be completely installed and available for inspection by the local inspection authorities prior to cabling system acceptance.
- .3 Refer to Section 26 05 00 – Common Results – Electrical, for additional fire stopping requirements.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .4 Section 33 65 73 – Concrete Encased Duct Banks and Vaults.

1.2 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.

1.3 SYSTEM DESCRIPTION

- .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.
Testing of all fibers.

1.4 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.

1.5 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.

1.6 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, updated, 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 8° 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
 - .6 Fiber splice panels shall be wall mounted.
- .3 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 90° 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. All individual cables must be labelled in all pits, and on entry and exit from all devices and buildings.
- .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.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 26 05 31 - Splitters, Junction, Pull Boxes, and Cabinets.
- .3 Section 26 05 34 - Conduits, Conduit Fastenings, and Fittings.
- .4 Section 33 65 73 – Concrete Encased Duct Banks and Vaults.

1.2 SYSTEM DESCRIPTION

- .1 Empty telecommunications raceways system consists of outlet boxes, cover plates, distribution cabinets, conduits, cabletroughs, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts.

PART 2 PRODUCTS

2.1 MATERIAL

- .1 Conduits: in accordance with Section 26 05 34 - Conduits, Conduit Fastenings, and Fittings.
- .2 Junction boxes, cabinets: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes, and Cabinets.
- .3 Outlet boxes 4x4 deep, conduit boxes, and fittings: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .4 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.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 SCOPE

- .1 Provide a complete new card access system to match existing card access system as shown on the Drawings. System shall include card reader, door contacts, request to exit device, electronic locking hardware, alarm monitoring workstations, power supplies, cable, alarm management software, and miscellaneous components as required. Provide all components necessary to form a fully operational system.
- .2 Division 26 is to provide all necessary conduit, rough in materials and labor to support the access control system components.
- .3 Program the access control system to meet the door interlocking and monitoring requirements of the Departmental Representative as shown on the drawings and described herein.
- .4 The access control system card readers shall be based upon RFID proximity technology.
- .5 Integrate the new areas with existing system and match existing operations as per the requirements of the Departmental Representative.

1.3 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.

1.4 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 SHOP DRAWINGS

- .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:
 - .2 Indicate mounting heights and locations.
 - .3 Zone layout drawing indicating number and location of zones and areas covered.
 - .4 Wiring diagrams.
 - .5 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.

1.6 MAINTENANCE MANUALS

- .1 Maintenance Data: Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 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.

1.7 GENERAL REQUIREMENTS

- .1 All new system components are to match existing system components. Contractor shall confirm on site all system component used prior to bid submission.
- .2 Security contractors and technician shall be certified in good standing by the manufacturer of the system used.
- .3 Systems to be complete with all necessary components to provide functions required; not every item is necessarily mentioned. System to be supplied and installed by an established communications contracting firm that is approved by the Departmental Representative and vendor.
- .4 Before proceeding with installation, successful system installer to submit to the consultant for approval a complete detailed proposal as outlined in Section 26 05 00 - Common Work Results.
- .5 All wiring for systems to be PVC insulated, FT6 rated, shielded, twisted pair, multi conductor or coaxial, as called for or as required. All wiring for systems to be plenum rated where required. System wiring to be terminated by Security Contractor.
- .6 Selection of type of cable to be at discretion of system installer. The system, when complete, must perform to the complete satisfaction of the Consultant and must be free of all interference from cross-talk, hum, switch and relay noise, etc. All wiring to be terminated on terminal strips or blocks, and to be neatly installed, laced and tagged where required. All terminals in terminal panels and junction boxes to be made with solderless connectors to terminal blocks with a separate terminal for each conductor.
- .7 The contractor shall be fully trained and factory certified on all security systems as required by this document.

- .8 All hardware required to make programming changes to the system(s) shall be included with the system.
- .9 Each system shall have sufficient power supply to operate the system and the manufacturers' recommended power for the system shall be less than 80% of the power supply rated power output.
- .10 All systems shall include sufficient back up power supply to operate all devices simultaneously without drawing more than 80% of the capacity of the power supply. The back-up power system shall have sufficient capacity to operate the entire system for a minimum of 24 hours under normal operating conditions. (All batteries to be minimum 7 amp hour)
- .11 All systems shall be locally managed and may require the ability to be remotely controlled and configured.

1.8 SYSTEM REQUIREMENTS

- .1 System to control access of new areas as per existing system operation.
- .2 System to control access of specified door(s) based on programmed time schedule, through use of personnel ID cards, or operator requests and provide hard copy of events.
- .3 System must provide live muster reporting.
- .4 Hardware and software to be provided to facilitate following functions:
 - .1 to secure door(s).
 - .2 to monitor door status.
 - .3 to release door(s) under fire conditions.
 - .4 to release door(s) when valid ID card is presented to card reader.
 - .5 to place door(s) in a secure or unsecured mode automatically from software time schedule.
 - .6 to place door(s) in a secure or unsecured mode via the terminal keyboard.
 - .7 to manually release door(s) for exiting.
 - .8 to verify valid ID cards, unlock door, display entry on LCD monitors and provide hard copy of event.
 - .9 to monitor personal safety alarms.
 - .10 to monitor security alarms.
 - .11 to prioritize alarm conditions.
 - .12 to graphically display alarm points, door status and monitor points accurately.
 - .13 to graphically allow the operator to manipulate input and output points via a mouse from both a text screen and a graphics screen.
 - .14 to produce high quality ID badges.
- .5 Authorized personnel will be supplied with a valid ID card to gain access through specified security doors during controlled hours.
- .6 Individual points will be controllable via the local intelligent field panel unit to place in a secure or non-secure mode. All points shall be able to be grouped to be controlled on an "if then" basis where one event will trigger another. Each input and output to be able to be controlled in this way on a system-wide basis.

- .7 System shall continuously scan all monitoring devices for change of state information. All doors are to be monitored for tamper (trouble) 24 hours each day. System shall have the capability to provide locked/unlocked status in addition to door position status on controlled doors.
- .8 All exit doors with magnetic locks to be released under fire alarm conditions. Coordinate exact requirements with fire alarm supplier.
- .9 Coordinate software programming requirements, time schedules, ID's, operators and display with Departmental Representative prior to system programming.
- .10 System software to allow the use of an expiry date and a start date on all cardholders on the system. Cards will only work between those dates.
- .11 System software to be able to cause actions based on inputs/outputs and time schedules. Software to be able to handle if/the statements, or logic, and logic and priorities.
- .12 Software application program to lock and unlock specified door(s) via valid ID cards, manual requests, by software time schedules, exit pushbuttons, security sensor bars, or key switches and provide status of each specified door.

1.9 TRAINING

- .1 Provide complete and comprehensive training and demonstration sessions for the Departmental Representative and staff.
- .2 Instruct personnel in operation, adjustment, and maintenance of equipment and systems, using provided operation and maintenance data as the basis for instruction.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 **To match existing site system.**

2.2 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. Provide all media converters required for a complete and operational system both for equipment supplied in this contract and connection to existing equipment or infrastructure as noted.
- .3 Power supplies: to CAN/ULC-S318 or UL 603.
- .4 Connectors and switches: to ORD-C634.

- .5 Existing system: The existing Access control system on the site uses OnGuard security software with Lenel hardware and controllers including LNL-3300 series controllers. All new equipment as provided in this contract must be fully compatible with the existing system as recognized by OnGuard and Lenel.
- .6 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 Dock site.
 - .8 Acceptable Products: 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 Acceptable Products: 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 Card 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 Acceptable Products: 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 Acceptable Products: APC BE600-BR.
- .10 Communications:
 - .1 Provide all required communications interface devices, media convertors, Ethernet switches, etc as required for a complete and operational system.

2.3 LABELLING

- .1 All equipment units (field panels, access control units, etc.) to have lamicoïd description label. Description to be in code as directed by Departmental Representative.
- .2 All wire and cable to be labelled with suitable identification code affixed to cable jacket near terminations. Label to be permanently affixed, vinyl, plastic or similar material.

2.4 WIRE AND CABLE

- .1 Wiring for door control system may be smaller than #14 AWG copper providing voltage drop is not greater than 5% when devices are in operation.
- .2 Multi-conductor cables to be complete with outer PVC jacket.

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.
- .4 System required use of a card reader on the inside of the building to allow egress from the space. This device shall NOT inhibit egress and will allow for use of the manual door hardware to facilitate an emergency egress as required. In the event of an unvalidated egress, the system shall go into a local audible alarm and provide an event in record of the incident. The audible alarm shall time out after 1 minute.

3.3 DOCUMENTATION

- .1 The contractor shall return the following documentation to Departmental Representative:
 - .1 As-built drawings showing location of all devices, controls, splice points, demarcation connection, panels and keypads. All zones shall be clearly identified on the drawings. Electrical panel circuit breaker shall be clearly identified and noted on both the panel cover and as-built drawings.
 - .2 One each: Installation, Training, and Operations Manuals
 - .3 Acceptance Test Plan and sign-off sheets.
 - .4 Manufacturer's cut sheets for all devices.
 - .5 Electrical inspection permit and report.
 - .6 Training session attendance sheet.

3.4 TESTS AND ADJUSTMENTS

- .1 Upon completion of system installation, tests to be conducted by the system installer to determine system conformity to the requirements of the specification. Tests to be conducted in presence of Departmental Representative and/or his representative who may suspend or discontinue tests at any time performance is considered unsatisfactory. Resumption of testing to cover the previously untested elements and any completed elements at the discretion of the Departmental Representative.
- .2 Entire system and its components (every device, sub-system, and interconnection to other systems) to be tested for proper operation and function.
 - .1 Test for all alarm annunciation and proper recording.
 - .2 Test cable system in accordance with requirements for telecommunications systems in Section 27.
 - .3 Test for failure modes.
 - .4 Test for simultaneous alarms on multiple systems.

- .5 Test and ensure data logging functionality and that all test results are recorded.
- .3 All equipment or wiring provided by system installer which tests prove to be defective or operating improperly to be corrected or replaced promptly at no additional cost to the Departmental Representative.

3.5 TRAINING

- .1 System installer to conduct training program for designated maintenance and operating personnel. This program to include but not be limited to the following:
 - .1 Operation: designated personnel to be trained to accomplish and understand all aspects of system operation.
 - .2 Maintenance: designated personnel to be trained to perform routine maintenance on the system.
 - .3 Training period schedule to be established by Departmental Representative. Training periods to take place after building completion and prior to system use.
 - .4 Total training time required is 16 hours. This amount will be split up as the client sees fit over the various security system (Access Control, CCTV, Intrusion, etc.).
 - .5 Contractor shall provide the Departmental Representative with a training attendance sign-off sheet. This sheet shall identify the site, time and date as well as a listing of all those in attendance.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Video cameras.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1- Safety Standard for Electrical Installations.
 - .2 Underwriters' Laboratories (UL)
 - .1 UL 294, Standard for Safety for Access Control System Units.
 - .2 UL 1076, Standard for Safety for Proprietary Burglar Alarm Units and Systems.
 - .3 Underwriters Laboratories of Canada (ULC)
 - .1 ULC-S317, Installation and Classification of Closed Circuit Video Equipment (CCVC) Systems for Institutional and Commercial Security Systems.

1.3 DEFINITIONS

- .1 CCTV: Closed Circuit Television.
- .2 CCVC: Closed Circuit Video Camera.
- .3 CCD: Charge Coupled Device.
- .4 FOV: Field of View.

1.4 DESIGN PERFORMANCE REQUIREMENTS

- .1 Support: Camera functions such as pan/tilt and zoom fully supported by CCTV system.
 - .1 Provide operator with ability to control all camera functions.
- .2 Alarm point monitoring: System capable, upon alarm recognition, of switching CCTV cameras associated with alarm point.
- .3 Switching:
 - .1 Provision to switch any camera in system to any monitor in system manually or automatically.
 - .2 Provision to switch system video recorders to selective monitor outputs in system.
- .4 Control: Provision for any camera equipped with pan, tilt, and/or motorized zoom lens:
 - .1 Manually control pan, tilt and lens functions.
 - .2 Set pan and tilt home position.
 - .3 Set and clear movement limits of pan and tilt mechanism.
 - .4 Adjust motorized zoom lens.
- .5 Enter and edit CCTV programs and save them for future use.
- .6 Set dwell time for viewing of any camera picture.
- .7 Define sequence for viewing cameras on each monitor.
- .8 Bypass cameras in system during sequencing to monitor.

- .9 Provide ability to display stored 'video image' of cardholder, and switch real-time camera to card reader location for specific card usage.
- .10 Overall control of CCTV provided through software control, which provides complete integration of security components.
- .11 Environment: Design video components and systems to operate with all specified requirements under following ambient temperatures:
 - .1 Indoor installations:
 - .1 Temperature: 0°C to 30°C.
 - .2 Humidity: 10 to 90%.
 - .2 Outdoor installations:
 - .1 Temperature: -40°C to 60°C.
 - .2 Humidity: 10 to 100%.

1.5 SUBMITTALS

- .1 Product Data: Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings: Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit shop drawings to indicate project layout, camera locations, point-to-point diagrams, cable schematics, risers, mounting details and identification labeling scheme including:
 - .1 Functional description of equipment.
 - .2 Technical data sheets of all devices.
 - .3 Device location plans and cable lists.
 - .4 Video camera surveillance chart.
 - .5 Video interconnection detail drawings.
- .3 Samples: Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit one sample of each camera selected complete with housing, brackets and mounting hardware.
 - .2 Camera will be returned for incorporation into work as appropriate.
- .4 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 Instructions: Submit manufacturer's installation instructions.
 - .3 Manufacturer's Field Services: Submit copies of manufacturer's field reports.
- .5 Maintenance Data: Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals. Include following:
 - .1 System configuration and equipment physical layout.
 - .2 Functional description of equipment.
 - .3 Instructions on operation, adjustment and cleaning.
 - .4 Illustrations and diagrams to supplement procedures.
 - .5 Manufacturer's operation instructions

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Video Camera Characteristics:
 - .1 Ethernet based, POE (Power over Ethernet) powered digital video camera providing coverage of local spaces.
 - .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 Ethernet cabling as per specifications for Cat 6 data outlets noted in this contract.
 - .6 Standard software application allowing local viewing of video camera at SCADA workstation

2.2 CAMERA POWER SUPPLY

- .1 Network POE Switch Custom designed for all cameras.

2.3 JUNCTION BOX

- .1 Metal, sized to handle all system conduit interconnections with appropriate expansion.

2.4 CONDUITS

- .1 Conduits to Section 26 05 34 - Conduits, Conduit Fastenings and Fittings.
- .2 Pullboxes at terminus of conduits shall be 103mm square flush mounted pullbox.
- .3 Provide blank covers for all junction boxes and future camera locations.
- .4 All conduits are minimum 27mm (1") unless noted otherwise.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions, product carton installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install video surveillance equipment and components in accordance with ULC-S317.
- .2 Install cable, boxes, mounting hardware, brackets, video cameras and system components in accordance with manufacturer's written installation instructions.
- .3 Install components secure, properly aligned and in locations shown on reviewed shop drawings.
- .4 Connect cameras to cabling in accordance with installation instructions.
- .5 Install ULC labels where required.

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 product[s] 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 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 During progress of Work at 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within 3 days of review, and submit, immediately, to Consultant.

3.4 VERIFICATION

- .1 Perform verification inspections and test in the presence of Departmental Representative.
 - .1 Ensure appropriate subcontractors, and manufacturer's representatives and security specialists are present for verification.
- .2 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 Non-existence of installation related damages.
 - .2 Compliance of device locations with reviewed shop drawings.
 - .3 Compatibility of equipment installation with physical environment.
 - .4 Inclusion of all accessories.
 - .5 Device and cabling identification.
 - .6 Application and location of ULC approval decals.
- .3 Technical verification: Purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:
 - .1 Measurements of tension and power.
 - .2 Connecting joints and equipment fastening.
 - .3 Measurements of signals (dB, lux, baud rate, etc).
 - .4 Compliance with manufacturer's specification, product literature and installation instructions.
- .4 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 Operation control of camera lens, pan, tilt and zoom.
 - .4 Switching of camera to any monitor.
 - .5 Switching of system video recorder to selective monitor.
 - .6 Demonstrate:
 - .1 Sequence viewing of cameras on each monitor.

- .2 Bypass capability.
- .3 Display of stored image to cardholder.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 61 00 – Common Product Requirements
- .3 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM D4791-10, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

1.3 ACTION AND INFORMATION SUBMITTALS

- .1 Provide 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 aggregate materials and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit gradation curves of aggregate material as outlined in Section 31 23 33.01 to Departmental Representative for review.
 - .2 Allow continual sampling by Departmental Representative during production when requested.
 - .3 Provide Departmental Representative with access to source and processed material for sampling.
 - .4 Supply new or clean sample bags or containers according appropriate to aggregate materials.
 - .5 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.
- .2 Transportation and Handling: handle and transport aggregates to avoid segregation, contamination and degradation.
- .3 Storage: store washed materials or materials excavated from underwater 24 hours minimum to allow free water to drain and for materials to attain uniform water content.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, free from adherent coatings and injurious amounts of disintegrated pieces or other deleterious substances.
- .2 Flat and elongated particles of coarse aggregate: to ASTM D4791.
 - .1 Greatest dimension to exceed 5 times least dimension.

- .3 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
 - .1 Screenings produced in crushing of quarried rock, boulders, gravel or slag.
- .4 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
 - .1 Crushed rock.
 - .2 Gravel and crushed gravel composed of naturally formed particles of stone.
 - .3 Light weight aggregate, including slag and expanded shale.

2.2 SOURCE QUALITY CONTROL

- .1 Inform Departmental Representative of proposed source of aggregates and provide gradation curves 4 weeks minimum before starting production.
- .2 If materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source.
- .3 Advise Departmental Representative 4 weeks minimum in advance of proposed change of material source.
- .4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions are acceptable for topsoil stripping.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with topsoil stripping only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Topsoil stripping:
 - .1 Do not handle topsoil while in wet or frozen condition or in any way soil structure is adversely affected.
 - .2 Begin topsoil stripping of areas as indicated after area has been cleared of grasses, weeds, brush and removed from site.
 - .3 Strip topsoil to depths as directed by Departmental Representative. Avoid mixing topsoil with subsoil.
 - .4 Stockpile in locations as directed by Departmental Representative.
 - .5 Dispose of topsoil as directed by Departmental Representative.
- .2 Aggregate source preparation:
 - .1 Prior to excavating materials for aggregate production, clear and grub area to be worked, and strip unsuitable surface materials. Dispose of cleared, grubbed and unsuitable materials as directed Departmental Representative.
 - .2 Where clearing is required, leave screen of trees between cleared area and roadways as directed.
 - .3 Clear, grub and strip area ahead of quarrying or excavating operation sufficient to prevent contamination of aggregate by deleterious materials.

- .4 When excavation is completed dress sides of excavation to nominal 1.5:1 slope, and provide drains or ditches as required to prevent surface standing water.
- .5 Trim off and dress slopes of waste material piles and leave site in neat condition.
- .6 Provide silt fence or other means to prevent contamination of existing watercourse or natural wetland features.
- .3 Processing:
 - .1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.
 - .2 Blend aggregates, as required in order to satisfy gradation requirements for material and, percentage of crushed particles, or particle shapes specified.
- .4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate gradation.
- .5 Where necessary, screen, crush, wash, classify and process aggregates with suitable equipment to meet requirements.
- .6 Stockpiling:
 - .1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Departmental Representative. Do not stockpile on completed pavement surfaces.
 - .2 Stockpile aggregates in sufficient quantities to meet project schedules.
 - .3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.
 - .4 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.
 - .5 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Departmental Representative within 48 hours of rejection.
 - .6 Stockpile materials in uniform layers of thickness as follows:
 - .1 Maximum 1.5 m for coarse aggregate and base course materials.
 - .2 Maximum 1.5 m for fine aggregate and sub-base materials.
 - .3 Maximum 1.5 m for other materials.
 - .7 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.
 - .8 Do not cone piles or spill material over edges of piles.
 - .9 Do not use conveying stackers.
 - .10 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

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 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.
- .4 Leave any unused aggregates in neat compact stockpiles as directed by Departmental Representative.
- .5 Waste Management: separate waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 Submittal Procedures.
- .2 Section 01 35 13 Special Procedures for Contaminated Sites.
- .3 Section 01 74 19 Waste Management and Disposal.
- .4 Section 31 23 33.01 Excavating, Trenching and Backfilling.

1.2 REFERENCES

- .1 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 Clearing consists of cutting off trees and brush vegetative growth to not more than specified height above ground and disposing of felled trees, previously uprooted trees and stumps, and surface debris.
- .2 Close-cut clearing consists of cutting off standing trees, brush, scrub, roots, stumps and embedded logs, removing at, or close to, existing grade and disposing of fallen timber and surface debris.
- .3 Clearing isolated trees consists of cutting off to not more than specified height above ground of designated trees, and disposing of felled trees and debris.
- .4 Underbrush clearing consists of removal from treed areas of undergrowth, deadwood, and trees smaller than 50 mm trunk diameter and disposing of fallen timber and surface debris.
- .5 Grubbing consists of excavation and disposal of stumps and roots boulders and rock fragments of specified size to not less than specified depth below existing ground surface.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples:
 - .1 Tree wound paint: manufacturer's product data sheets.
 - .2 Herbicide: manufacturer's product data sheets.
- .3 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.
- .2 Safety Requirements: worker protection.
 - .1 Workers must wear gloves, respirators, dust masks, long sleeved clothing, eye protection and other protective clothing when applying herbicide materials.
 - .2 Workers must not eat, drink or smoke while applying herbicide material.

- .3 Clean up spills of preservative materials immediately with absorbent material and safely discard to landfill.

1.6 TREE AND VEGETATION COMPENSATION

- .1 Tree replacement and vegetation compensation will be reviewed by the Departmental Representative with the Contractor during Construction. Tree replacement and vegetation compensation will be paid as a negotiated change order to the contract.

1.7 STORAGE AND PROTECTION

- .1 Prevent damage to fencing, trees, landscaping, natural features, bench marks, existing buildings, existing pavement, utility lines, site appurtenances, utilities, root systems of trees, which are to remain.
 - .1 Repair damaged items to approval of Departmental Representative.
 - .2 Replace trees designated to remain, if damaged or removed without authorization, as directed by Departmental Representative.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Consider felled timber from which saw logs, pulpwood, posts, poles, ties, or fuel wood can be produced as saleable timber.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Bituminous based paint of standard manufacture specially formulated for tree wounds.
- .2 Soil Material for Fill:
 - .1 Excavated soil material: free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, deleterious, or objectionable materials.
 - .2 Remove and store soil material for reuse in location approved by Departmental Representative.

PART 3 EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Refer to Section 01 35 13 Special Procedures for Contaminated Sites.
- .2 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 plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.
- .3 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .4 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 PREPARATION

- .1 Inspect site and verify with Departmental Representative, items designated to remain.

- .2 Locate and protect utility lines: preserve in operating condition active utilities traversing site.
 - .1 Notify Departmental Representative immediately of damage to or when unknown existing utility lines are encountered.
 - .2 When utility lines which are to be removed are encountered within area of operations, notify Departmental Representative in ample time to minimize interruption of service.
- .3 Notify utility authorities before starting clearing and grubbing.
- .4 Keep roads and walks free of dirt and debris.

3.3 APPLICATION

- .1 Manufacturer's instructions: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.4 CLEARING

- .1 Clearing includes felling, trimming, cutting of trees into sections and satisfactory disposal of trees and other vegetation designated for removal, including downed timber, snags, brush, rubbish occurring within cleared areas.
- .2 Clear as indicated by Departmental Representative by cutting at height of not more than 300 mm above ground. In areas to be subsequently grubbed, height of stumps left from clearing operations to be not more than 1000 mm above ground surface.
- .3 Cut off branches overhanging area cleared as directed by Departmental Representative.
- .4 Cut off unsound branches on trees designated to remain as directed by Departmental Representative.

3.5 ISOLATED TREES

- .1 Cut off isolated trees at height of not more than 300 mm above ground surface.
- .2 Grub out isolated tree stumps.
- .3 Prune individual trees as indicated.
- .4 Trim trees designated to be left standing within cleared areas of dead branches 4 cm or more in diameter; and trim branches to heights as indicated.
- .5 Cut limbs and branches to be trimmed close to bole of tree or main branches.
- .6 Paint cuts more than 3 cm in diameter with approved tree wound paint.

3.6 GRUBBING

- .1 Remove and dispose of roots larger than 7.5 cm in diameter, matted roots, and designated stumps from indicated grubbing areas.
- .2 Grub out stumps and roots to not less than 450 mm below ground surface.
- .3 Grub out visible rock fragments and boulders, greater than 300 mm in greatest dimension, but less than 1.0 m³.
- .4 Fill depressions made by grubbing with suitable material and to make new surface conform with existing adjacent surface of ground.

3.7 REMOVAL AND DISPOSAL

- .1 Remove cleared and grubbed materials to disposal.

3.8 FINISHED SURFACE

- .1 Leave ground surface in condition suitable stripping of topsoil to approval of Departmental Representative.

3.9 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 SECTIONS

- .1 Section 31 23 33.01 Excavating, Trenching and Backfilling

1.2 MEASUREMENT AND PAYMENT

- .1 Cost of blasting, blast survey, drilling, vibration monitoring, and rock removal will be paid by Contractor. Contractor Lump Sum Contract price for rock removal shall include estimated quantities to areas and volumes shown on the Contract Drawings. Variations (+/-) to estimated quantities will be made by Contract change.
- .2 Quantities for volume removed from solid rock masses will be calculated from cross-sections of original rock surface and design subgrade lines for excavation. Where design subgrade lines are less than 300mm below original rock surface, actual volumes removed will be measured up to a maximum of 300mm below original rock surface. Volume for boulders and rock fragments which cannot be lifted by equipment available on site will be determined by measuring three maximum mutually perpendicular dimensions with volume to be product of these three dimensions.
- .3 No payment will be made for removal of rock, including all subsequent remedial backfilling, in excess of the trench limits shown on Contract Drawings unless authorized by Departmental Representative.
- .4 Boulders and rock fragments which can be lifted by equipment available on site are considered incidental to contract work. No additional payment will be made for removal of individual boulders and rock fragments which meet above criteria.

1.3 REFERENCES

- .1 Definitions:
 - .1 Rock is defined as all solid rock in form of bedrock, masses, ledges, seams or layers and includes igneous rock of any sort, conglomerate, sandstone or shale, that requires breaking by continuous drilling and blasting before excavation and removal. Rock also includes rocks having individual volumes in excess of 1.0m³, removed by blasting or other means.
 - .2 Dense tills, hardpan, partially cemented materials, clay or frozen materials which do not require breaking by continuous drilling and blasting before excavation and removal are not classified as rock.”

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Blasting Submittals:
 - .1 Submit for approval to Departmental Representative and authorities having jurisdiction a written proposal of operations for removal of rock minimum 48 hours in advance of planned drilling and blasting work. Proposal to include the following:
 - .1 Proposed method of carrying out work, equipment, types and quantities of explosives to be used, loading charts and drill hole patterns, type of caps, blasting techniques, blast protection measures for items such as flying rock, vibration, dust and noise control and other pertinent details.
 - .2 Site location map indicating blast area, signage locations, fencing, flagger locations (where required).

- .3 Dates and timing of blasting. Times listed are to indicate within 15 minutes of proposed blast.
- .2 Submit records to Departmental Representative at end of each shift. Maintain complete and accurate record of drilling and blasting operations.
- .3 Provide written methodology for protection of existing structures and surface features including, but not necessarily limited to the following: buildings, retaining walls, fencing, sidewalks, roads, site lighting, duct banks, services tunnels, crane rails, sanitary drains, storm drains and watermains.
 - .1 Include within the written report how the contractor or subtrade will rectify damages that may occur due to blasting operations.
- .4 No blasting to proceed without written approval from Departmental Representative.
- .5 In the event a cruise ship is in the Dock, Contractor is to provide 48 hours' notice of blasting to allow Departmental Representative to inform and coordinate security personnel responsible for handing of bomb sniffing canines.
- .3 Qualification Statements:
 - .1 Retain licensed explosives expert to program and supervise blasting work, to interpret recommendations of pre-blasting report, and to determine precautions, preparation and operations techniques.
 - .2 Submit documentation verifying explosives expert's qualifications.
- .4 Contractor to submit pre- and post- blast rock surveys to Departmental Representative for review and verification of quantities. Survey of quantities by Contractor are at no additional cost to Contract.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6 QUALITY ASSURANCE

- .1 Blasting Survey and Monitoring:
 - .1 Visit property holders of adjacent buildings and structures in advance of blasting to determine existing conditions, conduct pre-blast survey where required, describe blasting and seismic recording operations and obtain their permission for setting up seismographs.
 - .2 Seismographic monitoring to be conducted during entire progress of blasting operations.
 - .3 Conduct post blast survey where required.
 - .4 Provide copies of pre-blast and post-blast survey to Departmental Representative.
- .2 Blasting and Vibration Control:
 - .1 Reduce ground vibrations to avoid damage to structures or remaining rock mass.
 - .2 Blasting not permitted within distance of 30 m of fresh concrete or grout poured within 24 hours.
 - .3 Complete blasting before any structural element including socketed piles and caissons, rock anchors, concrete footings, walls and columns are installed within 30 m from blast holes.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 ROCK REMOVAL

- .1 Co-ordinate this Section with Section 01 35 33 - Health and Safety Requirements.
- .2 Strip Rock of all earth.
- .3 Notify Departmental Representative minimum 48hrs prior to blasting.
- .4 Contractor to survey stripped rock surface at no additional cost to the contract to determine pre-blast rock surface.
- .5 In the event a cruise ship is in the Dock, Contractor is to provide 48 hours' notice of blasting to allow Departmental Representative to inform and coordinate security personnel responsible for handing of bomb sniffing canines.
- .6 Remove rock to alignments, profiles, and cross sections as indicated.
- .7 Explosive blasting is not permitted at locations indicated.
- .8 Do blasting operations in accordance with local and provincial codes.
- .9 Use rock removal procedures to produce uniform and stable excavation surfaces. Minimize overbreak, and to avoid damage to adjacent structures.
- .10 Excavate rock to horizontal surfaces with slope not to exceed Geotechnical Consultant's recommendations. Contractor to survey blasted rock surface at no additional cost to the contract to determine pre-blast rock surface upon completion of rock removal.
- .11 Prepare rock surfaces which are to bond to concrete, by scaling, pressure washing and broom cleaning surfaces.
- .12 Excavate trenches to lines and grades to minimum of 150 mm below pipe invert or duct bank as indicated. Provide recesses for bell and spigot pipe to ensure bearing will occur uniformly along barrel of pipe.
- .13 Cut trenches to widths as indicated.
- .14 Use pre-shearing, cushion blasting or other smooth wall drilling and blasting techniques unless specified otherwise.
- .15 Remove boulders and fragments which may slide or roll into excavated areas.
- .16 Correct unauthorized rock removal at no extra cost, in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.2 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Rock Disposal:
 - .1 Dispose of removed rock as indicated in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Submit to Departmental Representative for review location for offsite disposal of surplus rock.
 - .3 Dispose of surplus removed rock at an approved location offsite.

3.3

PROTECTION

- .1 Prevent damage to surroundings and injury to persons in accordance with Section 01 56 00 - Temporary Barriers and Enclosures. Erect fencing, post guards, sound warnings and display signs when blasting to take place.
- .2 Ensure adequate blast mats are in place to prevent fly rock.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 13 - 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 71 00 - Examination and Preparation.
- .8 Section 01 74 19 - Waste Management and Disposal.
- .9 Section 31 23 16.26 - Rock Removal.
- .10 Section 32 11 23 - Aggregate Base Courses

1.2 REFERENCES

- .1 Master Municipal Contract Documents (MMCD), Platinum Edition Volume II - 2009, British Columbia.
- .2 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 D422-632002, 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/ft³) (600 kN-m/m³).
 - .5 ASTM D1557-02e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2,700 kN-m/m³).
 - .6 ASTM D4318-05, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .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 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.
- .5 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.
- .6 APPENDIX B – EGD Archaeological Overview Assessment.

1.3 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
- .1.1 Rock: solid material in excess of 1.00m³, and which cannot be removed by means of heavy duty mechanical excavating equipment available on site. Frozen material not classified as rock
- .1.2 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 MEASUREMENT AND PAYMENT

- .1 With the exception of pay items listed hereunder, payment for all work performed in this Section will be included in the Contractor's Lump Sum Contract prices.
- .2 Additional payment for trench excavation by hand will only be made in addition to the work items involving trench work where excavation by machinery is not practicable and only under prior approval by Departmental Representative. Payment will be based on before and after excavation cross-section areas at sufficient equal intervals over the length of over-excavation.
- .3 Payment for over-excavation including backfilling will only be made for over-excavation authorized by Departmental Representative. Payment will be based on before and after

excavation cross-section areas at sufficient equal intervals over the length of over-excavation.

- .4 Payment for removal and disposal of disused pipes and headwalls encountered during trench excavation to specific disposal site will be in addition to trench work with no deduction of payment from such trench work. No payment will be made under this item for removal and disposal carried out as part of the operation for removal and disposal for excavated materials from trench work.
- .5 All costs incurred as a result of unauthorized excavation beyond neat lines or limits of excavation shown on Contract Drawings including remedial backfill will be at Contractor's cost.

1.5 EXCAVATION AND DISPOSAL

- .1 It is anticipated that excavated material will contain contamination. Excavated materials commonly found on the Esquimalt Graving Dock site are CCME Metals and PAHs IL+ and IL-. In accordance with Esquimalt Graving Dock procedures, Contractor is to:
 - .1 Transport excavated material to PWGSC Lot 203, located off Maplebank Road. Material is to be transported for stockpiling at Lot 203 through EGD site and exit at EGD Back Gate, located at the end of Maplebank Road. Use of pup trailer behind tandem axle dump truck for hauling to Lot 203 will not be permitted due to transport route constraints through EGD site.
 - .2 Place excavated material in 50m³ piles in location as directed by Departmental Representative.
 - .3 In accordance with Esquimalt Graving Dock Environmental Best Practices properly protect stockpiled soils from water infiltration and run off.
- .2 PWGSC's Soil Management Consultant (SMC) will coordinate the stockpile areas on Lot 203 in accordance with the Soil Management Plan. SMC will complete the task of soils sampling (at the expense of PWGSC) and PWGSC will provide the characterization reports to the Contractor for disposal of materials to an approved facility.
- .3 Contractor to submit to Departmental Representative for review and approval, location of proposed disposal facility prior to disposal of any material.
- .4 Payment for disposal (including loading and hauling costs) of characterized material will be paid as a negotiated change order to the contract. Contractor must provide PWGSC with all disposal records including weigh bills, disposal receipts and chain of custody documentation.

1.6 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Preconstruction Submittals:
 - .1 Contractor to submit records of underground utility pre-locates of existing utilities in accordance with Section 01 71 00 - Examination and Preparation for review by Departmental Representative.
 - .2 Submit construction equipment list for major equipment to be used in this section prior to start of Work.
 - .1 All tracked equipment to have rubber track pads when working on concrete or paved surfaces on site.
 - .3 Submit certificates for proposed granular materials to confirm compliance with the Canadian Council of Ministers of the Environment (CCME) Residential/Parkland (RL/PL) Land Usage Soil Quality Guidelines.

- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control:
 - .1 Submit name of professional engineer retained by the Contractor for design and review of temporary works related to underpinning and bracing of existing structure and excavations for review and approval by Departmental Representative.
 - .2 Submit name of testing laboratory retained by Contractor for materials testing for review and approval by Departmental Representative.
 - .3 Submit condition survey of existing conditions as described in EXISTING CONDITIONS article of this Section.
 - .4 Submit for review by Departmental Representative proposed dewatering heave prevention methods as described in PART 3 of this Section.
 - .5 Submit to Departmental Representative written notice at least 7 days prior to excavation work, to ensure cross sections are taken.
 - .6 Submit to Departmental Representative written notice when bottom of excavation is reached.
 - .7 Submit to Departmental Representative testing inspection results report as described in PART 3 of this Section.
- .4 Samples:
 - .1 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of fill materials and provide documentation that proposed fill meets CCME guidelines.

1.7 QUALITY ASSURANCE

- .1 Qualification Statement: submit proof of insurance coverage for professional liability for professionals retained by Contractor.
- .2 Submit design and supporting data for excavations at least 2 weeks prior to beginning Work. Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of British Columbia, Canada.
- .3 Keep design and supporting data on site.
- .4 Do not use soil material until written report of soil test results are reviewed and approved by Departmental Representative.
- .5 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.8 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.

1.9 EXISTING CONDITIONS

- .1 Examine Appendix B - EGD Archaeological Overview Assessment.
- .2 Buried services:
 - .1 Before commencing work verify location of buried services on and adjacent to work area.
 - .2 Conduct Ground Penetrating Radar (GPR) in all areas of excavation to identify location and approximate depth of services.
 - .3 Conduct a "Hydro-Vac" excavation of utilities identified on Contract documents and:

- .1 Conduct a survey and record vertical and horizontal location of service in UTM-10 NAD 86 coordinate and geodetic elevation format.
- .2 Record the diameter of piping, width and depth of concrete ducting and size of structures.
- .4 Arrange with appropriate authority for relocation of buried services that interfere with execution of work.
- .5 Remove obsolete buried services within 2 m of foundations: cap cut-offs.
- .6 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
- .7 Prior to beginning excavation Work, notify applicable Departmental Representative establish location and state of use of buried utilities and structures. Clearly mark such locations to prevent disturbance during Work.
- .8 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
- .9 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing or re-routing.
- .10 Record location of maintained, re-routed and abandoned underground lines on project record drawings.
- .11 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 Granular Base and Granular Sub-Base material: properties in accordance with the following requirements:
 - .1 Crushed 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		
	Granular Sub-Base (75mm crushed gravel)	Granular Base (19mm crushed gravel)	Sand
75 mm	100	-	-
50 mm	-	-	-
37.5 mm	60-100	-	-
25 mm	-	-	-
19 mm	35-80	100	-
12.5 mm	-	75-100	100
9.5 mm	26-60	60-90	-
4.75 mm	20-40	40-70	45-100
2.36 mm	15-30	27-55	30-90
2.00 mm	-	-	-

1.18 mm	10-20	16-42	-
0.600 mm	5-15	8-30	10-50
0.425 mm	-	-	-
0.300 mm	3-10	5-20	3-20
0.180 mm	-	-	-
0.150 mm	-	-	-
0.075 mm	0-5	2-8	0-8

- .2 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/m³; 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.

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 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.
 - .1 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, 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.

3.5 STOCKPILING

- .1 Stockpile fill materials in areas designated by Departmental Representative.
 - .1 Stockpile granular materials in manner to prevent segregation.
 - .2 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.6 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

- .1 Contractor is responsible for the protection and temporary support of all project excavations, with special attention to work adjacent to crane rails and existing structures and in tidally influenced zones.
- .2 Contractor to retain and pay for services of professional engineer registered in the Province of British Columbia for design and review of temporary works related to underpinning and bracing of existing structure and excavations.
- .3 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 WorkSafe BC.
 - .1 Where conditions are unstable, Contractor to retain and pay costs for geotechnical engineer to review condition and provide recommendations
- .4 Obtain permit from authority having jurisdiction for temporary diversion of water course.
- .5 Construct temporary Works to depths, heights and locations as indicated by Contractor's geotechnical engineer.
- .6 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.
- .7 When sheeting is required to remain in place, cut off tops at elevations as indicated.
- .8 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 Special Procedures for Contaminated Site, to approved runoff areas or

containment facilities 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 Advise Departmental Representative at least 7 days in advance of excavation operations. Excavate to lines, grades, elevations and dimensions as indicated.

.2 Remove concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation offsite.

.3 Excavation must not interfere with bearing capacity of adjacent foundations and slabs. Contractor to notify Departmental Representative immediately where undermining of slabs of foundations occurs. Contractor responsible for devising and executing a remediation plan for filling all voids associated with undermining of slabs and foundations.

.4 Do not disturb soil within branch spread of trees or shrubs that are to remain.

.1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw, as directed by the project Arborist.

.2 Provide 24 hours notice to Departmental Representative of need for Arborist on site.

.5 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. No more than 5 m of trench may be exposed at end of day's operation and must be securely covered. Road plates are to be used to cover exposed excavations in areas of vehicular travel.

.6 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.

.7 Restrict vehicle operations directly adjacent to open trenches.

.8 Dispose of surplus and unsuitable excavated material in location with PWGSC property approved by Departmental Representative.

.9 Do not obstruct flow of surface drainage or natural watercourses.

.10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.11 Notify Departmental Representative when bottom of excavation is reached.

.12 Obtain Departmental Representative approval of completed excavation.

.13 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.

.14 Correct unauthorized over-excavation as follows:

.1 Fill with granular base material to not less than 95% Modified Proctor Density.

.15 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 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.

3.10 BACKFILLING

- .1 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.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Place backfill material in uniform layers not exceeding 300 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .5 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.
- .6 Place unshrinkable fill in areas as indicated.
- .7 Consolidate and level unshrinkable fill with internal vibrators.
- .8 Install drainage system in backfill as indicated.

3.11 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.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 61 00 Common Product Requirements.

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/ft³) (600kN-m/m³).
 - .5 ASTM D1557-09, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft³) (2,700kN-m/m³).
 - .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 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 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.
- .4 Master Municipal Contract Documents (MMCD), Platinum Edition Volume II - 2009, British Columbia – Section 31 05 17.

1.3 ACTION AND INFORMATION 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 certificates for proposed granular materials to confirm compliance with the Canadian Council of Ministers of the Environment (CCME) Residential/Parkland (RL/PL) Land Usage Soil Quality Guidelines.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Granular Base and Granular Sub-Base material: properties in accordance with the following requirements:
 - .1 Crushed 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		
	Granular Sub-Base (75mm crushed gravel)	Granular Base (19mm crushed gravel)	Sand
75 mm	100	-	-
50 mm	-	-	-
37.5 mm	60-100	-	-
25 mm	-	-	-
19 mm	35-80	100	-
12.5 mm	-	75-100	100
9.5 mm	26-60	60-90	-
4.75 mm	20-40	40-70	45-100
2.36 mm	15-30-	27-55	30-90
2.00 mm	-	-	-
1.18 mm	10-20	16-42	-
0.600 mm	5-15	8-30	10-50
0.425 mm	-	-	-
0.300 mm	3-10	5-20	3-20
0.180 mm	-	-	-
0.150 mm	-	-	-
0.075 mm	0-5	2-8	0-8

PART 3 EXECUTION

3.1 PREPARATION

- .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 requirements of authorities having jurisdiction, sediment and erosion control plan, 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 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 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.
 - .7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
 - .8 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.
- .4 Compacting:
 - .1 Compact to density not less than 95% Modified Proctor Density to 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 by Departmental Representative.
 - .5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
- .5 Proof rolling:
 - .1 For proof rolling use standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm.
 - .2 Obtain written approval from Departmental Representative to use non-standard proof rolling equipment.
 - .3 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
 - .4 Where proof rolling reveals areas of defective subgrade:
 - .1 Remove base, sub-base and subgrade material to depth and extent as directed by Departmental Representative.
 - .2 Backfill excavated subgrade with common material and compact.
 - .3 Replace sub-base material and compact.
 - .4 Replace base material and compact in accordance with this Section.
 - .5 Where proof rolling reveals defective base or sub-base, remove defective materials to depth and extent as directed by Departmental Representative and replace with new materials in accordance with this section at no extra cost.

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 PROTECTION

- .1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Departmental Representative.

3.5

CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 Submittals Procedures
- .2 Section 01 35 33 Health and Safety Requirements
- .3 Section 01 74 11 Cleaning
- .4 Section 01 74 19 Waste Management and Disposal
- .5 Section 03 20 00 Concrete Reinforcing
- .6 Section 03 30 00 Cast-In-Place Concrete
- .7 Section 31 23 33.01 Excavating, Trenching and Backfilling.
- .8 Section 32 11 23 Aggregate Base Courses

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 D1557-12e1, Modified Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³(2,700 kN- m/m³)).
- .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.
 - .1 Submit concrete mix designs 2 weeks prior to construction

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 and:
 - .1 Hand-formed and hand-placed concrete:
 - Slump: 80mm
 - Air entrainment: 5-8%
 - Max. aggregate size: 20mm
 - Min. cement content: 335 kg/m³
 - Min. 28 day strength: 32 MPa
 - .2 Extruded concrete:
 - Slump: 0-25mm
 - Air entrainment: 6-9%
 - Max. aggregate size: 10mm
 - Fineness modulus: 2.1 to 2.4
 - Min. cement content: 335 kg/m³
 - Min. 28 day strength: 32 MPa
- .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 following requirements:
 - .1 Crushed stone or gravel per Section 32 11 23.
- .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:
 - .1 Granular material as specified on contract drawings
- .7 Curing compound: to be spray applied, liquid type conforming to ASTM C309 containing a fugitive dye, applied in accordance with manufacturer's recommendations, or other during methods such as sheet material and burlap mats, subject to Departmental Representative approval.

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 300 mm layers and compact to at least 95% Modified Proctor Density in compliance with ASTM D1557.

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 300 mm layers to at least 95% Modified Proctor Density in compliance with ASTM D1557.

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 2 mm deep, by drawing broom in direction normal to centre line.
- .4 Provide edging as indicated with 10 mm radius edging tool.

3.4 TOLERANCES

- .1 Finish surfaces to within 3 mm in 3 m as measured with 3 m straightedge placed on surface.

3.5 EXPANSION AND CONTROL JOINTS

- .1 Install expansion joints at intervals of 9 m.
- .2 Install transverse control joints after floating, when concrete is stiff, but still plastic, at intervals of 3 m.
- .3 Install tooled "dummy joint" at intervals of 1.5m between control joints.
- .4 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 Use 13mm pre-moulded hardboard joint material to form isolation joints joint filler in isolation joints.
- .3 Seal isolation joints with sealant noted on drawings.

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 1 day after placing, or sealing moisture in by curing compound as directed by Departmental Representative.
- .2 Where burlap is used for moist curing, place two pre-wetted layers on concrete surface and keep continuously wet during curing period of at least 7 days.
- .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 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 01 74 11 - Cleaning.
- .3 Section 01 74 19 - Waste Management and Disposal.
- .4 Section 03 30 00 - Cast-In-Place Concrete.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A90/A90M-09, Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - .3 ASTM A121-07, Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
 - .4 A653/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .5 ASTM C618-08a, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
 - .6 ASTM F1664-08, Standard Specification for Poly(Vinyl Chloride) (PVC)- Coated Steel Tension Wire Used with Chain-Link Fence.
 - .7 ASTM A123/A123M-09, Standard Specification for Zinc (Hot Dip Galvanized) coatings on Iron and Steel Products.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-138.1-96, Fabric for Chain Link Fence.
 - .2 CAN/CGSB-138.2-96, Steel Framework for Chain Link Fence.
 - .3 CAN/CGSB-138.3-96, Installation of Chain Link Fence.
 - .4 CAN/CGSB-138.4-96, Gates for Chain Link Fence.
 - .5 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-A3000-08, Cementitious Materials Compendium.
- .4 Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
- .5 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.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for concrete mixes, fences, posts and gates 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 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 fence and gate materials from damage.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to Work of this Section.
 - .1 Packaging Waste Management: remove for reuse of pallets, crates, padding, packaging materials as specified in Waste Reduction Workplan 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 CSA A23.1 and Section 03 30 00 - Cast-in-Place Concrete.
 - .1 Nominal coarse aggregate size: 20-5.
 - .2 Compressive strength: 20 MPa minimum at 28 days.
 - .3 Additives: fly ash to CSA A3000 ASTM C618.
- .2 Chain-link fence fabric: to CAN/CGSB-138.1.
 - .1 Type 1, Class A, medium style, Grade 2.
 - .2 Height of fabric: as indicated.
- .3 Posts, braces and rails: to CAN/CGSB-138.2, galvanized steel pipe. Dimensions as indicated.
- .4 Top, bottom tension wire: to CAN/CGSB-138.2, single strand, galvanized steel wire.
- .5 Tie wire fasteners: aluminum wire.
- .6 Tension bar: to ASTM A653/A653M, 5 x 20 mm minimum galvanized steel.
- .7 Gates: to CAN/CGSB-138.4.
- .8 Gate frames: to ASTM A53/A53M, galvanized steel pipe, standard weight 45 mm outside diameter pipe for outside frame, 35 mm 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.
- .9 Fittings and hardware: to CAN/CGSB-138.2, galvanized steel.
 - .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 Include projection with clips or recesses to hold 3 strands of barbed wire spaced 100 mm apart.
- .5 Projection of approximately 300 mm long to project from fence at 45 degrees above horizontal.
- .6 Turnbuckles to be drop forged.
- .10 Organic zinc rich coating: to CAN/CGSB-1.181 MPI #18.
- .11 Barbed wire: to ASTM A121 2 mm diameter galvanized steel wire aluminum coated steel wire 4 point barbs 125 mm spacing.
- .12 Barbed wire: to CAN/CGSB-138.2, 2.5 mm diameter.
- .13 Grounding rod: to Section 26 05 27 - Grounding - Primary 16 3 m long.

2.2 FINISHES

- .1 Galvanizing:
 - .1 For chain link fabric: to CAN/CGSB-138.1 Grade 2.
 - .2 For pipe: 550 g/m² minimum to ASTM A90.
 - .3 For barbed wire: to CAN/CGSB-138.2 ASTM A121, Class 2.
 - .4 For other fittings: to ASTM A123/A123M.

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 and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .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 requirements of authorities having jurisdiction sediment and erosion control drawings sediment and erosion control plan, 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.
- .2 Grading:
 - .1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts.
 - .1 Provide clearance between bottom of fence and ground surface of 30 mm to 50 mm.

3.3 RESTORATION OF FENCE

- .1 Restoration of existing fencing damaged or removed during work to be in accordance with this section.

3.4 ERECTION OF FENCE

- .1 Erect fence along lines as directed by Departmental Representative and to CAN/CGSB-138.3.
- .2 Excavate post holes to dimensions indicated 600 mm depth x 300 mm diameter as directed by Departmental Representative.
- .3 Space line posts 3 m apart, measured parallel to ground surface.
- .4 Space straining posts at equal intervals not to exceed 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 Departmental Representative.
- .6 Install corner post where change in alignment exceeds 10 degrees.
- .7 Install end posts at end of fence and at buildings.
 - .1 Install gate posts on both sides of gate openings.
- .8 Place concrete in post holes then embed posts into concrete to minimum 450 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 Install fence fabric after 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.

3.5 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.
 - .1 Cast gate rest in concrete as directed.
 - .2 Dome concrete above ground level to shed water.
- .4 Install gate stops where indicated.

3.6 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 as indicated.
 - .1 Pre-treat damaged surfaces according to manufacturers' instructions for zinc-rich paint.

3.7 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.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management Disposal.
- .3 Section 01 74 11 - Cleaning.

1.2 MEASUREMENT PROCEDURES

- .1 Preparation of sub-grade for placing of topsoil will be measured in square metres of area prepared.
- .2 Topsoil stripping will not be measured.
- .3 Measure supplying, placing and spreading topsoil in cubic metres as determined from actual surface area covered and depth of topsoil specified.
 - .1 Specified depth of topsoil: measured and approved by Departmental Representative, Consultant after settlement and consolidation as specified.
- .4 Measure finish grading in square metres from actual surface measurements as determined by Departmental Representative, Consultant.

1.3 PAYMENT

- .1 Testing of topsoil: Contractor will pay for cost of testing.

1.4 REFERENCES

- .1 Agriculture and Agri-Food Canada
 - .1 The Canadian System of Soil Classification, Third Edition, 1998.
- .2 Canadian Council of Ministers of the Environment
 - .1 PN1340-2005, Guidelines for Compost Quality.
- .3 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.

1.5 DEFINITIONS

- .1 Compost:
 - .1 Mixture of soil and decomposing organic matter used as fertilizer, mulch, or soil conditioner.
 - .2 Compost is processed organic matter containing 40% or more organic matter as determined by Walkley-Black or Loss On Ignition (LOI) test.
 - .3 Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth (C:N ratio below (25) (50)), and contain no toxic or growth inhibiting contaminants.
 - .4 Composed bio-solids to: CCME Guidelines for Compost Quality, Category (A) (B).

1.6 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Quality control submittals:
 - .1 Soil testing: submit certified test reports showing compliance with specified performance characteristics and physical properties as described in PART 2.3 - SOURCE QUALITY CONTROL.
 - .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.7 QUALITY ASSURANCE

- .1 Pre-installation meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements in accordance with Section 01 32 16 - Construction Progress Schedules - Bar (GANTT) Chart.

1.8 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 unused soil amendments from landfill to official hazardous material collections site approved by Departmental Representative.
 - .1 Do not dispose of unused soil amendments into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

PART 2 PRODUCTS

2.1 TOPSOIL

- .1 Topsoil for seeded areas: mixture of particulates, micro-organisms and organic matter which provides suitable medium for supporting intended plant growth.
 - .1 Soil texture based on The Canadian System of Soil Classification, to consist of 20 to 70 % sand, minimum 7 % clay, and contain 2 to 10 % organic matter by weight.
 - .2 Contain no toxic elements or growth inhibiting materials.
 - .3 Finished surface free from:
 - .1 Debris and stones over 50 mm diameter.
 - .2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
 - .4 Consistence: friable when moist.

2.2 SOIL AMENDMENTS

- .1 Fertilizer:
 - .1 Fertility: major soil nutrients present in following amounts:
 - .2 Nitrogen (N): 20 to 40 micrograms of available N per gram of topsoil.
 - .3 Phosphorus (P): 40 to 50 micrograms of phosphate per gram of topsoil.
 - .4 Potassium (K): 75 to 110 micrograms of potassium per gram of topsoil.
 - .5 Calcium, magnesium, sulfur and micro-nutrients present in balanced ratios to support germination and/or establishment of intended vegetation.
 - .6 Ph value: 6.5 to 8.0.
- .2 Peatmoss:
 - .1 Derived from partially decomposed species of Sphagnum Mosses.
 - .2 Elastic and homogeneous, brown in colour.
 - .3 Free of wood and deleterious material which could prohibit growth.
 - .4 Shredded particle minimum size: 5 mm.

- .3 Sand: washed coarse silica sand, medium to course textured.
- .4 Organic matter: compost Category A, in accordance with CCME PN1340, unprocessed organic matter, such as rotted manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability and contaminant requirements.
- .5 Limestone:
 - .1 Ground agricultural limestone.
 - .2 Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.
- .6 Fertilizer: industry accepted standard medium containing nitrogen, phosphorous, potassium and other micro-nutrients suitable to specific plant species or application or defined by soil test.

2.3 SOURCE QUALITY CONTROL

- .1 Advise Departmental Representative of sources of topsoil, manufactured topsoil to be utilized with sufficient lead time for testing.
- .2 Contractor is responsible for amendments to supply topsoil as specified.
- .3 Soil testing by recognized testing facility for PH, P and K, and organic matter.
- .4 Testing of topsoil will be carried out by testing laboratory designated by Departmental Representative.
 - .1 Soil sampling, testing and analysis to be in accordance with Provincial standards

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 requirements of authorities having jurisdiction, sediment and erosion control drawings, sediment and erosion control plan, 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 STRIPPING OF TOPSOIL

- .1 Begin topsoil stripping of areas as directed by Departmental Representative after area has been cleared of brush, weeds, grasses and removed from site.
- .2 Strip topsoil to depths as directed by Departmental Representative.
 - .1 Avoid mixing topsoil with subsoil where textural quality will be moved outside acceptable range of intended application.
- .3 Stockpile in locations as directed by Departmental Representative.
 - .1 Stockpile height not to exceed 2 m.
- .4 Disposal of unused topsoil is to be in an environmentally responsible manner but not used as landfill.
- .5 Protect stockpiles from contamination and compaction.

3.3 PREPARATION OF EXISTING GRADE

- .1 Verify that grades are correct.
 - .1 If discrepancies occur, notify Departmental Representative and do not commence work until instructed by Departmental Representative.
- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .3 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials.
 - .1 Remove soil contaminated with calcium chloride, toxic materials and petroleum products.
 - .2 Remove debris which protrudes more than 75 mm above surface.
 - .3 Dispose of removed material off site.
- .4 Cultivate entire area which is to receive topsoil to minimum depth of 100 mm.
 - .1 Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

3.4 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

- .1 Place topsoil after Departmental Representative has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm.
- .3 For sodded areas keep topsoil 15 mm below finished grade.
- .4 Spread topsoil as indicated to following minimum depths after settlement.
 - .1 150 mm for seeded areas.
 - .2 135 mm for sodded areas.
 - .3 300 mm for flower beds.
 - .4 500 mm for shrub beds
- .5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

3.5 FINISH GRADING

- .1 Grade to eliminate rough spots and low areas and ensure positive drainage.
 - .1 Prepare loose friable bed by means of cultivation and subsequent raking.
- .2 Consolidate topsoil to required bulk density using equipment approved by Departmental Representative.
 - .1 Leave surfaces smooth, uniform and firm against deep footprinting.

3.6 ACCEPTANCE

- .1 Departmental Representative, Consultant will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

3.7 SURPLUS MATERIAL

- .1 Dispose of materials except topsoil not required off site.

3.8 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 45 00 – Quality Control
- .3 Section 01 61 00 – Common Product Requirements
- .4 Section 01 74 11 – Cleaning
- .5 Section 01 74 19 – Waste Management and Disposal.
- .6 Section 03 20 00 – Concrete Reinforcing
- .7 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- μ m (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 D1557-12e1, Modified Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³(2,700 kN- m/m³)).
- .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 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

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.
- .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 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 minimum 27.6 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.
 - .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 H2O 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 Backfilling and 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 three units 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 95% Modified Proctor Density to ASTM D1557.
- .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% Modified Proctor Density to ASTM D1557.
- .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.

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.
 - .3 When amount of raise is less than 600 mm use standard manhole brick, modoloc 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 In accordance with Section 01 45 00 – Quality Control.

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 01 45 00 - Quality Control
- .3 Section 01 71 00 - Examination and Preparation
- .4 Section 03 30 00 - Cast-In-Place Concrete
- .5 Section 26 05 43.01 - Installation of Cables in Trenches and in Ducts
- .6 Section 31 23 33.01 - Excavating, Trenching, and Backfilling.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A82/A82M-05a, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - .2 ASTM A185/A185M-05a, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .3 ASTM C139-05, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
 - .4 ASTM C 478/C478M-06, Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - .5 ASTM C858-10e1, Standard Specification for Precast Concrete Utility Structures.
 - .6 ASTM D1056-00, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
 - .7 ASTM D3034, Standard Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer and Pipe Fittings.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B196.3-M.983, PVC Underground Telecommunication Cable Ducting and Fittings
 - .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.
 - .3 CSA A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .4 CSA A23.4-09, Precast Concrete – Materials and Construction
 - .5 CAN/CSA-G30.18-M92 (R2002), Billet-Steel Bars for Concrete Reinforcement.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATION 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.

- .3 Shop Drawings: submit following in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Submit shop drawings for precast vaults. Shop drawings to be signed and sealed by Professional Engineer registered to practice in British Columbia.
 - .2 Submit shop drawings for integrally cast tie off points located in vaults.
 - .3 Submit shop drawings for brass makers.
 - .4 Submit shop drawings for stainless steel vault number markers.
 - .5 Submit shop drawings for PVC Ducts, fittings and spacers.
 - .6 Submit shop drawings for vault drainage fittings.
 - .7 Submit shop drawings for vault frames and covers.
 - .8 Submit shop drawings for conduit directories.
- .4 Quality assurance submittals: submit following in accordance with Section 01 45 00 Quality Control.
 - .1 Test reports: submit certified test reports for specified materials 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.
- .5 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.4 QUALITY ASSURANCE

- .1 Pre-Installation Meetings: Contractor to attend pre-installation meeting with Consultants one week prior to beginning work of this Section, with contractor's representative and PWGSC 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 manufacturer's written instructions.

PART 2 PRODUCTS

2.1 PVC DUCTS

- .1 PVC ducts, Rigid PVC – Schedule 40, encased in reinforced concrete.

2.2 PVC DUCT FITTINGS

- .1 Rigid PVC opaque solvent welded type couplings, bell end fittings, plugs, caps, adaptors as required to make complete installation.
- .2 Expansion joints.
- .3 Rigid PVC 5-degree angle couplings.
- .4 Factory Bends.

2.3 PRECAST CONCRETE VAULTS

- .1 Precast Concrete Vaults, BCL 625 Live Loading

- .2 Precast Concrete: to CSA A23.4-09.
 - .1 Precast concrete vaults and auxiliary sections to be fabricated in steel forms.
- .3 Aggregates: to CSA A23.1/A23.2.
- .4 Cement: CAN/CSA-A3001, Type GU.
- .5 Steel welded wire fabric mesh reinforcing: to ASTM A82/A82M.ASTM A185/A185M
- .6 Neoprene gasket seals between vault sections: to ASTM D1056.
- .7 Top, walls, and bottom: reinforced concrete complete with damp proofing.
- .8 Walls and bottom: monolithic concrete construction.
- .9 Buoyancy Collar: Provide shop drawings showing anti-flotation measures where noted.
- .10 Vault step and ladder rung spacing: 405mm
- .11 Locate duct entrances and windows near corners of structures to facilitate cable racking.
- .12 Covers: fit frames without play.
- .13 Castings: warp and blow hole free.
- .14 Form steel and iron to shape and size with sharp lines and angles.
- .15 Inserts and bolts for racks integrally cast in concrete.
- .16 Tie off points for cable pulling equipment:
 - .1 Load rating to meet Contractor's pulling equipment requirements.
 - .2 Load rating to be clearly indicated on lamacoid mounted and securely fastened to wall above tie off point. Lamacoid to measure 152mm X 50mm and contain red text on white background.
 - .3 To be integrally cast into vault.
 - .4 To be installed in wall opposite each duct line entrance.
- .17 Cable racks, including rack arms and insulators: sized to accommodate cable.
- .18 Exposed metal: smooth finish without sharp lines and arises.
- .19 Provide lugs, rabbets, and brackets.
- .20 Drainage Sump: To be integrally cast into vault.

2.4 DRAINAGE

- .1 Floor drain fittings: concrete sump and pipe connection to drainage system.
- .2 Storm sewer connection: Manufactured wye connections to PVC mainline pipe to be made with extrusion moulded PVC or fabricated PVC fittings manufactured to ASTM D3034.

2.5 VAULT NECKS

- .1 Precast concrete.

2.6 VAULT FRAMES AND COVERS

- .1 High Voltage vault ductile iron covers - Round:
 - .1 Ductile Iron frame and casting, minimum BCL 625 Live Loading.
 - .2 Size: 762mm diameter clear opening.
 - .3 Bolt down covers with proprietary security device (Penta head) with 5 spare interface keys.
 - .4 Assigned vault numbers to be installed on plaques set in concrete adjacent to vault as noted on Contract Drawings.

- .2 Low voltage and communication vault ductile iron covers – Square single Door:
 - .1 Ductile Iron frame and hatch cover, Airport Extra Heavy Duty (Proof Load Tested to 90,718.47 kg.), bottom flange frame design.
 - .2 Size: 914.4mm x 914.4mm clear opening.
 - .3 Hardware: Type 316 Stainless Steel (bolts, nuts and Nylock nuts)
 - .4 Bolt down covers with proprietary security device (Penta head). Manufacturer to provide 5 spare interface keys.
 - .5 Lifting Mechanisms: Stainless steel mechanical spring strut and self-engaging safety bar.
 - .6 Finishes: Slip resistant surface.
 - .7 Safety Grate: Rated 300 PSF. Material shall be 6061-T6 aluminium for bars and angles.
 - .8 Assigned vault numbers to be installed on plaques set in concrete adjacent to vault as noted on Contract Drawings.

2.7 GROUNDING

- .1 Ground rods: in accordance with Section 26 05 27 - Grounding - Primary for cable rack grounding.

2.8 CABLE RACKS

- .1 Hot dipped galvanized cable racks and supports.
- .2 12 x 100 mm preset inserts for rack mounting.

2.9 CABLE PULLING

- .1 Pull rope: 6 mm stranded nylon, tensile strength 5 kN, continuous throughout each duct run with 3 m spare rope at each end.

2.10 MARKERS

- .1 Brass type cable markers:
 - .1 Brass.
 - .2 5 mm thickness and 100 mm diameter area with 5mm x 50mm leg for setting into concrete.
 - .3 Brass marker to have words: "Electric Cable", engraved in top surface, with arrows to indicate direction of duct runs.
 - .4 Contractor to submit sample of brass marker and engraving text to Departmental Representative 6 weeks prior to ordering for review and approval by PWGSC.
- .2 Vault number markers:
 - .1 Stainless Steel
 - .2 5mm thickness 200mm x 100mm.
 - .3 Stainless steel marker to indicate vault number and abbreviated description (LV-Low Voltage, HV-High Voltage, COM-Communications) engraved in top. Font: Helvetica 1
 - .4 Markers to be set flush in concrete surround and fastened securely with stainless steel fasteners minimum 300mm from vault lid.
 - .5 Contractor to submit sample of stainless steel marker and engraving text to Departmental Representative 6 weeks prior to ordering for review and approval by PWGSC.

2.11 CONDUIT DIRECTORIES

- .1 All vaults shall be equipped with engraved lamacoid conduit directories. Each wall of the vault with conduit entry shall have a directory.

- .2 Directories shall indicate conduit configuration, orientation, and conduit numbering as indicated on drawings.
- .3 Conduit directories shall indicate conduit installed for fibre use only.
- .4 Conduit directories shall be a minimum size of 216mm x 280mm (8.5" x 11").
- .5 Conduit directories shall be submitted to the departmental representative in .PDF file format for review and approval prior to engraving and installation.

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 GENERAL

- .1 Install underground duct banks including formwork.
- .2 Build duct bank on undisturbed soil or on well compacted granular fill not less than 150 mm thick, compacted to 95% Modified Proctor Density in accordance with ASTM D1557.
- .3 Verify no obstructions will necessitate change in grade of ducts between vaults before ducts are laid.
- .4 Prior to laying ducts, construct "mud slab" not less than 75 mm thick where necessary to protect trench bottom from disturbance due to water intrusion.
- .5 Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400.
- .6 Install base spacers at maximum intervals of 1.5 m levelled to grades indicated for bottom layer of ducts.
- .7 Lay PVC ducts with configuration and reinforcing as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts at not less than 40 mm horizontally and vertically.
 - .1 Stagger joints in adjacent layers at least 150 mm and make joints watertight.
 - .2 Encase duct bank with minimum 50mm thick concrete cover, or as indicated on Contract Drawings.
 - .3 Use galvanized steel conduit for sections extending above finished grade level.
- .8 Make transpositions, offsets and changes in direction using 5-degree bend sections, do not exceed a total of 20 degrees with duct offset.
- .9 Use bell ends at duct terminations in vaults or buildings.
- .10 Use conduit to duct adapters when connecting to conduits.
- .11 Terminate duct runs with duct coupling set flush with end of concrete envelope when dead ending duct bank for future extension.
- .12 Cut, ream and taper end of ducts in field in accordance with manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.
- .13 Allow concrete to attain 50% of its specified strength before backfilling.
- .14 Use anchors, ties and trench jacks as required to secure ducts and prevent moving during placing of concrete.
 - .1 Tie ducts to spacers with twine or other non-metallic material.
 - .2 Remove weights or wood braces before concrete has set and fill voids.

- .15 Clean ducts before laying:
 - .1 Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.
- .16 Duct cleaning:
 - .1 Pull steel mandrel (300 mm long x diameter 6 mm less than internal diameter of duct) through each duct immediately after placing of concrete.
 - .2 Then pull stiff bristle brush through duct; avoid disturbing or damaging ducts where concrete has not set completely.
 - .3 Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .17 Install four 3 m lengths of 15M reinforcing rods, one in each corner of duct bank when connecting duct to vaults or buildings.
 - .1 Wire rods to 15M dowels at vault or building and support from duct spacers.
 - .2 Protect existing cables and equipment when breaking into existing vaults.
 - .3 Place concrete down sides of duct bank filling space under and around ducts.
 - .4 Rod concrete with flat bar between vertical rows filling voids.
- .18 Install pull rope continuous throughout each duct run with 3 m spare rope at each end.

3.3 VAULTS

- .1 Install precast Vaults.
- .2 Install ground rod before placing precast vaults and make vault to duct connection as indicated.
- .3 Provide 115 mm deep window to facilitate cable bends in wall at each duct connection.
 - .1 Terminate ducts in bell-end fitting flush with window face.
 - .2 Provide four 15M steel dowels at each duct run connection to anchor duct run.
 - .3 On runs of 16 ducts and over, support concrete duct encasement on a 700 mm thick concrete support poured against vault wall between bottom of trench and bottom of duct run, provide dowels for anchoring.
- .4 Alternately connect large duct runs by leaving square opening in wall, later pouring duct run and wall opening in one pour, and install 15M x 3m reinforcing rods in duct run at vault connection.
- .5 Build up concrete vault neck to bring cover flush with finished grade or elevations specified on drawings in paved areas and 40 mm above grade in unpaved areas.
- .6 Install vault frames and covers for each vault:
 - .1 Set frames in concrete grout onto vault neck.
- .7 Drain floor towards sump with 1 to 48 slope minimum and install drainage fittings as indicated. No ponding or standing water in vault permitted.
- .8 Install cable racks, anchor bolts as indicated.
- .9 Grout frames of vaults:
 - .1 Cement grout to consist of two parts sand and one part cement and sufficient water to form a plastic slurry.
- .10 Ensure filling of voids in joint being sealed.
 - .1 Plaster with cement grout, walls, ceiling and neck.
- .11 Spray paint "X" on ceiling of vault above floor drain or sump pit.

3.4 MARKERS

- .1 Mark location of duct runs on face and top of exposed duct bank sections at 3m intervals.

- .2 Mark hard surfaced areas not terminating in vault with railway spike driven flush in edge of pavement, directly over run.
- .3 Mark ducts every 150 m along straight runs and changes in direction.
- .4 Where markers are removed to permit installation of additional duct, reinstall existing markers.
- .5 Provide drawings showing locations of all markers.

3.5 FIELD QUALITY CONTROL

- .1 Site Tests/Inspections:
 - .1 Inspection of duct will be carried out by Departmental Representative prior to placing.
 - .2 Placement of concrete and duct cleanout to be done when Departmental Representative present.

3.6 CLEANING

- .1 See Section 01 74 11 - Cleaning.

END OF SECTION