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**PART 1 GENERAL**

**1.1 References**

- .1 National Building Code of Canada (NBC) latest edition including all amendments up to tender closing date.
- .2 National Plumbing Code of Canada (NPCC) 2010.
- .3 Canadian Electrical Code – Latest Edition.

**1.2 Description of Work**

- .1 Work under this Contract covers the supply and installation of a new tank monitoring systems in Fish Tank Room R16-101. Work shall generally include:
  - All cutting and patching as necessary to install all services.
  - Cutting and patching of existing concrete block walls.
  - Supply and install all PLC's and tank monitoring system components as indicated.
  - All communications, low voltage and line voltage wiring and circuiting as indicated on drawings
  - Programming of the existing SCADA system as indicated.
  - Supply and installation of automatic shut off valve and associated controls.

**1.3 Codes**

- .1 Perform work in accordance with National Building Code of Canada (NBC) and any other code of provincial or local application provided that in any case of conflict or discrepancy, the more stringent requirements shall apply.
- .2 Meet or exceed requirements of:
  - .1 contract documents,
  - .2 specified standards, codes and referenced documents.

**1.4 Documents Required**

- .1 Maintain at job site, one copy each of following:
  - .1 Contract drawings.
  - .2 Specifications.
  - .3 Addenda.

- .4 Reviewed shop drawings.
- .5 Change orders.
- .6 Other modifications to Contract.
- .7 Field test reports.
- .8 Copy of approved work schedule.
- .9 Manufacturers' installation and application instructions.

**1.5 Work Schedule**

- .1 Provide within 10 working days after Contract award, schedule showing anticipated progress stages and final completion of work within time period required by Contract documents. Work to commence immediately upon award and substantially completed 4 to 6 weeks later.
- .2 Interim reviews of work progress based on work schedule will be conducted as decided by Departmental Representative and schedule updated by Contractor in conjunction with and to approval of Departmental Representative.

**1.6 Cost Breakdown**

- .1 Before submitting first progress claim submit breakdown of Contract price in detail as directed by Departmental Representative and aggregating contract price. After approval by Departmental Representative cost breakdown will be used as basis for progress payment.

**1.7 Contractor's Use of Site**

- .1 Use of site: to be co-ordinated with the Departmental Representative.
- .2 Use following areas for work and storage: available areas within site boundary.
- .3 Obtain and pay for use of additional storage or work areas.

**1.8 Project Meetings**

- .1 Project meetings to be held at times and locations as determined by Departmental Representative.

- .2 Departmental Representative will arrange project meetings and record and distribute minutes.

### **1.9 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 his approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental

### **1.11 Concealment**

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

### **1.12 Cutting and Patching**

- .1 Obtain Departmental Representative approval before cutting, boring or sleeving load-bearing members other than those indicated on the drawings.
- .2 Cut and patch as required to make work fit.
- .3 Make cuts with clean, true, smooth edges.
- .4 Where new work connects with existing and where existing work is altered, cut, patch and make good to match existing work.
- .5 Refinish surfaces to match adjacent finishes: for continuous surfaces refinish to nearest wall/ceiling intersections.
- .6 Core drill floor slabs for penetrations of mechanical and electrical work.
- .7 Cut concrete using concrete saw or multiple core drilling. Pneumatic or impact tools are not allowed without prior approval.

**1.13 Existing Services**

- .1 Where Work involves breaking into or connecting to existing services, carry out work at times directed with minimum of service interruption.
- .2 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
- .3 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.
- .4 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.

**1.14 Additional Drawings**

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

**1.15 Building Smoking Environment**

- .1 There is no smoking permitted on the project work site.

**PART 2 PRODUCTS (NOT APPLICABLE)**

**PART 3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

**PART 1 GENERAL**

**1.1 Section Includes**

- .1 Title and description of Work.
- .2 Contract Method.
- .3 Work sequence.
- .4 Contractor use of premises.
- .5 Departmental representative occupancy.

**1.2 Work Covered by Contract Documents**

- .1 Work of this contract comprises of all architectural, structural, mechanical and electrical work for the supply and installation of a new tank monitoring system in the Fish Tank Room R16-101 in pod R16 at the NAFC, Whitehills Facility, St. John's. Refer to Section 01 00 50 – General Instruction for further description of work.

**1.3 Contract Method**

- .1 Construct the Work under a single lump sum contract.

**1.4 Work Sequence**

- .1 Construct Work to accommodate Departmental Representative continued use of premises during construction.
- .2 Maintain fire access/control.

**1.5 Contractor Use of Premises**

- .1 Contractor has restricted use of site and shall co-ordinate with the Departmental Representative.
- .2 Contractor shall have limited use of premises for storage and access.
- .3 Coordinate use of premises under direction of the Departmental Representative.
- .4 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

**1.6 Departmental Representative Occupancy**

- .1 Departmental Representative will occupy premises during entire construction period for execution of normal operations.
- .2 Cooperate with the Departmental Representative in scheduling operations to minimize conflict and to facilitate usage.

**PART 2 PRODUCTS**

**2.1 Not Used**

- .1 Not used.

**PART 3 EXECUTION**

**3.1 Not Used**

- .1 Not used.

**END OF SECTION**



**PART 1 GENERAL**

**1.1 Section Includes**

- .1 Shop drawings and product data.
- .2 Samples.
- .3 Certificates and transcripts.

**1.2 Related Sections**

- .1 Section 01770 – Closeout Procedures.
- .2 Section 01780 - Closeout Submittals.

**1.3 Administrative**

- .1 Submit to Departmental Representative submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Work affected by submittal shall not proceed 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 co-ordinated 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 shall be 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 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.

**1.4 Shop Drawings and Product Data**

- .1 Refer to DFO Contract documents.
- .2 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.
- .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 7 days for Departmental Representative review of each submission.
- .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 any 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 shall 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 review, distribute copies.
  - .10 Submit 6 prints of shop drawings for each requirement requested in specification Sections and as consultant may reasonably request.
  - .11 Submit 6 electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by the Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
  - .12 Delete information not applicable to project.
  - .13 Supplement standard information to provide details applicable to project.
  - .14 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, 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.
  - .15 The review of shop drawings by Consultant for sole purpose of ascertaining conformance with general concept. This review shall not mean that DFO or the consultant 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 all requirements of construction and Contract Documents. 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 all sub-trades.

## **1.5 Samples**

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

- .2 Deliver samples prepaid to Departmental Representative 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 become standard of workmanship and material against which installed Work will be verified.

**1.6 Mock-ups**

- .1 N/A

**1.7 Progress Photographs**

- .1 Provide photos to the consultant at 25% completion.

**1.8 Certificates and Transcripts**

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
- .2 Submit transcription of insurance immediately after award of Contract.

**PART 2 PRODUCTS**

**2.1 Not Used**

- .1 Not Used.

**PART 3 EXECUTION**

**3.1 Not Used**

- .1 Not Used.

**END OF SECTION**

**PART 1**

**GENERAL**

**1.1 Section Includes**

- .1 Fire Safety Requirements.
- .2 Hot Work Permit.
- .3 Existing Fire Protection and Alarm Systems.

**1.2 Related Works**

- .1 Section 01 35 26.06 Health and Safety Requirements.

**1.3 Definitions**

- .1 Hot Work defined as:
  - .1 Welding work
  - .2 Cutting of materials by use of torch or other open flame devices.
  - .3 Grinding with equipment which produces sparks.
  - .4 Use of open flame torches such as for roofing work.

**1.4 Submittals**

- .1 Submit copy of Hot Work Procedures and sample of Hot Work permit to designated Infrastructure Support Representative for review, within fourteen (14) calendar days of acceptance of bid.
- .2 Submit in accordance with Section 01 33 00.

**1.5 Fire Safety Requirements**

- .1 Implement and follow fire safety measures during Work. Comply with following:
  - .1 National Fire Code.
  - .2 Fire Protection Standards FCC 301 and FCC 302.
  - .3 Federal and Provincial Occupational Health and Safety Acts and Regulations.
- .2 In event of conflict between any provisions of above authorities the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, Designated Infrastructure Support Representative will advise on the course of action to be followed.

**1.6 Hot Work Authorization**

- .1 Obtain designated Infrastructure Support Representative's written "Authorization to

Proceed" before conducting any form of Hot Work on site.

- .2 To obtain authorization submit to designated Infrastructure Support Representative:
  - .1 Contractor's typewritten Hot Work Procedures to be followed on site as specified below.
  - .2 Description of the type and frequency of Hot Work required.
  - .3 Sample Hot Work Permit to be used.
- .3 Upon review and confirmation that effective fire safety measures will be implemented and followed during performance of hot work, Designated Infrastructure Support Representative will give authorization to proceed as follows:
  - .1 Issue one written "Authorization to Proceed" covering the entire project for duration of work or;
  - .2 Subdivide the work into pre-determined, individual activities, each activity requiring a separately written authorization to proceed.
- .4 Requirement for individual authorization will be based on:
  - .1 Nature or phasing of work;
  - .2 Risk to Facility operations;
  - .3 Quantity of various trades needing to perform hot work on project or;
  - .4 Other situations deemed necessary by the Designated Infrastructure Support Representative to ensure fire safety on premises.
- .5 Do not perform any Hot Work until receipt of Designated Infrastructure Support Representative's written "Authorization to Proceed" for that portion of work.
- .6 In tenant occupied Facility, coordinate performance of Hot Work with Departmental Representative through the Designated Infrastructure Support Representative. When directed, perform Hot Work only during non-operative hours of the Facility. Follow Designated Infrastructure Support Representative's directives in this regard.

## 1.7 Hot Work Procedures

- .1 Develop and implement safety procedures and work practices to be followed during the performance of Hot Work.
- .2 Hot Work Procedures to include:
  - .1 Requirement to perform hazard assessment of site and immediate work area beforehand for each hot work event in accordance with Safety Plan specified in Section 01 35 26.06.
  - .2 Use of a Hot Work Permit system with individually issued permit by Contractor's Superintendent to worker or subcontractor granting permission to proceed with Hot Work.
  - .3 Permit required for each Hot Work event.
  - .4 Designation of a person on site as a Fire Safety Watcher responsible to conduct a fire safety watch for a minimum duration of four (4) hours immediately following the completion of the Hot Work.
  - .5 Compliance with fire safety codes, standards and occupational health and

- safety regulations specified.
- .6 Site specific rules and procedures in force at the site as provided by the Departmental Representative.
- .3 Generic procedures, if used, must be edited and supplemented with pertinent information tailored to reflect specific project conditions. Label document as being the Hot Work Procedures for this contract.
- .4 Procedures shall clearly establish responsibilities of:
  - .1 Worker performing hot work,
  - .2 Person issuing the Hot Work Permit,
  - .3 Fire Safety Watcher,
  - .4 Subcontractor(s) and Contractor.
- .5 Brief all workers and subcontractors on Hot Work Procedures and of Permit system. Stringently enforce compliance.

## **1.8 Hot Work Permit**

- .1 Hot Work Permit to include the following:
  - .1 Project name and project number;
  - .2 Building name and specific room or area where hot work will be performed;
  - .3 Date of issue;
  - .4 Description of hot work type needed;
  - .5 Special precautions to be followed, including type of fire extinguisher needed;
  - .6 Name and signature of permit issuer.
  - .7 Name of worker to which the permit is issued.
  - .8 Permit validity period not to exceed EIGHT (8) hours. Indicate start time/date and termination time/date.
  - .9 Worker's signature with time/date of hot work completion.
  - .10 Stipulated time period of safety watch.
  - .11 Fire Safety Watcher's signature with time/date.
- .2 Permit to be typewritten form. Industry Standard forms shall only be used if all data specified above is included on form.
- .3 Each Hot Work Permit to be completed in full, signed and returned to Contractor's Superintendent for safe keeping on site.

## **1.9 Fire Protection and Alarm Systems**

- .1 Fire protection and alarm systems shall not be:
  - .1 Obstructed.
  - .2 Shut-off, unless approved by designated Infrastructure Support Representative.
  - .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 Costs incurred, from the fire department, Departmental Representative, resulting from negligently setting off false alarms will be charged to the Contractor in the form of financial progress payment reductions and holdback assessments against the Contract.

**1.10 Documents on Site**

- .1 Keep Hot Work Permits and Hazard assessment documentation on site for duration of Work.
- .2 Upon request, make available to Designated Infrastructure Support Representative or to authorized safety Representative for inspection.

**END OF SECTION**



**PART 1 GENERAL**

**1.1 Related Sections**

- .1 Section 01 33 00 - Submittal procedures.

**1.2 References**

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2 Province of Newfoundland and Labrador
  - .1 Occupational Health and Safety Act, R.S.N. Latest Edition.

**1.3 Submittals**

- .1 Make submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
  - .1 Results of site specific safety hazard assessment.
  - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative and authority having jurisdiction, weekly.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit Material Safety Data Sheets (MSDS) to Departmental Representative.
- .7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 3 after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 3 days after receipt of comments from Engineer.
- .8 Departmental Representative review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .9 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.

- .10 On-site Contingency and Emergency Response Plan: Address standard operating procedures to be implemented during emergency situations.

#### **1.4 Filing of Notice**

- .1 File Notice of Project with Provincial authorities prior to commencement of Work.

#### **1.5 Safety Assessment**

- .1 Perform site specific safety hazard assessment related to project.

#### **1.6 Meetings**

- .1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

#### **1.7 Project/Site Conditions**

- .1 Work at site will involve contact with:
  - .1 Building occupants.

#### **1.8 General Requirements**

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to commencing any site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

#### **1.9 Responsibility**

- .1 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.
- .2 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.

**1.10 Compliance Requirements**

- .1 Comply with Occupational Health and Safety Act, Occupational Health and Safety Regulations, C. Nfld. Reg., Latest Edition.
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

**1.11 Unforeseen Hazards**

- .1 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, and follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction. Advise De verbally and in writing.

**1.12 Health and Safety Co-ordinator**

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
  - .1 Have minimum 2 years' site-related working experience specific to activities associated with building renovations.
  - .2 Have working knowledge of occupational safety and health regulations.
  - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
  - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
  - .5 Be on site during execution of Work and report directly to and be under direction of site supervisor.

**1.13 Posting of Documents**

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Departmental Representative.

**1.14 Correction of Non-Compliance**

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.

- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

**1.15 Blasting**

- .1 N/A

**1.16 Powder Actuated Devices**

- .1 N/A

**1.17 Work Stoppage**

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

**PART 2 PRODUCTS**

**2.1 Not Used**

- .1 Not used.

**PART 3 EXECUTION**

**3.1 Not Used**

- .1 Not used.

**END OF SECTION**

**PART 1      GENERAL**

**1.1          Fires**

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

**1.2          Disposal of Wastes**

- .1      All waste materials must be disposed of at an approved landfill site. The Contractor is responsible for obtaining permission from the operator of the landfill prior to disposing of wastes. The Contractor shall provide the DFO Departmental Representative with written permission from the operator of the landfill prior to the final disposal of wastes.
- .2      Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers. All wastes must be disposed of in an approved landfill.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 Section Includes**

- .1 Barriers.

**1.2 Related Sections**

- .1 Section 02 06 00 – Demolition.

**1.3 Installation and Removal**

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

**1.4 Dust Tight Screens**

- .1 Provide dust tight screens and dust barriers to localize dust generating activities, and for protection of workers, finished areas of Work and public.
- .2 Maintain and relocate protection until such work is complete.

**1.5 Protection of Building Finishes**

- .1 Provide protection for finished and partially finished building and equipment during performance of work.
- .2 Provide necessary screens, covers etc.
- .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.

**PART 2 PRODUCTS**

**2.1 Not Used**

- .1 Not Used.

**PART 3 EXECUTION**

**3.1 Not Used**

- .1 Not Used.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 Section Includes**

- .1 Product quality, availability, storage, handling, protection, and transportation.
- .2 Manufacturer's instructions.
- .3 Quality of Work, coordination and fastenings.
- .4 Existing facilities.

**1.2 Precedence**

- .1 For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

**1.3 Reference Standards**

- .1 Within text of each specifications section, reference may be made to reference standards.
- .2 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .3 If there is question as to whether any product or system is in conformance with applicable standards, Consultant reserves right to have such products or systems tested to prove or disprove conformance.
- .4 Cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.
- .5 Conform to latest date of issue of referenced standards in effect on date of submission of Tenders, except where specific date or issue is specifically noted.

**1.4 Quality**

- .1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own

expense and be responsible for delays and expenses caused by rejection.

- .3 Should any dispute arise as to quality or fitness of products, decision rests strictly with the Consultant based upon requirements of Contract Documents.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 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.

### **1.5 Availability**

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are foreseeable, notify Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .2 In event of failure to notify the Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the Consultant reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

### **1.6 Storage, Handling and Protection**

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent



spontaneous combustion.

- .8 Remove and replace damaged products at own expense and to satisfaction of the Consultant.
- .9 Touch-up damaged factory finished surfaces to the Consultant's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

**1.7 Transportation**

- .1 Pay costs of transportation of products required in performance of Work.

**1.8 Manufacturer's Instructions**

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify the Consultant] in writing, of conflicts between specifications and manufacturer's instructions, so that the Consultant may establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Consultant to require removal and re-installation at no increase in Contract Price or Contract Time.

**1.9 Quality of Work**

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify the Consultant if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. The Consultant and Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with the Consultant, whose decision is final.

**1.10 Co-Ordination**

- .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

**1.11 Concealment**

- .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation, inform the Consultant if there is interference. Install as directed by the Consultant.

**1.12 Remedial Work**

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

**1.13 Location of Fixtures**

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform the Consultant of conflicting installation. Install as directed.

**1.14 Fastenings**

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

**1.15 Fastenings -  
Equipment**

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

**1.16 Protection of  
Work in Progress**

- .1 Prevent overloading of any part of building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of the Consultant.
- .2 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants.
- .3 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

**1.17 Existing  
Utilities**

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, building occupants and pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

**PART 2        GENERAL**

**2.1            Not Used**

.1            Not used.

**PART 3        GENERAL**

**3.1            Not Used**

.1            Not used.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 Section Includes**

- .1 Progressive cleaning.
- .2 Final cleaning.

**1.2 Related Section**

- .1 Section 01 74 21 - Waste Management and Disposal.
- .2 Section 01 77 00 - Closeout Procedures.

**1.3 Project Cleanliness**

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Departmental Representative or other Contractors.
- .2 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.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris.
- .5 Provide and use clearly marked separate bins for recycling. Refer to Section 01 74 21 - Waste Management and Disposal.
- .6 Remove waste material and debris from site and deposit in waste container at end of each working day.
- .7 Dispose of waste materials and debris off site.
- .8 Clean interior areas prior to start of finish 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.

**1.4 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 other than 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.

**PART 2 PRODUCTS**

**2.1 Not Used**

- .1 Not Used.

**PART 3 EXECUTION**

**3.1 Not Used**

- .1 Not Used.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 Section Includes**

- .1 List significant generic types of products, work, or requirements specified. Do not include procedure, process, preparatory work, or final adjusting and cleaning. Include Waste Audit, Waste Reduction Workplan, Materials Source Separation Program, and Cost/Revenue Analysis Workplan.

**1.2 Definitions**

- .1 Waste Audit (WA): Relates to projected waste generation. Involves measuring and estimating quantity and composition of waste, reasons for waste generation, and operational factors which contribute to waste.
- .2 Waste Reduction Workplan (WRW): Written report which addresses opportunities for reduction, reuse, or recycling of materials. WRW is based on information acquired from WA (Schedule A).
- .3 Demolition Waste Audit (DWA): Relates to actual waste generated from project.
- .4 Materials Source Separation Program (MSSP): Consists of a series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .5 Cost/Revenue Analysis Workplan (CRAW): Based on information from WRW, and intended as financial tracking tool for determining economic status of waste management practices.
- .6 Waste Management Coordinator (WMC): Designate individual who is in attendance on-site, full-time. Designate, or have designated, individuals from each Subcontractor to be responsible for waste management related to their trade and for coordinating activities with WMC.
- .7 Separate Condition: Refers to waste sorted into individual types.

**1.3 Site Visit**

- .1 Pre-tender site visit: Walk-through of project site prior to completion of tender submittal is mandatory. Date, time and location to be arranged by the Departmental Representative.

**1.4 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.

**1.5 Use of Site and Facilities**

- .1 Execute work with least possible interference or disturbance to normal use of premises.
- .2 Maintain security measures established by existing facility.

**1.6 Submittal**

- .1 Submit requested submittals in accordance with Section 01330 - Submittal Procedures.
- .2 Prepare and submit the following submittals prior to project start-up:
  - .1 Submit 2 copies of completed Waste Audit (WA): Schedule A.
  - .2 Submit 2 copies of completed Waste Reduction Workplan (WRW): Schedule B.
  - .3 Submit 2 copies of completed Demolition Waste Audit (DWA): Schedule C.
  - .4 Submit 2 copies of Cost/Revenue Analysis Workplan (CRAW): Schedule D.
  - .5 Submit 2 copies of Materials Source Separation Program description.

**1.7 Waste Audit**

- .1 Conduct WA prior to project start-up.
- .2 Prepare Waste Audit: Schedule A.
- .3 Record, on Waste Audit - Schedule A, extent to which materials or products used consist of recycled or reused materials or products.

**1.8 Waste Reduction Workplan**

- .1 Prepare WRW prior to project start-up.
- .2 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.
- .3 Describes management of waste.
- .4 Identify opportunities for reduction, reuse, and/or recycling (3Rs) of materials. Based on information acquired from WA.
- .5 Post workplan or summary where workers at site are able to review its content.

**1.9 Demolition Waste Audit**



- .1 Prepare Demolition Waste Audit (DWA) prior to project start-up.
- .2 Complete Demolition Waste Audit (DWA): Schedule C.

**1.10 Cost/Revenue Analysis Workplan**

- .1 Prepare CRAW: Schedule D.

**1.11 Materials Source Separation Program**

- .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 approved by Departmental Representative.
- .3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and/or recyclable materials.
- .4 Provide containers to deposit reusable and/or 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. Transport to approved and authorized recycling facility.
- .8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition. Ship materials to site operating under Certificate of Approval. Materials must be immediately separated into required categories for reuse or recycling.

**1.12 Waste Processing Sites**

- .1 For approved sites, contact Provincial Department of Environment.

**1.13 Disposal of Wastes**

- .1 Burying of rubbish and waste materials is prohibited unless approved by Departmental Representative.
- .2 Disposal of waste, volatile materials, mineral spirits, oil, paint thinner, into waterways, storm, or sanitary sewers is prohibited.

**1.14 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, stockpile, store and catalogue salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Protect structural components not removed for demolition from movement or damage.
- .6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Departmental Representative.
- .7 Protect surface drainage, mechanical and electrical from damage and blockage.

**1.15 Scheduling**

- .1 Coordinate work with other activities at site to ensure timely and orderly progress of the work.

**PART 2 PRODUCTS**

**2.1 Not Used**

- .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 Separate recyclable materials from general waste stream and stockpile in separate piles or containers, to approval of Departmental Representative, and consistent with applicable fire regulations. Mark containers or stockpile areas. Provide instruction on disposal practices.
- .2 On-site sale of salvaged, recovered, reusable, recyclable materials is not permitted.

**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.
- .2 Section 01 91 13 - Commissioning.

**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 of satisfactory completion of Contractor's Inspection and that corrections have been made.
  - .2 Request Departmental Representative Inspection.
- .2 Departmental Representative Inspection: Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.
- .3 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 Operation of systems have been demonstrated to Departmental Representative personnel.
  - .5 Work is complete and ready for Final Inspection.
- .4 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative and Contractor. If Work is deemed incomplete by Departmental Representative complete outstanding items and request reinspection.
- .5 Declaration of Substantial Performance: when Departmental Representative consider deficiencies and defects have been corrected and it appears requirements of Contract have been substantially performed, make application for certificate of Substantial Performance.

- .6 Commencement of Lien and Warranty Periods: date of Departmental Representative acceptance of submitted declaration of Substantial Performance shall be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.
- .7 Final Payment: When Departmental Representative consider final deficiencies and defects have been corrected and it appears requirements of Contract have been totally performed, make application for final payment. If Work is deemed incomplete by Departmental Representative, complete outstanding items and request reinspection.
- .8 Payment of Holdback: After issuance of certificate of Substantial Performance of Work, submit an application for payment of holdback.

**PART 2 PRODUCTS**

**2.1 Not Used**

- .1 Not Used.

**PART 3 EXECUTION**

**3.1 Not Used**

- .1 Not Used.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 Section Includes**

- .1 As-built, samples, and specifications.
- .2 Equipment and systems.
- .3 Product data, materials and finishes, and related information.
- .4 Operation and maintenance data.
- .5 Spare parts, special tools and maintenance materials.
- .6 Warranties and bonds.

**1.2 Related Sections**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 77 00 - Closeout Procedures.
- .3 Section 01 91 13 - Commissioning.
- .4 Division 22 and 26.

**1.3 Submissions**

- .1 Submit two (2) copies of 'As-Built' drawings and Maintenance Manuals for approval by the Departmental Representative.
- .2 Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- .3 Copy will be returned after final inspection, with Departmental Representative comments.
- .4 Revise content of documents as required prior to final submittal.
- .5 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, two final copies of operating and maintenance manuals in English.
- .6 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .7 If requested, furnish evidence as to type, source and quality of products provided.

- .8 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .9 Pay costs of transportation.

**1.4 Format**

- .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 systems, under 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.

**1.5 Contents - Each Volume**

- .1 Table of Contents: provide title of project;
  - .1 date of submission; names,
  - .2 addresses, and telephone numbers of Consultant and Contractor with name of responsible parties;
  - .3 schedule of products and systems, indexed to content of volume.
- .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.

#### **1.6 As-builts and Samples**

- .1 In addition to requirements in General Conditions, maintain at the site for Departmental Representative 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.

#### **1.7 Recording Actual Site Conditions**

- .1 Record information on set of blue line opaque drawings, and in copy of Project Manual, 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 Final Survey**

- .1 N/A

**1.9 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.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.

- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 91 13 - Commissioning.
- .15 Additional requirements: As specified in individual specification sections.

**1.10 Materials and Finishes**

- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional Requirements: as specified in individual specifications sections.

**1.11 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 site; 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.

**1.12 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 site; 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.

**1.13 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 site; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

**1.14 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.

**1.15 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 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.

**PART 2 PRODUCTS**

**2.1 Not Used**

- .1 Not Used.

**PART 3 EXECUTION**

**3.1 Not Used**

- .1 Not Used.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 Section Includes**

- .1 Commissioning of all new mechanical and electrical systems and components including:
  - .1 Testing and adjustment
  - .2 Demonstrations
  - .3 Instructions of all procedures for Departmental Representative personnel
  - .4 Updating as-built data
  - .5 Co-ordination of Operation and Maintenance material.

**1.2 References**

- .1 National Fire Code.
- .2 CSA (Canadian Standards Association).
- .3 Canadian Electrical Code.

**1.3 Quality Assurance**

- .1 Personnel to be employed in the Commissioning activities shall be qualified trades persons, certified testing agencies and factory approved by the Commissioning Team Leader or the Departmental Representative.

**1.4 Pre-commissioning**

- .1 The purpose of the pre-commissioning process is to ensure the project is completed to permit the execution of the Commissioning process for this project.
- .2 The Pre-commissioning process must be fully completed to the satisfaction of the Commissioning Team prior to conducting the Commissioning process.
- .3 The Pre-commissioning Team shall consist of:
  - .1 General Contractor.
  - .2 Departmental Representative (or the designated Departmental representative)
  - .3 Departmental Representative
  - .4 Applicable sub-trade representative.
  - .5 Equipment Manufacturer's representative.
  - .6 Others as identified by the Engineer.
- .4 The Pre-commissioning process shall include the site verification that all systems are operable and performed to the intent of the Specification.

**1.5 Commissioning**

- .1 The Commissioning process shall be conducted once all pre-commissioning activities are completed.
- .2 The purpose of the Commissioning process is to fully test all systems including mechanical and electrical components and operating procedures by challenging these systems to realistic operation conditions.
- .3 The Commissioning activities shall be co-ordinated by the General Contractor.
- .4 The Commissioning exercise shall be conducted over period deemed necessary by the Departmental Representative for the mechanical section of the specifications.
- .5 Commissioning activities for the mechanical systems shall have available up to date as-built drawing information and accurate Operations and Maintenance Manuals. These documents shall be a major part of this activity.
- .6 Contractor shall arrange for all outside suppliers, equipment manufacturers, test agencies and others as identified in the commissioning sections of this specification and bear all associated cost.
- .7 The Commissioning Team shall be comprised of the individuals or groups as identified in Section 1.2 Pre-commissioning, including the Engineer.

**1.6 Procedures**

- .1 Ensure all required personnel are present at the scheduled activities.
- .2 Provide all documentation and drawings as defined in the specifications.

**1.7 Preparation**

- .1 Provide test instruments required for all activities as defined by the Engineer.
- .2 Verify all systems were Pre-commissioned.
- .3 Confirm all scheduled activities will have identified personnel available.

**1.8 System Demonstration**

- .1 Perform all start up operations, control adjustment, trouble shooting, servicing and maintenance of each item of equipment as defined by the Engineer.
- .2 Departmental Representative will provide list of personnel to receive instructions and will co-ordinate their attendance at agreed upon times.

- .3 Prepare and insert additional data in operations and maintenance manuals and update as-built drawings when need for additional data becomes apparent during the Commissioning exercise.
- .4 Where instruction is required, instruct personnel in all phases of operation and maintenance using Operation and Maintenance Manuals as the basis of instruction.
- .5 Review all contents of the manuals in detail to explain all aspects of operation and maintenance.

**1.9 Schedule of Activities**

- .1 The events concerning the Pre-commissioning and Commissioning activities shall be conducted based on a pre-established schedule with all members of the Commissioning Team.
- .2 For Contract purposes, the schedule of activities will be as follows:
  - .1 Pre-commissioning - to be completed prior to commissioning by the Contractor.
  - .2 Commissioning:
    - One half (1/2) day – all trades.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **RELATED SECTIONS**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 01 74 21 - Construction / Demolition Waste Management and Disposal.
- .3      Section 01 78 00 - Closeout Submittals.

**1.2**            **SUBMITTALS**

- .1      Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2      Shop drawings; submit drawings stamped and signed for approval by Departmental Representative.
- .3      Shop drawings to show:
  - .1      Mounting arrangements.
  - .2      Operating and maintenance clearances.
- .4      Shop drawings and product data accompanied by:
  - .1      Detailed drawings of bases, supports, and anchor bolts.
  - .2      Acoustical sound power data, where applicable.
  - .3      Points of operation on performance curves.
  - .4      Manufacturer to certify current model production.
  - .5      Certification of compliance to applicable codes.
- .5      In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .6      Closeout Submittals:
  - .1      Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2      Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
  - .3      Operation data to include:
    - .1      Control schematics for systems including environmental controls.
    - .2      Description of systems and their controls.
    - .3      Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4      Operation instruction for systems and component.



- .5 Description of actions to be taken in event of equipment failure.
- .6 Valves schedule and flow diagram.
- .7 Colour coding chart.
- .4 Maintenance data to include:
  - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
  - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
  - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .7 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
  - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings or AutoCAD files. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
  - .3 Use different colour for each service.
  - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 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).

- .3 Submit to Departmental Representative for approval and make corrections as directed.
- .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
- .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

### **1.3 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

### **1.4 MAINTENANCE**

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- .1 All materials used on this project shall be new and CSA approved unless noted otherwise.

## **PART 3 EXECUTION**

### **3.1 PAINTING, REPAIRS AND RESTORATION**

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.

- .3 Restore to new condition, finishes which have been damaged.

### **3.2 CLEANING**

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork.

### **3.3 COORDINATION**

- .1 Contractor to allow for offsets of piping to accommodate site interferences. Coordinate all work prior to any piping installation to ensure ceiling heights can be achieved.
- .2 Contractor to allow for 40 domestic water offsets into joist space to accommodate interferences with other trades/own trades. Allow for 40mm dia piping in offset allowance

### **3.4 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
  - .1 Perform tests as specified in other sections of this specification.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

### **3.5 DEMONSTRATION**

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Contractor to supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.

- .5 Departmental Representative may record these demonstrations on video tape for future reference.

**3.6 PROTECTION**

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **RELATED SECTIONS**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 01 35 29.06 - Health and Safety Requirements.
- .3      Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .4      Section 01 78 00 - Closeout Submittals.
- .5      Section 22 05 00 – Common Work Results for Plumbing.
- .6      Section 23 05 05 - Installation of Pipework.

**1.2**            **REFERENCE STANDARDS**

- .1      Do the work in accordance with National Plumbing Code – 2015 and local authority having jurisdiction except where specified otherwise.

**1.3**            **SHOP DRAWING AND PRODUCT DATA**

- .1      Submit shop drawings in accordance with Specification Section - Shop Drawings, Product Data, Samples & Mock-ups.

**1.4**            **MAINTENANCE MANUALS**

- .1      Provide maintenance data for incorporation into manuals specified in Specification Section Operation and Maintenance Manual.
- .2      Data to include:
  - .1      Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
  - .2      Details of operation, servicing and maintenance.
  - .3      Recommend spare parts list.

**PART 2**      **PRODUCTS**

**2.1**            **P.V.C. PIPE AND FITTINGS**

- .1      Pipe: All P.V.C. (polyvinyl chloride) piping and fittings shall be Schedule 80 Type 1, Grade 1 PVC (Cell classification 12454-B) conforming to ASTM D2466 with a maximum service temperature of 60°C, and a design stress of 13780 kPa.

- .2 Joints: All pipe & fittings shall be joined by solvent cement unless otherwise noted.

**2.2 TRUE UNION BALL VALVES, PVC**

- .1 True Union Ball Valves to be of PVC Type I, cell classification 12454-B, with safety-shear stem, polypropylene handle, EPDM o-rings, and union nuts with buttress threads. All valve components shall be replaceable and valve to be approved for potable water systems. All valve seal carriers shall be safety blocked.
- .2 Acceptable Material: 'Chemline' CTVU series Safe-Bloc or approved equal.

**2.3 BUTTERFLY VALVES**

- .1 All butterfly valves to be wafer style, ANSI 150 lb. drilling, once piece moulded PVC body, EPDM seals, flanged connections, and lever handles.
- .2 Acceptable Material: 'Chemline' TBA series or approved equal.

**2.4 WAFER CHECK VALVES**

- .1 Wafer check valves shall have a PVC body capable of slipping between standard flanges, with EPDM seals to meet standard B.137.0.
- .2 Acceptable Material: 'Chemline' SCA series, or approved equal.

**2.5 BALL CHECK VALVES**

- .1 All ball check valves shall be PVC Type 1, Grade 1, cell classification 12454-A with EPDM rubber seat and slip-out true union ends.
- .2 Acceptable Material: 'Chemline', BCA series or approved equal.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Install all piping, fittings, valves and specialties in accordance with the manufacturers recommendations.
- .2 Run all piping straight and true with building lines.
- .3 All flange bolts and nuts to be 304 stainless steel.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **RELATED SECTIONS**

- .1      Section 01 74 11 – Cleaning.
- .2      Section 01 74 21 – Construction / Demolition Waste Management and Disposal

**1.2**            **WASTE MANAGEMENT AND DISPOSAL**

- .1      Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2      Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3      Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4      Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

**1.3**            **QUALITY ASSURANCE**

- .1      Installers to be certified to journeyperson.

**PART 2**      **PRODUCTS (NOT USED)**

**PART 3**      **EXECUTION**

**3.1**            **CONNECTIONS TO EQUIPMENT**

- .1      In accordance with manufacturer's instructions unless otherwise indicated.
- .2      Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
  - .1      Unions are not required in installations using grooved mechanical couplings (The couplings shall serve as unions).
- .3      Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

- .4 Provide flexible pipe connector at equipment connections to prevent vibration attenuation and stress relief. Couplings shall be placed in close proximity to the source of the vibration, as per manufacturer's recommendations.

### 3.2 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

### 3.3 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.
- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

### 3.4 AIR VENTS

- .1 Install automatic air vents at high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

### 3.5 DIELECTRIC WATERWAY FITTINGS AND COUPLINGS

- .1 General: Compatible with system, to suit pressure rating of system.
- .2 Locations: Where dissimilar metals are joined.
- .3 NPS 2 and under: Isolating waterway fittings, unions or bronze valves.
  - .1 Waterway fittings shall be complete with thermoplastic liner.
- .4 Over NPS 2: Isolating waterway fittings and flanges.
  - .1 Waterway fittings shall be complete with thermoplastic liner.



**3.6 PIPEWORK INSTALLATION**

- .1 Installation by certified journey person.
- .2 Screwed fittings jointed with Teflon tape or pipe dope as recommended by manufacturer.
- .3 Grooved joint couplings and fittings shall be installed in accordance with the manufacturer's written installation instructions.
  - .1 Gaskets shall be verified as suitable for the intended service prior to installation. Gaskets shall be molded and produced by the coupling manufacturer.
  - .2 The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.
- .4 Push-to-connect piping: Prepare copper tube and install in strict accordance with installation instructions. Pipe ends shall be cleaned, free from indentations, projections, burrs and foreign matter. Use a tube preparation tool as supplied by the manufacturer to clean and make installation mark. Push copper tube into fittings to installation depth mark, per installation instructions. Keep fittings free of dirt and oil.
- .5 Protect openings against entry of foreign material.
- .6 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .7 Assemble piping using fittings manufactured to ANSI standards.
- .8 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.
  - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .9 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .10 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .11 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .12 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .13 Group piping wherever possible and as indicated.

- .14 Ream pipes, remove scale and other foreign material before assembly.
- .15 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .16 Provide for thermal expansion as indicated.
- .17 Valves:
  - .1 Install in accessible locations.
  - .2 Remove interior parts before soldering.
  - .3 Install with stems above horizontal position unless otherwise indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Install globe valves in bypass around control valves.
  - .6 Use ball or butterfly valves at branch take-offs for isolating purposes except where otherwise specified.
  - .7 Install butterfly valves on chilled water and related condenser water systems only.
  - .8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
  - .9 Install ball valves for glycol service.
  - .10 Use chain operators on valves NPS 2-1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
- .18 Check Valves:
  - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.
  - .2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

### 3.7 SLEEVES

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:

- .1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
- .2 Other floors: Terminate 25 mm above finished floor.
- .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint.
- .6 Sealing:
  - .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.
  - .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
  - .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
  - .4 Ensure no contact between copper pipe or tube and sleeve.

### **3.8 ESCUTCHEONS**

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.
- .3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

### **3.9 PREPARATION FOR FIRESTOPPING**

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 - Firestopping.
- .2 Uninsulated unheated pipes not subject to movement: No special preparation.
- .3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation, or install per manufacturer's recommendation as specified within the associated approval.
- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

### **3.10 FLUSHING OUT OF PIPING SYSTEMS**

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in relevant sections of other Divisions.

- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.
- .4 Upon operation of hydronic systems the bypass filters shall be checked and filter elements replaced until hydronic system runs clean.

**3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

- .1 Advise Departmental Representative, 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: Test as specified in relevant sections of other sections or Divisions.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of other Divisions.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Departmental Representative. Work to be carried out in off hours after 5 p.m., weekends or holidays.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

**END OF SECTION**

**PART 1**      **General**

**1.1**            **GENERAL**

- .1      This Section covers items common to Sections of Division 26. This section supplements requirements of Division 1, Division 23, Division 27, Division 28, Division 33 and Division 34. Refer to Section 01 00 00 – Bid Depository Sections where applicable for bid depository.

**1.2**            **REFERENCES**

- .1      Canadian Standards Association (CSA)
  - .1      CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
  - .2      CAN/CSA-22.3 No. 1, Overhead Systems.
  - .3      CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

**1.3**            **CARE, OPERATION AND START-UP**

- .1      Instruct Departmental Representative and operating personnel in the operation, care and maintenance of systems, system equipment and components.
- .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      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.
- .4      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 all aspects of its care and operation.

**1.4**            **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. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

## **1.5 SUBMITTALS**

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, 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 coordinated 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 of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .5 Quality Control: in accordance with Section 01 45 00 - Quality Control.
  - .1 Provide CSA certified equipment and material. Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for approval before delivery to site.
  - .2 Submit test results of installed electrical systems and instrumentation.
  - .3 Submit, upon completion of Work, load balance report as described in sentence 3.4.6.
  - .4 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.

## **1.6 PERMITS, FEES AND INSPECTION**

- .1 Submit to Electrical Inspection Division and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Departmental Representative will provide drawings and specifications required by Electrical Inspection Division and Supply Authority at no cost.
- .4 Notify Departmental Representative of changes required by Electrical Inspection Division prior to making changes.
- .5 Furnish Certificates of Acceptance from Electrical Inspection Division or authorities having jurisdiction on completion of work to Departmental Representative.

**1.7 CO-ORDINATION**

- .1 Co-ordinate work with work of other divisions to avoid conflict.
- .2 Locate distribution systems, equipment, and materials to provide minimum interference and maximum usable space.
- .3 Where interference occurs, Departmental Representative must approve relocation of equipment and materials regardless of installation order.
- .4 Notwithstanding the review of shop drawings, this division may be required to relocate electrical equipment which interferes with the equipment of other trades, due to lack of co-ordination by this Division. The cost of this relocation shall be the responsibility of this Division. The Departmental Representative shall decide the extent of relocation required.

**1.8 CUTTING AND PATCHING**

- .1 Inform all other divisions in time, concerning required openings. Where this requirement is not met, bear the cost of all cutting. Openings shall be the responsibility of Division 26. Obtain written approval of Structural engineer before drilling any beams or floors.

**1.9 PROTECTION**

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark all live parts “LIVE 120 VOLTS”, or with appropriate voltage in English.
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

**1.10 RECORD DRAWINGS**

- .1 Obtain and pay for three sets of white prints. As the job progresses, mark these prints to accurately indicate installed work. Have the white prints available for inspection at the site at all times and present for scrutiny at each job meeting.
- .2 Show on the record drawings the installed inverts of all services entering and leaving the building and the property. Dimension underground services at key points of every run in relation to the structure and building.
- .3 Indicate exact location of all services for future work. Show and dimension all work embedded in the structure.
- .4 Submit record drawings within 30 days prior to start of commissioning.

**1.11 INSPECTION OF WORK**

- .1 The Departmental Representative will make periodic visits to the site during construction to ascertain reasonable conformity to plans and specifications but will not execute quality control. The Contractor shall be responsible for the execution of his work in conformity with the construction documents and with the requirements of the inspection authority.

**1.12 SCHEDULING OF WORK**

- .1 Any work that disturbs the normal operation of facility shall be coordinated with the Departmental Representative and scheduled accordingly.
- .2 Become familiar with the phasing requirements for the work and comply with these conditions.
- .3 No additional monies will be paid for contractor's requirement to comply with work phasing conditions.

**1.13 FIRE RATING OF PENETRATIONS**

- .1 Maintain fire ratings around conduits passing through floors, ceilings and fire rated walls.
- .2 Use 3M brand or equal fire barrier products at each penetration.
- .3 Acceptable products for fire barrier products shall be 3M #CP25 fire barrier caulk, #303 putty, #FS 195 wrap and #CS195 sheet.
- .4 Acceptable manufacturers: Nelson, Fire Stop Systems, 3M or approved equal. Material of same manufacturer to be used throughout project..

**PART 2 PRODUCTS**

**2.1 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings, where applicable.
- .2 Wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 23 and shown on mechanical drawings. Division 23 –Contractor is responsible for all conduit, wiring and connections below 50V which are related to control systems in Division 25 and shall comply with the requirements of Division 26 for standard of quality.



**2.2 MATERIALS AND EQUIPMENT**

- .1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Division.
- .3 Factory assemble control panels and component assemblies.

**2.3 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

**2.4 WARNING SIGNS**

- .1 As specified and to meet requirements of Electrical Inspection Department and Departmental Representative.
- .2 Porcelain enamel decal signs, minimum size 175 x 250 mm.

**2.5 WIRING TERMINATIONS**

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

**2.6 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates and labels as follows:
  - .1 Nameplates: Lamicoid 3 mm thick plastic engraving sheet, black white face, black white core, mechanically attached with self tapping screws.
  - .2 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 Labels:
  - .1 Embossed plastic labels with 6 mm high letters unless specified otherwise.

- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for average of twenty-five (25) letters per nameplate and label.
- .5 Identification to be English (and French where applicable).
- .6 Nameplates for terminal cabinets and junction boxes to indicate system name and voltage characteristics.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system name and voltage.

**2.7 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings, either numbered or 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 code: to CSA C22.1, Canadian Electrical Code.
- .4 Use colour coded wires in communication cables, matched throughout system.

**2.8 CONDUIT AND CABLE 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.

<u>Conduit System</u>	<u>Prime Color</u>	<u>Auxiliary Color</u>
up to 250 V	Yellow	
up to 600 V	Yellow	Green

**PART 3 EXECUTION**

**3.1 NAMEPLATES AND LABELS**

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

**3.2 CONDUIT AND CABLE INSTALLATION**

- .1 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

**3.3 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical at following heights unless indicated otherwise.
  - .1 Local switches: 1200 mm.
  - .2 Wall receptacles:
    - .1 General: 400 mm.
    - .2 In mechanical rooms: 1400 mm.
  - .3 Panelboards: as required by Code or as indicated.
  - .4 Telephone and interphone outlets: 300 mm.
  - .5 Wall mounted telephone and interphone outlets: 1400 mm.

**3.4 CO-ORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

**3.5 FIELD QUALITY CONTROL**

- .1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks – the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.
- .2 The work of this division to be carried out by a contractor who holds a valid Code 1 Electrical Contractor License as issued by the Province.
- .3 Perform tests in Accordance with this section as noted and Section 01 91 13 – Commissioning (Cx) Requirements.
- .4 Load Balance:
  - .1 Measure phase current to panelboard 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 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.
- .5 Conduct and pay for following tests:
  - .1 Circuits originating from branch distribution panels.
  - .2 Motors, heaters and associated control equipment including sequenced operations of systems where applicable.
- .6 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .7 Carry out tests in presence of Departmental Representative.
- .8 Provide instruments, meters, equipment and personnel required to conduct tests during and conclusion of project.
- .9 Submit test results for Departmental Representative review and include in Commissioning Manuals specified in Section 01 91 13 – Commissioning (Cx) Requirements.

### **3.6 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      Materials and installation for wire and box connectors.

**1.2**            **RELATED SECTIONS**

- .1      Section 26 05 00 – Common Work Results - Electrical.

**1.3**            **REFERENCES**

- .1      Canadian Standards Association (CSA)
  - .1      CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes and Fittings.
  - .2      CAN/CSA-C22.2 No.65, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2      Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1      EEMAC 1Y-2, 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 C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2      Fixture type splicing connectors to: CSA C22.2 No.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 stranded copper conductors.
  - .2      Clamp for copper bar.
  - .3      Stud clamp bolts.
  - .4      Bolts for copper bar.
  - .5      Sized for conductors and bars as indicated.
- .4      Clamps or connectors for armoured cable, aluminum sheathed cable, flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2 No.18.

**PART 3**      **EXECUTION**

**3.1**            **INSTALLATION**

- .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**      **RELATED SECTIONS**

- .1      Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.
- .2      Refer to drawings for wiring type required under different applications.

**1.2**      **REFERENCES**

- .1      Canadian Standards Association (CSA)
  - .1      CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.
  - .2      CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.

**PART 2**      **PRODUCTS**

**2.1**      **BUILDING WIRES**

- .1      Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2      Copper and ACM alloy conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.
- .3      Copper conductors: size as indicated, with thermoplastic insulation type TWH rated at 600 V, typically used for insulated ground wires.
- .4      Type ACM conductors permitted for feeders above 60 amps.

**2.2**      **ARMOURED CABLES**

- .1      Conductors: insulated, copper, size as indicated.
- .2      Type: AC90.
- .3      Armour: interlocking type fabricated from aluminum strip.
- .4      Connectors: standard as required, complete with double split rings.

**2.3**      **CONTROL CABLES**

- .1      Type LVT: 2 soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket. Low energy 300 V control cable: stranded annealed copper conductors sized as indicated, with PVC insulation type TW - 40° C polyethylene insulation with shielding of tape coated with paramagnetic material wire braid over each conductor and overall covering of PVC jacket. To be FT-6 rated.

**PART 3**      **EXECUTION**

**3.1**            **FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 No splices permitted in panel board feeders in new construction. Splices in re-work or renovation projects only with pre-approval by Departmental Representative.

**3.2**            **GENERAL CABLE INSTALLATION**

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

**3.3**            **INSTALLATION OF BUILDING WIRES**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34- Conduits, Fastenings and Fittings.

**3.4**            **INSTALLATION OF ARMoured CABLES (AC-90)**

- .1 Group cables wherever possible.
- .2 Use permitted only for work in movable partitions and vertical power supply drops to lighting fixtures.



**3.5           INSTALLATION OF CONTROL CABLES**

- .1       Install control cables in conduit as indicated.
- .2       Ground control cable shield.

**END OF SECTION**

**PART 1**      **GENERAL (NOT APPLICABLE)**

**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 as required.
- .2      All supports, fasteners and attachments to be 304 stainless steel.

**PART 3**      **EXECUTION**

**3.1**            **INSTALLATION**

- .1      Secure equipment to hollow or 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.
  - .4      Strap AC-90 cable at box location plus every 900 mm.
- .7      Suspended support systems.
  - .1      Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  - .2      Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

- .8 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing, wood blocking, plastic strap or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **RELATED SECTIONS**

- .1      Section 01 33 00 – Submittal Procedures.
- .2      Section 01 91 13 – General Commissioning (Cx) Requirements.
- .3      Section 26 05 00 – Common Work Results – Electrical.

**1.2**            **SUBMITTALS**

- .1      Submit shop drawings and product data for cabinets.
- .2      Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3      Provide drawings stamped and signed by professional engineer registered or licensed in the Province of Newfoundland and Labrador, Canada.

**PART 2**      **PRODUCTS**

**2.1**            **SPLITTERS**

- .1      Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2      Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3      At least three spare terminals on each set of lugs in splitters less than 400 A.

**2.2**            **JUNCTION AND PULL BOXES**

- .1      Welded steel construction with screw-on flat covers for surface mounting.
- .2      Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

**2.3**            **CABINETS**

- .1      Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.
- .2      Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 19 mm fir plywood backboard for surface flush mounting.

**PART 3**      **EXECUTION**

**3.1**            **SPLITTER INSTALLATION**

- .1      Install splitters and mount plumb, true and square to the building lines.
- .2      Extend splitters full length of equipment arrangement except where indicated otherwise.

**3.2**            **JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1      Install pull boxes in inconspicuous but accessible locations.
- .2      Mount cabinets with top not higher than 2 m above finished floor.
- .3      Install terminal block as indicated in Type T cabinets.
- .4      Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

**3.3**            **IDENTIFICATION**

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

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **RELATED SECTIONS**

- .1      Section 26 05 00 – Common Work Results – Electrical.
- .2      Section 26 05 29 – Hangers and Supports for Electrical Systems.
- .3      Section 26 05 34 – Conduits, Conduit Fastenings and Fittings.

**1.2**            **REFERENCES**

- .1      Canadian Standards Association (CSA)
  - .1      CSA C22.1, Canadian Electrical Code, Part 1.

**PART 2**      **PRODUCTS**

**2.1**            **OUTLET AND CONDUIT BOXES GENERAL**

- .1      Size boxes in accordance with CSA C22.1.
- .2      102 mm square or larger outlet boxes as required for special devices.
- .3      Gang boxes where wiring devices are grouped.
- .4      Blank cover plates for boxes without wiring devices.
- .5      347 V outlet boxes for 347 V switching devices.
- .6      Combination boxes with barriers where outlets for more than one system are grouped.

**2.2**            **GALVANIZED STEEL OUTLET BOXES**

- .1      Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2      Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .3      102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .4      102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

**2.3 CONDUIT BOXES**

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

**2.4 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE**

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables. For use in wood stud construction only.

**2.5 FITTINGS - GENERAL**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.
- .5 Double split rings for AC-90 terminations.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware, a National Standard of Canada.
  - .2 CSA C22.2 No. 45, Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.
  - .6 CAN/CSA C22.2 No. 227.3, Nonmetallic Mechanical Protection Tubing (NMPT), a National Standard of Canada.

**1.2**      **SUBMITTALS**

- .1 Product data: submit manufacturer's printed product literature, specifications and datasheets.
  - .1 Submit cable manufacturing data.
- .2 Quality assurance submittals:
  - .1 Test reports: submit certified test reports.
  - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3 Instructions: submit manufacturer's installation instructions.

**PART 2**      **PRODUCTS**

**2.1**      **CONDUITS**

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .2 Flexible metal conduit: to CSA C22.2 No. 56, aluminum liquid-tight flexible metal.
- .3 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3,

**2.2**      **CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.



- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m oc.
- .4 Threaded rods, 6 mm dia., to support suspended channels.

### **2.3 CONDUIT FITTINGS**

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90°, 45 ° or 22.5° bends are required for 25 mm and larger conduits.
- .3 Ensure conduit bends other than factory “ells” are made with an approved bender. Making offsets and other bends by cutting and rejoining 90 degree bends are not permitted.
- .4 Connectors and couplings for EMT. Steel set-screw type, size as required.

### **2.4 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

### **2.5 FISH CORD**

- .1 Polypropylene.

## **PART 3 EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install all conduit, conduit fittings and accessories in accordance with the latest edition of the Canadian Electrical Code in a manner that does not alter, change or violate any part of the installed system components or the CSA/UL certification of these components.

- .2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .3 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .4 Surface mount conduits except in finished areas or as indicated.
- .5 Use electrical metallic tubing (EMT) except in cast concrete and above 2.4 m not subject to mechanical injury, as well as concealed work in masonry construction.
- .6 Use flexible metal conduit for connection to motors in dry areas connection to recessed incandescent fixtures without a prewired outlet box connection to surface or recessed fluorescent fixtures work in movable metal partitions.
- .7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .8 Use AC-90 for vertical power supply drops to light fixtures.
- .9 Minimum conduit size for lighting and power circuits: 19 mm. 12 mm conduit is acceptable for switch leg drops only where one two-wire circuit and ground is required.
- .10 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .11 Mechanically bend steel conduit over 19 mm dia.
- .12 Install fish cord in empty conduits.
- .13 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .14 Dry conduits out before installing wire.

### 3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended channels.
- .5 Do not pass conduits through structural members except as indicated.

- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

**3.4 CONCEALED CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

**3.5 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 01 33 00 - Submittal Procedures.
- .2      Section 01 91 13 – General Commissioning (Cx) Requirements.
- .3      Section 26 05 00 – Common Work Results - Electrical.

**PART 2**      **PRODUCTS**

**2.1**            **DISCONNECT SWITCHES**

- .1      Fusible and non-fusible, disconnect switch in CSA Enclosure type 1, size as indicated.
- .2      Provision for padlocking in on-off switch position by three locks.
- .3      Mechanically interlocked door to prevent opening when handle in ON position.
- .4      Fuses: size as indicated, to Section 26 28 13.01 - Fuses - Low Voltage.
- .5      Fuseholders: suitable without adaptors, for type and size of fuse indicated.
- .6      Quick-make, quick-break action.
- .7      ON-OFF switch position indication on switch enclosure cover.

**2.2**            **EQUIPMENT IDENTIFICATION**

- .1      Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2      Indicate name of load controlled on size 4 nameplate.

**PART 3**      **EXECUTION**

**3.1**            **INSTALLATION**

- .1      Install disconnect switches complete with fuses as indicated.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SCOPE OF WORK**

- .1      Testing and commissioning are called for throughout the individual specifications. This does not relieve this trade from providing all testing and commissioning necessary to ensure that systems and equipment operate as required and that they interface with other systems and equipment as required.

**1.2**            **SECTION INCLUDES**

- .1      Commissioning of all building electrical systems and component including:
  - .1      Testing and adjustment.
  - .2      Demonstrations and Training.
  - .3      Instructions of all procedures for Departmental Representative personnel.
  - .4      Updating as-built data.
  - .5      Co-ordination of Operation and Maintenance material.

**1.3**            **RELATED SECTION**

- .1      Section 01 77 00 – Closeout Procedures.
- .2      Section 01 91 13 – General Commissioning (Cx) Requirements.
- .3      Section 26 05 00 – Common Work Results - Electrical.

**1.4**            **REFERENCES**

- .1      CSA (Canadian Standards Association).
- .2      Underwriters Laboratories of Canada.

**1.5**            **QUALITY ASSURANCE**

- .1      Provide qualified trades persons, certified testing agencies, factory trained and approved by the Commissioning Team Leader.
- .2      Submit the names of all personnel to be used during the Commissioning activities for Departmental Representative.

**1.6**            **COMMISSIONING**

- .1      The purpose of the commissioning process is to fully test all building systems including architectural, mechanical and electrical components and operating procedures by challenging these systems to realistic operation conditions.
- .2      The Commissioning activities shall be co-ordinated by the General Contractor.

- .3 Commissioning activities for the electrical systems must have available up to date as-built drawing information and accurate Operations and Maintenance Manuals. These documents shall be a major part of this activity.
- .4 Contractor shall be responsible to update all documentation with information and any changes duly noted during the Commissioning exercise.
- .5 Contractor shall arrange for all outside suppliers, equipment manufacturers, test agencies and others as identified in the commissioning sections of this specification. The cost associated with this requirement shall be included as part of the tender price.

## **1.7 SUBMITTALS**

- .1 A commissioning document shall be prepared by the Departmental Representative prior to conducting these activities for use by the Commissioning Team.
- .2 The electrical sub-contractor shall be responsible for ensuring all activities are properly documented in this manual and co-ordinated through the General Contractor.
- .3 As-built drawings and data books must be available two weeks prior to commissioning for review and use by the consultant and Commissioning Team prior to the start of the commissioning activities.

## **1.8 PREPARATION**

- .1 Provide test instruments required for all activities as defined in the commissioning documents.
- .2 Verify all systems are in compliance with the requirements of the commissioning documents prior to the precommissioning check out operation.
- .3 Confirm all scheduled activities have identified personnel available.
- .4 Where systems or equipment do not operate as required, make the necessary corrections or modifications, re-test and re-commission.

## **1.9 SYSTEM DESCRIPTION**

- .1 Perform all start up operations, control adjustment, trouble shooting, servicing and maintenance of each item of equipment as defined in the commissioning documentation.
- .2 Departmental Representative will provide list of personnel to receive instructions and will co-ordinate their attendance at agreed upon times.
- .3 Prepare and insert additional data in the operations and maintenance manuals and update as-built drawings when need for additional data becomes apparent during the commissioning exercise.

- .4 Where instruction is specified in the commissioning manual, instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
- .5 Conduct presentation on Departmental Representative premises. Departmental Representative will provide space.

**1.10 FINAL REPORT**

- .1 This trade shall assemble all testing data and commissioning reports and submit them to the Departmental Representative.
- .2 Each form shall bear signature of recorder, and that of supervisor of reporting organizer.

**1.11 SCHEDULE OF ACTIVITIES**

- .1 Commissioning activities shall be conducted based on pre-established schedule with all members of the commissioning team, refer to Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 In addition, there will be two meetings held through the contract duration to introduce the parties of the commissioning team, establish the schedules and deadlines for the various activities and review the Commissioning Manual.
- .3 Adhering to the established schedule is very important as the co-ordination and scheduling of the participants will be difficult to alter once this is established. Close co-ordination of this schedule is important.
- .4 In the event project cannot be commissioned in the allotted time slot, the contractor shall pay for all costs associated with assembling the Commissioning Team at a later date. If the contractor has not performed his duties to reach commissioning stage as outlined earlier, he will incur all expenses of other trades and the Commissioning Team due to his non-compliance.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

.1            Section Includes:

- .1            This Section includes SCADA software and hardware for control of process equipment, process oriented machinery, and process systems.
- .2            The SCADA system supplier, as defined below shall be responsible for the following:
  - .1            Connection of all CL<sub>2</sub> and O<sub>2</sub> monitoring equipment and connection to existing SCADA system
  - .2            Supply of all control panels required to achieve process controls.
  - .3            Provide all required equipment and labour to connect the building internet connection for remote monitoring and alarms for staff at multiple locations in the facility.
  - .4            Complete system graphics representing all system points and operational setpoints, alarms and status.

**1.2**            **RELATED SECTIONS**

- .1            The contractor is to ensure that all related work is co-ordinated among all specification sections, as well as between other Divisions, and that the tender price includes all related work. The referenced sections below are for guidance only and are not necessarily a complete list of related sections.
- .2            Section 01 33 00 – Submittal Procedures.
- .3            Section 01 35 29.06 – Health and Safety Requirements.
- .4            Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .5            Section 40 94 43 - Programmable Logic Controllers

**1.3**            **REFERENCES**

- .1            American National Standards Institute (ANSI)
  - .1            ANSI/ISA 5.5, Graphic Symbols for Process Displays.
- .2            American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
  - .1            ANSI/IEEE 260.1, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3            American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
  - .1            ASHRAE STD 135, BACNET - Data Communication Protocol for Building



- .4 Automation and Control Network.
- .4 Canadian Standards Association (CSA International).
  - .1 CAN/CSA-Z234.1, Canadian Metric Practice Guide.
- .5 Consumer Electronics Association (CEA).
  - .1 CEA-709.1-B, Control Network Protocol Specification.
- .6 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Assessment Act (CEAA).
  - .2 Canadian Environmental Protection Act (CEPA).
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .8 Transport Canada (TC).
  - .1 Transportation of Dangerous Goods Act (TDGA).
- .9 National Electrical Manufacturers Association (NEMA)

#### 1.4 **ACRONYMS, ABBREVIATIONS AND DEFINITIONS**

- .1 Acronyms used in SCADA
  - .1 AEL - Average Effectiveness Level
  - .2 AI - Analog Input
  - .3 AO - Analog Output
  - .4 BACnet - Building Automation and Control Network
  - .5 BC(s) - Building Controller(s)
  - .6 BECC - Building Environmental Control Centre
  - .7 CAB - Canadian Automated Building (CAB) Protocol
  - .8 CAD - Computer Aided Design
  - .9 CDL - Control Description Logic
  - .10 CDS - Control Design Schematic
  - .11 COSV - Change of State or Value
  - .12 CPU - Central Processing Unit
  - .13 DI - Digital Input
  - .14 DO - Digital Output
  - .15 DP - Differential Pressure
  - .16 ECU - Equipment Control Unit
  - .17 HVAC - Heating, Ventilation, Air Conditioning
  - .18 IDE - Interface Device Equipment
  - .19 I/O - Input/Output
  - .20 ISA - Industry Standard Architecture
  - .21 LAN - Local Area Network
  - .22 LCU - Local Control Unit
  - .23 MCU - Master Control Unit

- .24 NC - Normally Closed
- .25 NO - Normally Open
- .26 OS - Operating System
- .27 O&M - Operation and Maintenance
- .28 OWS - Operator Work Station
- .29 PC - Personal Computer
- .30 PCI - Peripheral Control Interface
- .31 PCMCIA - Personal Computer Micro-Card Interface Adapter
- .32 PID - Proportional, Integral and Derivative.
- .33 RAM - Random Access Memory
- .34 ROM - Read Only Memory
- .35 SP - Static Pressure
- .36 TCU - Terminal Control Unit
- .37 USB - Universal Serial Bus
- .38 UPS - Uninterruptible Power Supply
- .39 WAN- Wide Area Network

## 1.5

### DEFINITIONS

- .1 AI: Analog Input
- .2 AO: Analog Output
- .3 Control Panel Designer: A firm or individual that is responsible for designing the layout of control panels. This person will choose the devices to be included in the panel, and will decide on the actual layout.
- .4 CPU: Central Processing Unit
- .5 DI: Digital Input
- .6 DO: Digital Output
- .7 HMI: Human-Machine Interface
- .8 I/O Input and/or Output
- .9 Node: A network connection point. Examples include a PLC, PC, Operator Interface Terminal, Switch, Server, etc.
- .10 Open Protocol: A network protocol whose configuration code is available with or without a fee or license.
- .11 Operator Interface Terminal: A terminal usually embedded in a control panel that allows the operator to view and modify control system parameters. Operator Interface Terminals are not capable of running commercially available software.
- .12 Operator Station: A terminal that runs a commercially available operating system such as Windows. An Operator Station will usually execute the SCADA software. Operator Stations are usually desktop mounted personal computers. However, they may be computers that are designed to be embedded in the doors of control panels and
- .13 PID: Control action, proportional plus integral plus derivative.
- .14 PLC: Programmable Logic Controller
- .15 Public Domain: A network protocol whose configuration code is available without the

- need to pay a fee or buy a license.
- .16 SCADA: Supervisory Control and Data Acquisition. A SCADA System is a computer (typically a personnel computer), or a group of computers and servers running a software dedicated for SCADA purposes. This SCADA software can exchange over industrial networks, with PLC's, VFD's, and other industrial devices. Typically, the SCADA software will allow for trending, graphic display, alarm tracking, and reporting of data.
  - .17 SCADA System Provider: A company that takes a commercially available SCADA software package, and then develops a project specific application. This company will typically supply hardware for the SCADA software and application to operate on.
  - .18 SDT: Site Demonstration Test
  - .19 Point: may be logical or physical.
    - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
    - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction which related equipment (stop, start) and value or damper actuators.
  - .20 Point Name: composed of two parts, point identifier and point expansion.
    - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
      - .1 Area descriptor: building or part of building where point is located.
      - .2 System descriptor: system that point is located on.
      - .3 Point descriptor: physical logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
    - .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system", and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
    - .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
      - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.
  - .21 Point Object Type: points fall into following object types:
    - .1 AI (analog input)
    - .2 AO (analog output)
    - .3 DI (digital input)
    - .4 DO (digital output)
    - .5 Pulse inputs

- .22 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
  - .1 Printouts: to ANSI/IEEE 260.1.

**1.6 SYSTEM DESCRIPTION**

- .1 Refer to control schematics, sequences of operation and related Divisions of specifications for system architecture.
- .2 Work covered by sections referred to above consists of fully operational SCADA system, including, but not limited to the following:
  - .1 PLC Controllers.
  - .2 Control devices as listed in I/O point summaries and/or shown on the control drawings.
  - .3 New/updated SCADA graphics (VTScada by Trihedral)
  - .4 Data communications equipment necessary to affect SCADA data transmission system to water treatment plant.
  - .5 Field control devices.
  - .6 Software/Hardware complete with full documentation.
  - .7 Complete operating and maintenance manuals.
  - .8 Training of personnel.
  - .9 Acceptance tests, technical support during commissioning, full documentation.
  - .10 Wiring interface co-ordination of equipment supplied by others.
  - .11 Miscellaneous work as specified in these sections and as indicated.
- .3 Design Requirements:
  - .1 Design and provide conduit and wiring linking elements of system.
  - .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed prior to installation.
  - .3 Location of controllers as reviewed by Departmental Representative prior to installation.
  - .4 Provide utility and emergency power to all SCADA devices.
  - .5 Metric references: in accordance with CAN/CSA Z234.1.
- .4 Language Operating Requirements:
  - .1 Provide English interface to system through operator selectable access codes.
  - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.
  - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.
  - .4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for

- .5 maintaining optimal operating efficiency.  
Include, in English:
  - .1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definitions).
  - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in English at specified OWS. Point name expansions in English.
  - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.
- .6 The network design to be a fully distributed network, with each primary system having its own locally mounted dedicated controller. Any failure in the network shall **not** in any way affect the control of these primary systems. Connecting hardware points from one system to more than one controller is not acceptable. Any points associated with a system are to be connected to one dedicated controller. Each dedicated controller to have a locally mounted control and display device to allow the operator to view and adjust any point on the controller.
- .7 All wiring associated with the SCADA communication network as well as all control wiring and conduit associated with the SCADA at 50 volts or less. Wire and conduit above 50 volts by Electrical Division.
- .8 The SCADA system for this facility to be accessible by designated personnel via the existing Internet connection for monitoring and control purposes. The SCADA contractor to provide all the required hardware, software, gateways, etc. needed to permit connection to the SCADA. This shall include all hardware, software, programming, start-up and commissioning required.

## 1.7 SUBMITTALS

- .1 In addition to below make submittals in accordance with Section 01 33 00 - Submittal Procedures Submit for review:
  - .1 Equipment list and systems manufacturers within ten (10) working days after award of contract.
- .2 Quality Control:
  - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
  - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
  - .3 Submit proof of compliance to specified standards with shop drawings and product data
  - .4 In lieu of such evidence, submit certificate from testing organization, approved by third party Engineer registered in Canada, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
  - .5 For materials whose compliance with organizational standards/codes/ specifications is not regulated by organization using its own listing or label as

proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

- .6 Permits and fees: in accordance with general conditions of contract.
- .7 Existing devices intended for re-use: submit test report.
- .3 Product Data:
  - .1 The SCADA system provider shall be responsible for the accuracy and completeness of all aspects of the SCADA submittal. This includes SCADA software detailed herein, and applicable hardware. If the SCADA system provider is providing Operator Interface Terminals, then the relevant Operator Interface Terminal Submittals must be completed in addition to the four types listed below:
    - .1 Design submittal:
    - .2 System Documentation Submittals
    - .3 Testing Submittals
    - .4 Training Submittals:

## 1.8 QUALITY ASSURANCE

- .1 Have local office(Newfoundland Island) for at least 5 years staffed by factory trained personnel capable of installing and providing instruction, routine maintenance and emergency service on systems.
- .2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.
- .3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
- .4 Ensure factory qualified supervisory personnel continuously direct and monitor work and attend site meetings.
- .5 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .6 Be able to provide factory trained personnel on site within two (2) working days notice or provide instructions on maintenance and emergency service on system.
- .7 SCADA system shall use an Ethernet network as the preferred peer-to-peer network. To protect the municipality's ability to competitively bid future projects, the Ethernet network shall utilize open protocols that are in the public domain. This protocol shall be the Modbus TCP/IP Network. Equipment to convert a non-public domain Ethernet protocol to a public domain protocol shall not be accepted.
- .8 SCADA System Availability Requirements:
  - .1 A fundamental objective of the SCADA System Supplier's proposed system design shall be to ensure that no single equipment failure or temporary error condition can disable the system operation or generate any spurious control commands to the system equipment.

- .2 Single Point of Failure:
  - .1 The SCADA equipment configuration shall prevent any single hardware or software failure from causing loss of any system function or from causing overall system malfunction. Single hardware failures may cause loss of specific communication channels temporarily until failed equipment is replaced.
- .3 SCADA Operational Checks: The SCADA System Supplier's proposed system shall continually check the operation of all devices in the system and report any problem to the user. Upon detecting a malfunction, the failed operation shall be attempted a number of times (programmable) in order to determine whether the malfunction is temporary or permanent. Permanent malfunctions shall be alarmed and logged. Temporary malfunctions shall not be alarmed but shall be logged for maintenance purposes. Failed devices shall be automatically replaced by spare or backup devices if such devices are available.
- .4 System Availability: During the System Availability Demonstration, the SCADA system shall achieve an average availability rate for all functions of at least 99.95 percent. This is equivalent to a total downtime of approximately 4 hours per year for the System.

#### 1.9 DELIVERY, STORAGE AND HANDLING

- .1 Deliver Operator Stations and SCADA software in packaging designed to prevent damage from static electricity, and physical damage.
- .2 Store Operator Stations and SCADA software according to manufacturers' requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect Operator Stations and SCADA software from exposure to dirt, fumes, water, corrosive substances, and physical damage. Also, protect the Operator Stations and SCADA software from all forms of electrical and magnetic energy that could reasonably cause damage.
- .3 Material Delivery Schedule: provide Departmental Representative with "Materials Delivery Schedule" within 2 weeks after award of contract.
- .4 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.
  - .5 Place materials defined as hazardous or toxic in designated containers.
  - .6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional, Municipal, and Provincial regulations.

- .7 Label location of salvaged material's storage areas and provide barriers and security devices.
- .8 Ensure emptied containers are sealed and stored safely.
- .9 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .10 Fold up metal and plastic banding, flatten and place in designated area for recycling

**1.10 EXISTING CONDITIONS - CONTROL COMPONENTS**

- .1 Do not utilize existing control wiring and provide all new wiring and conduit.
- .2 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed
- .3 Upgrade any existing systems as necessary to complete work outlined in this project scope.

**PART 2      PRODUCTS**

**2.1 SCADA SYSTEM**

- .1 Panels to be NEMA rated to suit environmental requirements.
- .2 Panels to have hinged doors equipped with standard keyed-alike cabinet locks, keyed to same key.
- .3 Provide LCD touchscreen HMI display in face of new PLC control panel with display of all status points.
- .4 Wiring within panels to be contained within properly sized rigid PVC slotted wall wire duct. All wiring within the wire duct to be concealed with a non-slip cover.
- .5 Control panels to be NEMA 4x fiberglass.
- .6 Terminations for the connection of power wiring, communication wiring and field mounted devices to be at properly identified terminal blocks mounted within the control panel.
- .7 All control panels to be provided with an internally mounted 120 volt duplex power receptacle.
- .8 All control panels to be identified with permanently mounted Lamecoid tags to identify the control panel and the systems served by the control panel. Submit schedule of labels with shop drawing submission.
- .9 Provide low voltage transformers in panels or elsewhere as required.
- .10 Provide adaptors between metric and imperial components.
- .11 Provide battery UPS at each control panel and at computer station
- .12 Acceptable Material: VTScada, Trihedral

**PART 3      EXECUTION**

**3.1 MANUFACTURER'S RECOMMENDATIONS**

- .1 Installation to be to manufacturer's recommendations. Provide printed copies of



recommendations with shop drawings or product data.

### 3.2 **GRAPHICS**

- .1 Provide all new graphics for work included in this contract.
- .2 Graphics to be visually represent tanks and sensors arrangement accurately with all status, alarms, all ModBUS points, etc. displayed.
- .3 Graphics to show all control points including but not limited to all alarm setpoints, valve position, O<sub>2</sub> levels, CL<sup>2</sup> levels and alarms.
- .4 Graphics to include accurate flow diagram with all piping and valve/equipment arrangements
- .5 Graphics to be completed showing accurate floor plan arrangement with all tanks and sensors identified with live data displayed.
- .6 Graphics to be reviewed and approved by Departmental Representative and any changes required completed as part of the contract.
- .7 Provide the ability to set-up trends.

### 3.3 **PAINTING**

- .1 Painting to be in accordance with NEMA, supplemented as follows:
- .2 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
- .3 Restore to new condition, finished surfaces which have been damaged too extensively to be primed and touched up to make good.
- .4 Clean and prime exposed hangers, racks, fastenings, and other support components.
- .5 Paint all unfinished equipment installed indoors to NEMA.

### 3.4 **FACTORY ACCEPTANCE TEST (FAT):**

- .1 Description:
  - .1 Thorough testing and verification for all deliverable equipment, software, and associated documentation shall be performed on all SCADA System Provider proposed system components. The tests shall be performed to verify that the equipment is manufactured and assembled correctly, is operating as designed, and complies with the contractual requirements. The tests shall be performed to verify that the software and hardware will meet the functional and performance requirements of this document. The equipment shall be interconnected and subjected to comprehensive system testing that simulates field conditions and operations. The Factory Acceptance Test (FAT) shall include the test and verification activities specified in this section. The FAT will be attended by the Engineer. The FAT will be conducted by the SCADA System Provider.
- .2 System Configuration Verification:
  - .1 Prior to beginning the Factory Acceptance Testing, the stem/subsystem/elements shall be subjected to deliverable configuration and serialization verification. A copy of the System Inventory List annotated to reflect this verification shall be included with the Factory Acceptance Test Report. No equipment replacement or substitutions shall be permitted without rigorous quality control accounting and retesting of affected equipment.

- .3 Equipment Test and Verification:
  - .1 Hardware Tests:
    - .1 The Factory Acceptance Test shall include individual end-item verification and integrated tests of all hardware. These tests shall include visual inspection verification, running standard hardware diagnostic programs, and running all special diagnostic programs used by the SCADA System Provider to demonstrate that the hardware integration task has been completed. Performance testing of all Individual Servers and Workstations, including demonstration of CPU, Memory and Storage functions shall be conducted. All hardware enclosures shall be inspected. As a minimum, the following shall be inspected and verified:
      - .1 Cabinet enclosures
      - .2 Frame structure
      - .3 Paint work and finish
      - .4 Dimensions
  - .2 Inspections:
    - .1 As a minimum the following inspections shall be performed:
      - .1 CFE and Console Panels physical layout
      - .2 Power supply mounting
      - .3 Power cable routing
      - .4 Data cable routing
      - .5 Wiring runs across hinges properly installed
      - .6 Fans and blowers are unobstructed
      - .7 Power conditioning correctly installed.
- .4 System Functional Test
  - .1 Test Functionalities:
    - .1 The functional test shall exercise and demonstrate the successful operation of every specified system function and shall include, but not be limited to, the following:
      - .1 Rigorous exercising of all devices both individually and collectively.
      - .2 Verification of proper scanning and data acquisition of all status and data points.
      - .3 Verification of proper Control Strategy up/down loading to the PLCs/RTUs.
      - .4 Demonstration of analog input, pulse input, and analog output accuracy.
      - .5 Testing of all user interface functions.
      - .6 Verification of all control operations to ensure that they result in the correct sequence of operation at all the PLCs/RTUs using the test PLC/RTU.
      - .7 Simulation of communication error conditions and demonstration of error detection and handling.
      - .8 All specified display types, reports, and operator/user procedures

- must be shown to be implemented and verified for accuracy.
- .9 Create and process device failure conditions including PLC failure, Operator Workstation failure, peripheral failures, etc. Special attention shall be given to creating failures in the middle of operator sequences and control actions such as:
  - .10 Communication failure after a command is issued but before the result is recorded in the database.
  - .11 Computer failure after a command is issued but before the result is recorded in the database.
  - .12 Failure of a major communications component.
  - .13 Incorrect operator entry in the middle of a multi-step action.
  - .14 Operator Workstation failure in the middle of a control action.
  - .15 Demonstration of all redundant functions and components.
  - .16 Demonstration of all required alarm processing functionality, including audible annunciation.
  - .17 Demonstration of all required historical capture, storage, and retrieval functions.
  - .18 Demonstration of all required data logging functions.
  - .19 Demonstration of all required IT interface functions.
  - .20 Demonstration of all required device control functions.
  - .21 Demonstration of all required database management functionality.
  - .22 Demonstration of all required software support utilities.
  - .23 Demonstration of all system diagnostics, both on-line and off-line.
  - .24 Demonstration of correct operation of calculated quantities including totalized values
  - .25 Demonstrate the proper operation of all changes to the system negotiated and approved during the implementation period.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1      This Section includes Programmable logic controllers for control of process equipment, process oriented machinery, and process systems.

**1.2**            **RELATED SECTIONS**

- 1.      Section 40 94 33.20 - SCADA Software and Hardware

**1.3**            **REFERENCES**

- .1      Canadian Standards Association (CSA)
  - .1      C22.2 No.205, Signal Equipment.
- .2      Institute of Electrical and Electronics Engineers (IEEE)
  - .1      IEEE C37.90.1, Surge Withstand Capabilities Test for Protective Relays and Relays Systems.

**1.4**            **DEFINITIONS**

- .1      Acronyms used in this section include: see Section 40 94 33.20 - SCADA Software and Hardware

**1.5**            **DESIGN REQUIREMENTS**

- .1      To include:
  - .1      Scanning of AI and DI connected inputs for detection of change of value and processing the detection of alarm conditions.
  - .2      Perform On-Off digital control of connected points, including the resulting required states generated through programmable logic output.
  - .3      Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.
  - .4      Control of systems as described in sequence of operations.
  - .5      Execution of optimization routines as listed in this section.
- .2      Field Termination and Interface Devices.
  - .1      To conform to CSA C22.2 No. 205.
  - .2      Electronically interface sensors and control devices to processor unit.
  - .3      Include, but not be limited to, following:
    - .1      Programmed firmware or logic circuits to meet functional and technical requirements.
    - .2      Power supplies for operation of logic devices and associated field equipment.

- .3 Lockable wall cabinet.
- .4 Required communications equipment and wiring .
- .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
- .6 Input/Output interface to accept as minimum AI, AO, DI, DO functions as specified.
- .7 Wiring terminations: use conveniently located screw type or spade lug terminals.
- .4 AI interface equipment to:
  - .1 Convert analog signals to digital format with 12 bit analog-to-digital resolution.
  - .2 Provide for following input signal types and ranges:
    - .1 4 - 20 mA;
    - .2 0-10V DC
    - .3 10 K ohm.
  - .3 Meet IEEE C37.90.1 surge withstand capability.
  - .4 Have common mode signal rejection greater than 60 dB to 60 Hz.
  - .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
- .5 AO interface equipment:
  - .1 Convert digital data from controller processor to acceptable analog output signals using 12 bit digital-to-analog resolution.
  - .2 Provide for following output signal types and ranges:
    - .1 4 - 20 mA.
    - .2 0 - 10 V DC.
    - .3 Meet IEEE C37.90.1 surge withstand capability.
- .6 DI interface equipment:
  - .1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
  - .2 Meet IEEE C37.90.1 surge withstand capability.
  - .3 Accept pulsed inputs up to 2 kHz.
- .7 DO interface equipment:
  - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
  - .2 Switch up to 5 amps at 220 V AC using optional interface relay.
- .3 Controller's and associated hardware and software: operate in conditions of 0°C to 44°C and 20 % to 90 % non-condensing RH.
- .4 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.
  - .1 Provide for conduit entrance from top, bottom or sides of panel.

- .2 ECUs to be mounted in equipment enclosures or separate enclosures.
- .3 Mounting details as approved by Departmental Representative for ceiling mounting.
- .5 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .6 Provide surge and low voltage protection for interconnecting wiring connections.

## **1.6 PRODUCT PROTECTION**

- .1 Control panel designer shall provide independent line fuses or circuit breakers, per the manufacturer's recommendation, for each power Supply, Input Module, Output Module, and other modules with separately derived power requirements.
- .2 Control panel designer shall insure that communication signals, 4-20mA signals, embedded HART signals, are properly conditioned for the PLC and protected from all sources of radiated energy or harmonics.

## **1.7 SPARE I/O**

- .1 Each PLC will be sized to handle the required I/O plus a percentage of spares. When calculating spare I/O count, all fractional I/O points will be rounded up to the next whole I/O point. The resultant I/O count will be rounded up to next whole I/O card. When configuring spare I/O counts, use the following criteria:
  - .1 Analog Inputs (AI): Required for the PLC plus 20
  - .2 Analog Outputs (AO): Required for the PLC plus 10
  - .3 Digital Inputs (DI): Required for the PLC plus **10**
  - .4 Digital Outputs (DO): Required for the PLC plus 10

## **1.8 SUBMITTALS**

- .1 Make Submittals in accordance with Section 01 33 00 – Submittal Procedures
  - .1 Submit product data sheets for each product item proposed for this project.
- .2 Operation and Maintenance Data: Provide for each PLC component literature detailing routine maintenance requirements (if any).

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- .1 Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - .1 Allen Bradley 2080 series

- .2 Qualified Manufacturers:
  - .1 Only manufacturers that have been selling PLCs for a minimum of **10** years will be considered acceptable.

## 2.2 PROGRAMMABLE LOGIC CONTROLLERS

- .1 GENERAL:
  - .1 The PLC shall collect data, perform process control functions, communicate with other PLCs, and distribute process information along the local area network.
  - .2 The PLC shall be able to have its program downloaded from a remote workstation over the local area network, and be locally programmed from a portable laptop computer.
  - .3 The executive firmware of all intelligent modules shall be stored in Flash memory and shall be able to be updated in the field using standard programming tools. Executive firmware files shall be readily available via a public web site.
  - .4 The PLC shall have provisions for communicating unsolicited messages (report by exception) to an operator interface to reduce network traffic.
  - .5 The PLC shall be field expandable to allow for the expansion of the system by the simple addition and configuration of hardware.
  - .6 Each component shall include a clearly visible faceplate with appropriate data such as the manufacturer's model number and a brief description of the component's function.
  - .7 All cables and connectors shall be as specified by the manufacturer. Cables shall be assembled and installed per the manufacturer's recommendations.
  - .8 Each discrete point shall have a light emitting diode on the face of the module to indicate point status. Green shall indicate that the point is logic level "1", also referred to as "on" or "high".
- .2 The PLC shall utilize Ethernet protocols that meet the following:
  - .1 Protocols that are assigned to port 502 of the TCP/IP stack by the IANA (Internet Assigned Numbers Authority).
  - .2 Protocols that are supported by the Open DeviceNet Vendors Association (ODVA)
  - .3 Programming software will have embedded network configuration tools that utilize FDT/DTM technologies. PLC systems that have the PLC programming and network configuration tools in separate software will not be acceptable.
  - .4 Will not rely on third party vendors to meet the above criteria.
- .3 PLC PROGRAMMING REQUIREMENTS:
  - .1 All specified PLC platforms will be programmed using the same programming software package. PLCs that use multiple software programming packages under similar trade names will not be accepted. The programming software will have the following:
    - .2 Use of all textural and graphic languages specified in IEC 61131-3.
    - .3 An additional language dedicated to organization of the PLCs programs and function blocks. This language shall be in Sequential Function Chart (SFC) format.

- .4 The software shall allow the program to be subdivided into two large functional areas. One area is for normal program execution, the other is for process that must be executed on a periodic, or very rapid, basis. Each area shall allow multiple subsections of programming code. Each subsection can contain be of any language type supported by IEC 61131-3 or SFC.
- .5 Addressing shall be as follows.
  - .1 Digital and Analog I/O will be mapped to fixed addresses.
  - .2 Processor status will be mapped to fixed addresses
  - .3 Internal words and other internal data can either be unmapped, or mapped to fixed addresses. If unmapped, the programming software will determine the location.
  - .4 Internal words, I/O and other non processor status data will be able to be addressed by an alpha numeric pneumonic. This name will be used in unmapped variables, and in lieu of the address for mapped variables.
- .6 Ability to store and retrieve instruction comments, program comments, rung comments, and other comments and notes in the PLC processor.
- .7 Ability to convert from one supported PLC platform to another supported platform. Conversion shall be accomplished by exporting the program code, and importing to a new program with the desired PLC platform and configuration.
- .8 Textual syntax of the IL and ST languages, as specified in Annex B.2 and B.3 of IEC 61131-3, 2nd Edition, including all directly and indirectly referenced productions out of Annex B.1.
- .9 The PLC programming software shall have the following tools for monitoring and troubleshooting the PLC program.
  - .1 Power flow animation for graphical languages.
  - .2 A breakpoint capability to automatically halt the program just before a certain sequence is initiated.
  - .3 Ability to advance the program step by step to insure proper operation.
  - .4 Ability to create watch points for desired variables. These watch points will display the real time value of the variable.
  - .5 Monitoring of step activity times within the SFC language.
  - .6 The use of color to indicate execution progress.
  - .7 The ability to create HMI like screens for enhanced troubleshooting and program monitoring.
  - .8 Ability to create a table that will track a chosen variety of variables.
- .10 The PLC programming software shall allow creation of standard programming blocks. The blocks will be as follows:
  - .1 The programmer will see each instance of a given block. To reduce PLC memory size, and increase processing speed, the programming software will use one instance for each type of DFB. The PLC will automatically manage calls and execution to insure proper code execution.
  - .2 The programming blocks will contain programming sections. Each programmer added section can be designated as any of the four IEC languages.



- .3 The programming block will be able to be inserted into all four of the IEC languages in the main program. This ability will not be dependent on the languages used inside the block.
- .4 An internal database using unmapped variables. The variables associated with this block will be separate from the PLC database to prevent mapping conflicts.
- .5 Each block will appear to be a single instruction in the programming environment. The designer of the block will be able to designate pin assignments and names. These pins will be used to connect to the PLC database.
- .11 Programming software shall have integrated tools for network configuration, and communication capabilities. PLC's that use separate programming, communication, and network configuration software shall not be accepted.

## 2.3

### WEB SERVICES:

- .1 Description: The PLC's shall be designed for connection to the World Wide Web. These PLC's will have standard and customizable web pages.
- .2 Standard web pages: The PLC shall have a standard web page integral with the processor. This page shall display all internal status points, status registers, and alarm word. Also, the status of each I/O point will be accessible.
- .3 Customizable web pages: The PLC shall have the ability to store, operate, and display on a standard web browser custom configured web pages. These pages shall be created by the programmer to display the actual process or machine being operated.
- .4 The PLC shall be capable of:
  - .1 ModbusTCP messaging: The web services shall use Modbus TCP messaging over port 502 of the TCP packet. Protocols reliant on UDP will not be acceptable.
  - .2 I/O scanning service: I/O scanning will allow the PLC to control I/O scanning capable I/O located remotely from the main panel.
  - .3 Fast Device Replacement (FDR): The PLC shall act as a faulty device replacement client/server. This will enable the PLC to automatically download IP address and configuration to FDR client devices.
  - .4 SNMP Network Management: The PLC shall manage the different components through a SNMP connection. This will allow the PLC monitor network, and device integrity.
  - .5 Global Data: The PLC shall use Global Data service to ensure real time communication between stations in the same distribution group while minimizing network loading. Global Data servicing will use Real-Time Publisher Subscriber producer consumer based protocol.
  - .6 NTP Time synchronization service: The PLC shall be capable of synchronizing from its internal clock from a reference clock on a NTP server. This time can then be used to time stamp internal events.
  - .7 SMTP: The PLC shall be capable of SMTP email transmission service.
  - .8 Bandwidth monitoring service: The PLC shall be capable of monitoring

the bandwidth to determine load level.

- .5 Interconnection: The PLC web services shall be compatible with other devices that utilize port 502, or ODVA supported Ethernet protocols for communication. This includes power equipment, HMI, switches, and VFD's.

## 2.4 PLC:

- .1 Description: A chassis mount PLC designed for up to 1024 points of I/O.
- .2 The PLC shall:
  - .1 Collect data, perform process control functions, communicate with other PLCs, and distribute process information along the local area network.
  - .2 Be able to have its program downloaded from a remote workstation over a network, or locally programmed from a portable laptop computer.
  - .3 Allow for the expansion of the system by addition and configuration of hardware.
- .3 Executive firmware shall be stored in Flash memory and can be updated in the field using standard programming tools. Executive firmware files shall be readily available via a public web site.
- .4 Each discrete point shall have a light emitting diode to indicate point status. Green shall indicate that the point is logic level "1", also referred to as "on" or "high".
- .5 The PLC shall utilize Ethernet protocols that meet the following:
  - .1 Protocols that are assigned to port 502 of the TCP/IP stack by the IANA (Internet Assigned Numbers Authority).
  - .2 Protocols that are supported by the Open DeviceNet Vendors Association (ODVA)
  - .3 Programming software will have embedded network configuration tools that utilize FDT/DTM technologies. PLC systems that have the PLC programming and network configuration tools in separate software will not be acceptable.
  - .4 Will not rely on third party vendors to meet the above criteria.
- .6 Processors:
  - .1 Each General Processor shall have a USB terminal port for programming. The processor shall accept an 8Mb SD memory card. This card shall be capable of storing, at a minimum application files, data files, PDF files, CAD files, Microsoft office files. Processor performance shall be rated at least 6,900 instructions per millisecond at a program make up of 65% Boolean and 35% numerical. Acceptable processors are detailed below:
    - .1 General Processors
      - .1 2,048 Kb of internal user RAM. Processor shall have a multi-protocol serial port.
      - .2 4,096 Kb of internal user RAM. Processor shall have a multi-protocol serial port, and a CANopen master port.
      - .3 4,096 Kb of internal user RAM. Processor shall have a multi-

- protocol serial port, and an Ethernet port.
- .4 4,096 Kb of internal user RAM. Processor shall have an Ethernet port, and a CANopen master port.
- .2 Upon power loss, the PLC shall insure memory is transferred to flash memory before PLC RAM powers down. PLCs with a battery backup will not be accepted.
- .3 The PLC shall have on board status lights to indicate the following various functions:
  - .1 Green RUN lamp that will illuminate while the program is executing
  - .2 Red ERR lamp that will illuminate when a fault occurs in the processor
  - .3 Red I/O Lamp that will illuminate upon an I/O failure or configuration fault.
  - .4 Yellow SER COM lamp will illuminate when activity is present on the serial port
- .7 Distributed I/O
  - .1 The PLC platform can also be used as I/O for Distributed I/O applications. The system will have a small processor with limited memory that can serve as an intelligent Distributed I/O interface module. The on internal memory will be 400Kb.
  - .2 The Distributed I/O interface module will be able to support 4 total racks on I/O including the rack that holds the interface module.
  - .3 The Distributed I/O interface module will communicate to Modicon Quantum PLC's via Ethernet.
  - .4 The Distributed I/O interface module will consist of a single Ethernet port.
    - .1 General I/ O Cards: The PLC shall have a series of general I/O cards. They will be as follows:
      - .1 Analog Inputs: All Analog input cards will offer isolation between channels.
        - .1 Four (4) channel +/- 10V, 0-20mA, B,E Thermocouple, Pt 100, Pt 1000, Ni 1000, 2 or 4-wire temperature probes input card.
        - .2 Four (4) and Eight (8) channel RTD and Thermocouple cards.
      - .2 Analog Outputs: All analog output cards will offer isolation between channels,
        - .1 Two (2) channel +/- 10V, 0-20mA output card
    - .3 Discrete Inputs:
      - .1 Sixteen (16) channel sink and source 24VDC input cards
      - .2 Sixteen (16) channel 120VAC input card
      - .3 Thirty two (32) channel sink 24VDC input card

- .4 Sixty four (64) channel sink 24VDC input card
- .4 Discrete Outputs:
  - .1 Sixteen (16) channel 24VDC (0.5A/channel) protected transistor sink and source output cards
  - .2 Thirty-two (32) channel 24VDC (0.5A/channel) protected transistor source output card
  - .3 Sixty-Four (64) channel 24VDC (0.5A/channel) protected transistor sink output card
  - .4 Eight (8) channel 24VDC 24VDC/240VAC isolated relay output card
  - .5 Sixteen (16) channel 24VDC/240VAC relay output card
  - .6 Sixteen (16) channel 48-240VAC (1A/channel) triac output card.
- .8 Communication Capabilities: The PLC shall support the following without the need for third party modules
  - .1 10/100Mb Ethernet with fast device replacement (FDR) capability, standard web page and custom web page capability. A memory card will be available to store web pages and data.
  - .2 ASi V2 Master
  - .3 Serial protocols including Modbus, Unitelway, and ASCII.
  - .4 DNP3
  - .5 CANopen
  - .6 The PLC shall have an Ethernet card with four (4) ports. Each port shall be capable of communicating both Modbus TCP, and Ethernet I/P simultaneously. Cards requiring that the port be configured for one protocol will not be accepted. The card will also support daisy chain wiring.
- .9 Power Supplies: The PLC shall have chassis mounted power supplies to provide power for the processor and applicable modules. The power supplies shall be available in both 24 VDC and 115 VAC models. The available power ratings will be from 16 to 36W.
  - .1 Chassis: The chassis shall come in 4, 6, 8, and 12 position configurations. The cards will be secured to the chassis via a screw connection.
- .10 Other:
  - .1 Programming cable: The PLC shall utilize a USB to Mini B cable for programming. This cable shall be compatible with those designed for downloading digital cameras to USB compatible PC. Accordingly, this cable shall be available through most traditional retail stores serving the consumer electronics market.
  - .2 Alarming: The PLC shall have a configurable alarming capability. Each alarm point can be configured to display an alphanumeric message in the alarm buffer. The buffer can be displayed via a web page, or on an operator interface screen.
  - .3 I/O Connector cables:
    - .1 Unterminated connector cables shall have one end terminated to HE10 terminal block modules. The other end shall be unterminated to allow custom interface to panel devices.

- .2 Terminated connector cables shall have one end terminated to interface to terminal block, or FCN socket, cards. The other end shall be terminated to interface with HE10 terminal block modules.
- .11 Acceptable Material: Allen Bradley 2080 series or approved equal. (To be compatible with existing system)

### **PART 3      EXECUTION**

#### **3.1      LOCATION**

- .1 Location of Controllers to be approved by Departmental Representative.
- .2 Connect to existing PLC network and update all existing programming and graphics to incorporate all work under this scope.
- .3 Provide all communications wiring to connect to existing system.

#### **3.2      PROGRAMMING SEQUENCES**

- .1 The following sequences shall be programmed and fully tested prior to substantial completion:
  - .1 On high CL<sub>2</sub> the motorized valve shall be closed and alarm initiated.
  - .2 Provide the following alarms:
    - .1 High CL<sub>2</sub>
    - .2 Low O<sub>2</sub>(Per tank)
  - .3 On low dissolved oxygen sensed at any tank an alarm shall be initiated

#### **3.3      INSTALLATION**

- .1 Provide all low voltage wiring in EMT conduit to all field devices, communication wiring, etc.
- .2 Any fasteners, supports ,etc. to be type 304 stainless steel.
- .3 Install Controllers in secure NEMA 4x rated enclosures.
- .4 Provide necessary power from local 120 V branch circuit panel for equipment.
- .5 Install tamper locks on breakers of circuit breaker panel.
- .6 Provide Uninterruptible Power Supply (UPS) at each PLC panel location.
- .7 Anchor PLCs within enclosures as recommended by the PLC manufacturer.
- .8 Provide spacing around PLC as required by the PLC manufacturer to insure adequate cooling. Insure that the air surrounding and penetrating the PLC has been ambiently

conditioned to maintain the required temperature and humidity range of the PLC.

- .9 Wires entering and exiting PLC components shall be sized to comply with the PLC manufacturers requirements. Doors on all components shall be able to be fully closed when all the wires are installed.
- .10 Ventilation slots shall not be blocked, or obstructed by any means.
- .11 For chassis mounted PLCs, no wiring, wire ducts, or other devices shall obstruct the removal of cards from the rack.
- .12 PLC lights, keys, communication ports, and memory card slots shall be accessible at all times. Lights shall be visible at all times when enclosure door is opened.

**3.4 DEMONSTRATION**

- .1 Control panel supplier shall provide a qualified service representative to train Departmental Representative maintenance personnel to adjust, operate, and maintain PLCs. Manufacturer's standard training will be sufficient unless specified elsewhere.

**END OF SECTION**