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**Puntledge River Hatchery**  
**Electrical Room and Whole Building Standby**  
**Generator Upgrade**  
**Courtenay, British Columbia**  
February 20, 2019

Final revision  
2019 December 18

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END OF SECTION

**Part 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

**1.2 LOCATION OF WORK COVERED BY CONTRACT DOCUMENTS**

- .1 Work of this Contract comprises renovation of the Puntledge Hatchery Facility located at 38 Powerhouse Road, Courtenay B.C.

**1.3 GENERAL DESCRIPTION OF WORK COVERED BY CONTRACT DOCUMENTS**

- .1 The Puntledge River Hatchery main facility is served by BC Hydro at 347/600V and presently equipped with a standby power system supplying only the 120/208V loads. The objective of this project is to renovate the electrical system such that the entire facility is served by a standby system. A secondary objective of this project is to remove and replace existing equipment deemed to have reached end of service life.
- .2 The Puntledge River is a spawning watershed for chinook and other salmonids. Hatchery operations must be maintained to accommodate the natural spawning cycles of these fish. These spawning cycles present an opportunity for a scheduled shut down during August and early September. The bulk of this project is to be executed between August 4th and September 4th 2020. Refer to section 01 32 16 Construction Progress Schedule for key milestones.
- .3 The scope of work of this project includes, but is not necessarily limited to:
  - .1 Removal of existing (interior) standby generator.
  - .2 Repair to wall penetrated by existing (and to be removed) generator system
  - .3 Installation of an Owner supplied permanent standby generator located outside.
  - .4 Replacement of existing electrical distribution equipment with new equipment supplied under this contract. Items include: main power distribution center c/w main breaker, BC Hydro metering, 347/600V distribution panel, 208V step down transformer, transfer switch, 120/208V main panel.
  - .5 Installation of ducting, conductors and other required supporting elements.
  - .6 Reconnection of existing systems and loads to new panels.
  - .7 Upgrade Roof Top Unit feeder & disconnect in order to facilitate future heater upgrade within the RTU.
  - .8 System commissioning.
- .4 Further details pertaining to the scope of work are described in the drawings and additional specification sections.

**1.4 CONTRACT METHOD**

- .1 Construct Work under single contract.

**1.5 SUBMITTALS**

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

- .2 Submit Project construction progress schedule in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart.
- .3 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - Submit project Waste Management Plan highlighting recycling and salvage plan
    - .1 Submit end-of-project recycling rates, salvage rates, and landfill rates.

## **1.6 WORK BY OTHERS**

- .1 Not used

## **1.7 FUTURE WORK**

- .1 Not used

## **1.8 WORK SEQUENCE**

- .1 Construct Work in stages to accommodate Departmental Representative's continued] use of premises during construction.
- .2 Co-ordinate Progress Schedule and co-ordinate with Departmental Representative Occupancy during construction.
- .3 Required stages:
  - .1 Generator installation
  - .2 Main distribution upgrade
  - .3 System commissioning
- .4 Maintain fire access/control.
- .5 Protect workers and public safety.

## **1.9 CONTRACTOR USE OF PREMISES**

- .1 Limit use of premises for work, for storage and for access to allow:
  - .1 Departmental Representative occupancy.
  - .2 Partial Departmental Representative occupancy.
  - .3 Public access.
- .2 Co-ordinate use of premises under direction of Departmental Representative.
- .3 Normal hours of operation at this facility are 07:30-16:00 Monday through Friday.
- .4 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .5 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.

- .6 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Departmental Representative.
- .7 Ensure that operations conditions of exiting work at completion are still the same, equal to or better than that which existed before new work started.

#### **1.10 DEPARTMENTAL REPRESENTATIVE OCCUPANCY**

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

#### **1.11 DEPARTMENTAL REPRESENTATIVE FURNISHED ITEMS**

- .1 Departmental Representative Responsibilities:
  - .1 Arrange for delivery of shop drawings, product data, samples, manufacturer's instructions, and certificates to Contractor
  - .2 Deliver supplier's bill of materials to Contractor.
  - .3 Arrange and pay for delivery to site in accordance with Progress Schedule.
  - .4 Inspect deliveries jointly with Contractor.
  - .5 Submit claims for transportation damage.
  - .6 Arrange for replacement of damaged, defective or missing items.
  - .7 Arrange for manufacturer's field services; arrange for and deliver manufacturer's warranties and bonds to Contractor.
- .2 Contractor Responsibilities:
  - .1 Designate submittals and delivery date for each product in progress schedule.
  - .2 Review shop drawings, product data, samples, and other submittals. Submit to Consultant notification of observed discrepancies or problems anticipated due to non-conformance with Contract Documents.
  - .3 Receive and unload products on Site.
  - .4 Inspect deliveries jointly with Departmental Representative; record shortages, and damaged or defective items.
  - .5 Handle products on Site, including uncrating and storage.
  - .6 Protect products from damage, and from exposure to elements.
  - .7 Assemble, install, connect, adjust, and finish products.
  - .8 Provide installation inspections required by public authorities.
  - .9 Repair or replace items damaged by Contractor.
- .3 Schedule of Departmental Representative furnished items:
  - .1 250 kVA Standby Diesel Generator, 347/600A inclusive of sub base tank, enclosure, and necessary supporting systems such as battery charger, block heater, control panel, etc.

**1.12 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING**

- .1 Execute work with least possible interference or disturbance to building operations, occupants, public and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.
- .2 Wall penetrations associated with the removed standby generator are to be filled in.
- .3 Interior and exterior surfaces finished to match appearance of surrounding area.
- .4 Provide consultant with details of proposed repair prior to proceeding.

**1.13 EXISTING SERVICES**

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Give Departmental Representative 72 hours' notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to tenant operations.
- .3 Provide alternative routes for personnel and vehicular traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .5 Submit schedule for approval by Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Provide temporary services when directed by Departmental Representative to maintain critical building and tenant services.
- .7 Where unknown services are encountered, immediately advise Departmental Representative and Consultant and confirm findings in writing.
- .8 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .9 Record locations of maintained, re-routed and abandoned service lines.

**1.14 DOCUMENTS REQUIRED**

- .1 Maintain at job site, one copy of each document as follows:
  - .1 Contract Drawings.
  - .2 Specifications.
  - .3 Addenda.
  - .4 Reviewed Shop Drawings.
  - .5 List of Outstanding Shop Drawings.
  - .6 Change Orders.

- .7 Other Modifications to Contract.
- .8 Field Test Reports.
- .9 Copy of Approved Work Schedule.
- .10 Health and Safety Plan and Other Safety Related Documents.
- .11 Other documents as specified.

**Part 2 PRODUCTS**

**2.1 NOT USED**

- .1 Not used.

**Part 3 EXECUTION**

**3.1 NOT USED**

- .1 Not used.

**END OF SECTION**



**Part 1 GENERAL****1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 - Submittal Procedures.

**1.2 DEFINITIONS**

- .1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.
- .2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.
- .3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- .4 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.
- .5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .6 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .7 Milestone: significant event in project, usually completion of major deliverable.
- .8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .9 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

**1.3 REQUIREMENTS**

- .1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .2 Plan to complete Work in accordance with prescribed milestones and time frame.
- .3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.
- .4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Departmental Representative within 15 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .3 Submit Project Schedule to Departmental Representative within 5 working days of receipt of acceptance of Master Plan.

**1.5 PROJECT MILESTONES**

- .1 Project milestones form interim targets for Project Schedule.
- .2 This hatchery facility must remain operational except for a period of time in August. The project schedule must accommodate this. Key milestones are:
  - .1 Supply of shop drawings completed within 20 working days of Award of Contract date.
  - .2 Start of demolition and disconnection of BC Hydro service: Aug 4<sup>th</sup> 2020.
  - .3 Re-energization of BC Hydro service to building: Aug 11<sup>th</sup> 2020
  - .4 Generator commissioning and reconnection of all building loads: Sep 4<sup>th</sup> 2020.
  - .5 Submission of close out materials – September 15<sup>th</sup>, 2020
- .3 The contractor may initiate tasks not disruptive to facility operations prior to the scheduled shutdown on August 4th. Include description and timeline in schedule and coordinate with Departmental Representative.

**1.6 MASTER PLAN**

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as a Bar (GANTT) Chart.
- .2 Departmental Representative will review and return revised schedules within 5 working days.
- .3 Revise impractical schedule and resubmit within 5 working days.
- .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

**1.7 PROJECT SCHEDULE**

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
  - .1 Award.
  - .2 Shop Drawings, Samples.
  - .3 Permits.
  - .4 Mobilization.
  - .5 Procurement/Supplied Equipment
  - .6 Excavation.
  - .7 Generator Foundation.

- .8 Disconnection of BC Hydro service.
- .9 Demolition
- .10 Re-energization of BC Hydro service.
- .11 Installation and Wiring
- .12 Interior repairs (Walls, Floors and Ceiling).
- .13 Testing and Commissioning.

## **1.8 PROJECT SCHEDULE REPORTING**

- .1 Update Project Schedule on weekly basis reflecting activity changes and completions, as well as activities in progress.
- .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

## **1.9 PROJECT MEETINGS**

- .1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
- .2 Weather related delays with their remedial measures will be discussed and negotiated.

## **Part 2 PRODUCTS**

### **2.1 NOT USED**

- .1 Not used.

## **Part 3 EXECUTION**

### **3.1 NOT USED**

- .1 Not used.

**END OF SECTION**

**Part 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

- .1 Not used.

**1.2 REFERENCE STANDARDS**

- .1 Not used.

**1.3 ADMINISTRATIVE**

- .1 Submit to Consultant submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings and product data 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 Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Consultant 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 Owner or Consultant's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Owner or Consultant's review of submittals.
- .10 Keep one reviewed copy of each submission on site.

**1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 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.

- .3 Allow 5 business days for Consultant's review of each submission.
- .4 Adjustments made on shop drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.
- .5 Make changes in shop drawings as Consultant may require, consistent with Contract Documents. When resubmitting advise Consultant in writing of revisions other than those requested.
- .6 Accompany submissions with transmittal letter, in containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification of each shop drawing.
  - .5 Other pertinent data.
- .7 Submissions include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationship to adjacent work.
- .8 After Consultant's review, distribute copies.
- .9 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Consultant may reasonably request.

- .10 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Consultant where shop drawings will not be prepared due to standardized manufacture of product.
- .11 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Consultant.
- .12 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Consultant.
  - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
  - .2 Certificates must be dated after award of project contract complete with project name.
- .13 Submit electronic copies of manufacturer's instructions for requirements requested in specification Sections and as requested by Consultant.
  - .1 Pre-printed material describing installation of product, system or material, including special notices and Safety Data Sheets concerning impedances, hazards and safety precautions.
- .14 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .15 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Consultant.
- .16 Delete information not applicable to project.
- .17 Supplement standard information to provide details applicable to project.
- .18 If upon review by Consultant, no errors or omissions are discovered or if only minor corrections are made electronic copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .19 The review of shop drawings by Fisheries and Oceans Canada (DFO) is for sole purpose of ascertaining conformance with general concept.
  - .1 This review shall not mean that DFO approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
  - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

## **1.5 CERTIFICATES AND TRANSCRIPTS**

- .1 Immediately after award of Contract, submit proof that contractor is covered by Workers' Compensation Board at level required per DFO.

- .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 RELATED REQUIREMENTS**

- .1 Section 01 33 00 - Submittal Procedures.

**1.2 REFERENCE STANDARDS**

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Province of British Columbia
  - .1 Workers Compensation Act, RSBC 1996

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit 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.
- .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 WHMIS Safety Data Sheets (SDS) for hazardous material.
- .7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 5 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 5 days after receipt of comments.
- .8 Departmental Representative's 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 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 beginning of Work.



- .2 Contractor shall be responsible and assume the Principal Contractor role for each work zone location and not the entire complex. Contractor shall provide a written acknowledgement of this responsibility with 3 weeks of contract award.
- .3 Work zone locations include:
  - .1 Hatchery operations building and adjacent exterior site.
- .4 Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

## **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 REGULATORY REQUIREMENTS**

- .1 Do Work in accordance with Reference Standards cited in Para. 1.2.

## **1.8 PROJECT/SITE CONDITIONS**

- .1 Work at site will involve contact with:
  - .1 Energized electrical systems.
  - .2 Excavation equipment.

## **1.9 GENERAL REQUIREMENTS**

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning 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.

## **1.10 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 Contractor will be responsible and assume the role Constructor as described in the Ontario Occupational Health and Safety Act and Regulations for Construction Projects.
- .3 Contractor shall be the Principal Contractor as described in the Quebec Act Respecting Health and Safety code for the Construction for only their scope and areas of work as defined and described this project specification.

- .4 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.

#### **1.11 COMPLIANCE REQUIREMENTS**

- .1 Comply with Workers Compensation Act, B.C. Reg. RSBC 1996.
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

#### **1.12 UNFORSEEN HAZARDS**

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of British Columbia and advise Departmental Representative
- .2 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise Safety Officer] and follow procedures in accordance with Acts and Regulations of British Columbia and advise Departmental Representative verbally and in writing.

#### **1.13 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 site-related working experience specific to activities associated with electrical trade.
  - .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.

#### **1.14 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 British Columbia having jurisdiction, and in consultation with Departmental Representative.

#### **1.15 CORRECTION OF NON-COMPLIANCE**

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative or Consultant.
- .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.

**1.16 BLASTING**

- .1 Blasting or other use of explosives is not permitted.

**1.17 POWDER ACTUATED DEVICES**

- .1 Use powder actuated devices only after receipt of written permission from Departmental Representative.

**1.18 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 RELATED REQUIREMENTS**

- .1 Section 01 35 29.06 - Health and Safety Requirements.

**1.2 REFERENCE STANDARDS**

- .1 Canada Green Building Council (CaGBC)
  - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
  - .2 Rating System Addenda for New Construction and Major Renovations LEED Canada-NC Version 1.0-[Addendum 2007].
  - .3 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
  - .4 LEED Canada 2009 for Design and Construction-[2010], LEED Canada 2009 for Design and Construction Leadership in Energy and Environmental Design Green Building Rating System Reference Guide
  - .5 LEED Canada for Existing Buildings, Operations and Maintenance-[2009], LEED Canada 2009 Leadership In Energy and Environmental Design Green Building Rating System Reference Guide.
- .2 Canadian Construction Documents Committee (CCDC)
  - .1 CCDC 2-2008 Stipulated Price Contract.
- .3 U.S. Environmental Protection Agency (EPA)/Office of Water
  - .1 EPA 832/R-92-005-[92], Storm Water Management for Construction Activities, Chapter 3.
  - .2 EPA General Construction Permit (GCP) [2012].

**1.3 DEFINITIONS**

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for hazardous materials and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit copies of WHMIS Safety Data Sheets (SDS) in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review by Departmental Representative.
- .4 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.
- .5 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .6 Include in Environmental Protection Plan:
  - .1 Name of person responsible for ensuring adherence to Environmental Protection Plan.
  - .2 Name and qualifications of person responsible for manifesting hazardous waste to be removed from site.
  - .3 Name and qualifications of person responsible for training site personnel.
  - .4 Descriptions of environmental protection personnel training program.
  - .5 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
  - .6 Drawings indicating locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
  - .7 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather.
    - .1 Plans to include measures to minimize amount of material transported onto paved public roads by vehicles or runoff.
  - .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.
    - .1 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
  - .9 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
  - .10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
  - .11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
  - .12 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

- .13 Waste Water Management Plan identifying methods and procedures for management and discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
- .14 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.
- .15 Pesticide treatment plan to be included and updated, as required.

## **1.5 FIRES**

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

## **1.6 DRAINAGE**

- .1 Develop and submit erosion and Sediment Control Plan (ESC) identifying type and location of erosion and sediment controls provided. Plan to include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- .2 Provide temporary drainage and pumping required to keep excavations and site free from water.
- .3 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.
- .4 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

## **1.7 SITE CLEARING AND PLANT PROTECTION**

- .1 Protect trees and plants on site and adjacent properties as indicated.
- .2 Protect trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of [2] m minimum.
- .3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.
  - .1 Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.
- .5 Restrict tree removal to areas indicated or designated by Departmental Representative.

## **1.8 WORK ADJACENT TO WATERWAYS**

- .1 Construction equipment to be operated on land only.
- .2 Waterways to be kept free of excavated fill, waste material and debris.
- .3 Design and construct temporary crossings to minimize erosion to waterways.
- .4 Do not skid logs or construction materials across waterways.

- .5 Avoid indicated spawning beds when constructing temporary crossings of waterways.

## **1.9 POLLUTION CONTROL**

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
  - .1 Provide temporary enclosures where directed by Departmental Representative.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

## **1.10 HISTORICAL/ ARCHAEOLOGICAL CONTROL**

- .1 Provide historical, archaeological, cultural resources, biological resources, and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on project site: and identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in area are discovered during construction.
- .2 Plan: include methods to assure protection of known or discovered resources and identify lines of communication between Contractor personnel and Departmental Representative.

## **1.11 NOTIFICATION**

- .1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.
  - .1 Take action only after receipt of written approval by Departmental Representative.
- .3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

## **Part 2 PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

**Part 3 EXECUTION**

**3.1 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

**END OF SECTION**



**Part 1 GENERAL**

**1.1 INSPECTION**

- .1 Allow Consultant access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Consultant instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

**1.2 PROCEDURES**

- .1 Notify appropriate agency, Departmental Representative, and Consultant in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

**1.3 REJECTED WORK**

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative or Consultant as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of Departmental Representative, it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Consultant.

**1.4 REPORTS**

- .1 Submit electronic copy of inspection and test reports to Consultant.

**END OF SECTION**

**Part 1 GENERAL**

**1.1 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 products or systems are 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 borne by Owner in event of conformance with Contract Documents or by Contractor in event of non-conformance.

**1.2 QUALITY**

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3 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.
- .4 Should disputes arise as to quality or fitness of products, decision rests strictly with Consultant based upon requirements of Contract Documents.
- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

**1.3 AVAILABILITY**

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for 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 Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Consultant reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

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

**1.5 TRANSPORTATION**

- .1 Pay costs of transportation of products required in performance of Work.
- .2 Transportation cost of products supplied by Owner will be paid for by Owner. Unload, handle and store such products.

**1.6 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 Consultant in writing, of conflicts between specifications and manufacturer's instructions, so that Consultant will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Consultant to require removal and re-installation at no increase in Contract Price or Contract Time.

**1.7 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 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. Consultant 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 Consultant, whose decision is final.

**1.8 CO-ORDINATION**

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

**1.9 CONCEALMENT**

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

**1.10 REMEDIAL WORK**

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate 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.

**1.11 LOCATION OF FIXTURES**

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

**1.12 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.

**1.13 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.

**1.14 PROTECTION OF WORK IN PROGRESS**

- .1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of Consultant.

**1.15 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, and/or 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 PRODUCTS**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 EXECUTION**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

- .1 Not used.

**1.2 REFERENCE STANDARDS**

- .1 01 74 19 Waste Management and Disposal

**1.3 PROJECT CLEANLINESS**

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris,
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
- .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 marked separate bins for recycling. Refer to Section [01 74 19 - Waste Management and Disposal].
- .6 Dispose of waste materials and debris off site.
- .7 Clean interior areas prior to start of finishing work and maintain areas free of dust and other contaminants during finishing operations.
- .8 Store volatile waste in covered metal containers and remove from premises at end of each working day.
- .9 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .10 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .11 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 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.
- .5 Remove stains, spots, marks and dirt from electrical equipment.
- .6 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .7 Broom clean and wash exterior walks, steps and surfaces affected by the Work.
- .8 Remove dirt and other disfiguration from exterior surfaces affected by the Work.
- .9 Sweep and wash clean paved areas affected by the Work. .

**1.5 WASTE MANAGEMENT AND DISPOSAL**

Separate waste materials for reuse and recycling in accordance with Section [01 74 19 - Waste Management and Disposal].

**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 SUMMARY**

- .1 This Section includes requirements for management of construction waste and disposal, which forms the Contractor 's commitment to reduce and divert waste materials from landfill and includes the following:
  - .1 Preparation of a Construction Waste Management Plan that provides guidance on a logical progression of tasks and procedures to be followed in a pollution prevention program to reduce or eliminate the generation of waste, the loss of natural resources, and process emissions through source reduction, reuse, recycling, and reclamation.
  - .2 Owner has established that this project shall generate the least amount of waste possible and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors be employed by the Contractor.

**1.2 RELATED REQUIREMENTS**

- .1 Section 26 05 05 Selective Demolition For Electrical

**1.3 REFERENCE STANDARDS**

- .1 Not used

**1.4 DEFINITIONS**

- .1 Clean Waste: Untreated and unpainted; not contaminated with oils, solvents, sealants or similar materials.
- .2 Construction [and Demolition] Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, [re modeling],[repair and demolition] operations.
- .3 Hazardous: Exhibiting the characteristics of hazardous substances including properties such as ignitability, corrosiveness, toxicity or reactivity.
- .4 Nonhazardous: Exhibiting none of the characteristics of hazardous substances, including properties such as ignitability, corrosiveness, toxicity, or reactivity.
- .5 Nontoxic: Not poisonous to humans either immediately or after a long period of exposure.
- .6 Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- .7 Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- .8 Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form; recycling does not include burning, incinerating, or thermally destroying waste.



- .9 Return: To give back reusable items or unused products to vendors for credit.
- .10 Reuse: To reuse a construction waste material in some manner on the project site.
- .11 Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- .12 Sediment: Soil and other debris that has been eroded and transported by storm or well production run off water.
- .13 Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- .14 Toxic: Poisonous to humans either immediately or after a long period of exposure.
- .15 Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- .16 Volatile Organic Compounds (VOC's): Chemical compounds common in and emitted by many building products over time through outgassing:
  - .1 Solvents in paints and other coatings;
  - .2 Wood preservatives; strippers and household cleaners;
  - .3 Adhesives in particleboard, fiberboard, and some plywood; and foam insulation.
  - .4 When released, VOC's can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.
- .17 Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.
- .18 [Construction Waste Management Plan]: A project related plan for the collection, transportation, and disposal of the waste generated at the construction site; the purpose of the plan is to ultimately reduce the amount of material being landfilled.

## **1.5 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination: Coordinate waste management requirements with all Divisions of the Work for the project, and ensure that requirements of the Construction Waste Management Plan are followed.
- .2 Preconstruction Meeting: Arrange a pre-construction meeting in accordance before starting any Work of the Contract attended by the Departmental Representative to discuss the Construction Waste Management Plan and to develop mutual understanding of the requirements for a consistent policy towards waste reduction and recycling.

## **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide required information in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
  - .1 Construction Waste Management Plan for this project prior to any waste removal from site and that includes the following information:

- .1 Alternative Waste Disposal: Prepare a listing of each material proposed to be salvaged, reused, recycled or composted during the course of the project, and the proposed local market for each material.
- .2 Landfill Materials: Identify materials that cannot be recycled, reused or composted and provide explanation or justification.
- .3 Landfill Options: The name of the landfill where trash will be disposed of; landfill materials will form a part of the total waste generated by the project.
- .4 Transportation: A description of the means of transportation of the recyclable materials, whether materials will be site separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site, and destination of materials.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Storage Requirements: Implement a recycling/reuse program that includes separate collection of waste materials as appropriate to the project waste and the available recycling and reuse programs in the project area.
- .2 Handling Requirements: Clean materials that are contaminated before placing in collection containers and ensure that waste destined for landfill does not get mixed in with recycled materials:
  - .1 Deliver materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to recycling process.
  - .2 Arrange for collection by or delivery to the appropriate recycling or reuse facility.
- .3 Hazardous Waste and Hazardous Materials: Handle in accordance with applicable regulations.

## **Part 2 PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **Part 3 EXECUTION**

### **3.1 CWM PLAN IMPLEMENTATION**

- .1 Contractor is responsible for designating an onsite party or parties responsible for instructing workers and overseeing and documenting results of the CWM Plan for the project.

**END OF SECTION**

**Part 1 GENERAL**

**1.1 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-warranty Meeting:
- .2 Convene meeting one week prior to contract completion with contractor's representative, Departmental Representative, and consultant in order to:
  - .1 Verify project warranty requirements.
  - .2 Review manufacturer's installation instructions where applicable.
- .3 Departmental Representative to establish communication procedures for:
  - .1 Notifying construction warranty defects.
  - .2 Determine priorities for type of defects.
  - .3 Determine reasonable response time.
- .4 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
- .5 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Three weeks prior to Substantial Performance of the Work, submit to the Consultant an electronic copy of the operating and maintenance manuals.
- .3 Upon approval of electronic version of operating and maintenance manuals proceed to provide Departmental Representative two hard copy versions of these materials.

**1.3 FORMAT**

- .1 Organize data as 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.
  - .1 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 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .6 Drawings: provide with reinforced punched binder tab.
  - .1 Bind in with text; fold larger drawings to size of text pages.

#### **1.4 CONTENTS - PROJECT RECORD DOCUMENTS**

- .1 Table of Contents for Each Volume: provide title of project;
- .2 Date of submission; names.
- .3 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
- .4 Schedule of products and systems, indexed to content of volume.
- .5 For each product or system:
  - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .6 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .7 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .8 Typewritten Text: as required to supplement product data.
  - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

#### **1.5 AS -BUILT DOCUMENTS AND SAMPLES**

- .1 Maintain at site for Departmental Representative one record copy of:
  - .1 Contract Drawings.
  - .2 Specifications.
  - .3 Addenda.
  - .4 Change Orders and other modifications to Contract.
  - .5 Reviewed shop drawings, product data, and samples.
  - .6 Field test records.
  - .7 Inspection certificates.
  - .8 Manufacturer's certificates.
- .2 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
  - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .3 Maintain record documents in clean, dry and legible condition.
  - .1 Do not use record documents for construction purposes.

#### **1.6 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS**

- .1 Contract Drawings and shop drawings: mark each item to record actual construction, including:
  - .1 Field changes of dimension and detail.

- .2 Changes made by change orders.
- .3 Details not on original Contract Drawings.
- .2 Specifications: 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.
- .3 Provide digital photos, if requested, for project records.

## **1.7 EQUIPMENT AND SYSTEMS**

- .1 For each item of equipment and each system include description of unit or system, and component parts.
- .2 Panel board circuit directories: provide electrical service characteristics, list of all circuits.
- .3 Additional requirements: as specified in individual specification sections.

## **1.8 MAINTENANCE MATERIALS**

- .1 Spare Parts required are limited to one set of replacement fuses for each fused disconnect or fusible system.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to site; place and store.

## **1.9 WARRANTIES AND BONDS**

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Departmental Representative approval.
- .3 Warranty management plan to include required actions and documents to assure that Departmental Representative receives warranties to which it is entitled.
- .4 Contractor to arrange warranty review with Departmental Representative two weeks before completion of work.
- .5 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
  - .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 applicable item of work.
  - .4 Verify that documents are in proper form, contain full information, and are notarized.
  - .5 Co-execute submittals when required.

- .6 Retain warranties and bonds until time specified for submittal.
- .6 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .7 Include information contained in warranty management plan as follows:
  - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
  - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items.
  - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
    - .1 Name of item.
    - .2 Model and serial numbers.
    - .3 Location where installed.
    - .4 Name and phone numbers of manufacturers or suppliers.
    - .5 Names, addresses and telephone numbers of sources of spare parts.
    - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
    - .7 Cross-reference to warranty certificates as applicable.
    - .8 Starting point and duration of warranty period.
    - .9 Summary of maintenance procedures required to continue warranty in force.
    - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
    - .11 Organization, names and phone numbers of persons to call for warranty service.
    - .12 Typical response time and repair time expected for various warranted equipment.
  - .4 Contractor's plans for attendance at 4- and 9-month post-construction warranty inspections.
  - .5 Procedure and status of tagging of equipment covered by extended warranties.
  - .6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .8 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .9 Written verification to follow oral instructions.
  - .1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

## **Part 2 PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

**Part 3 EXECUTION**

**3.1 NOT USED**

.1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 03 20 00 - Concrete Reinforcing
- .2 Section 03 30 00.1 - Cast-in-Place Concrete Short Form

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA-O86-14, Supplement No. 1 to CAN/CSA-O86-01, Engineering Design in Wood.
  - .3 CSA O121-17, Douglas Fir Plywood.
  - .4 CSA O151-17, Canadian Softwood Plywood.
  - .5 CSA O153-13(R2017), Poplar Plywood.
  - .6 CAN/CSA-O325-16, Construction Sheathing.
  - .7 CSA O437 Series-93(R2011), Standards for OSB and Waferboard.
  - .8 CSA S269.1-16, Falsework and Formwork.
- .2 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S701.1:2017, Standard for Thermal Insulation, Polystyrene Boards..
- .3 Other
  - .1 ANSI/ACI-347, Concrete Formwork, Recommended Practice.
  - .2 COFI Exterior Plywood for Concrete Formwork.

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Store and manage hazardous materials in accordance with Manufacturer's recommendations.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for reuse or recycling.
  - .2 Place materials defined as hazardous or toxic in designated containers.
  - .3 Divert wood materials from landfill to a recycling, reuse or composting facility as approved by DCC Representative.
  - .4 Divert plastic materials from landfill to a recycling facility as approved by DCC Representative.
  - .5 Divert unused form release material from landfill to an official hazardous material collections site as approved by the DCC Representative.
  - .6 Divert metal materials from landfill to a recycling facility as approved by DCC Representative.



**1.4 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Indicate method and schedule of construction, materials, arrangement of joints, ties, shores, liners, and locations of temporary embedded parts. Comply with CSA S269.1 for falsework and formwork drawings.
- .3 Each shop drawing submitted to bear the stamp and signature of qualified professional engineer registered in the Province of B.C.

**1.5 SAMPLES**

- .1 Submit sample of formwork tie for water-tight structures for review by DCC Representative.

**1.6 DESIGN AND INSPECTION OF FORMS AND FALSEWORK**

- .1 Forms and falsework to be designed by a professional engineer registered in the Province of British Columbia. Erection drawing to be prepared in accordance with WorkSafe BC Occupational Health and Safety Regulation and signed and sealed by a professional engineer registered in the Province of British Columbia.
- .2 Formwork and falsework to be inspected in accordance with WorkSafe BC Occupational Health and Safety Regulations.
- .3 The design and inspection of the formwork and falsework is the responsibility of the Contractor.

**1.7 MEASUREMENT FOR PAYMENT**

- .1 No measurement will be made under this Section. Include costs for all other items in the applicable lump sum price, unless otherwise noted.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Formwork materials: plywood and wood formwork materials to CSA-O121 and CAN/CSA-S269.1.
- .2 Falsework materials: to CSA S269.1.
- .3 Form ties: Removable or snap-off metal ties, fixed or adjustable length, of a type that no metal will be within 40 mm of the concrete surface when forms have been removed. Use tapered plastic cones at faces of concrete to allow for grouting or filling with precast concrete plugs. Use waterstop flange at mid-length of single wire tie for watertight structures. Multiple strand ties are not permitted.
- .4 Taper bolts: Provide a neoprene waterstop plug installed at centreline of hole with adhesive. Fill holes on each side of waterstop to within 40 mm of surface with nonshrink grout. Pack 40 mm depth to surface with crystalline waterproofing, specified in Section 03 30 00.01 – Cast-in-Place Concrete Short Form. Submit cleaning and installation procedure for review by DCC Representative.

- .1 For concrete without special architectural features, use wood and wood product formwork materials to CAN/CSA-A23.1.11.
- .5 Form release agent: non-staining, non-toxic, biodegradable, low VOC. Form release agent: chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing concrete from sticking to forms

### **Part 3 Execution**

#### **3.1 FABRICATION AND ERECTION**

- .1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings. Report discrepancies to the DCC Representative.
- .2 Obtain DCC Representative's approval for use of earth forms framing openings not indicated on drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Design, fabricate and erect falsework in accordance with CSA S269.1 and COFI Exterior Plywood for Concrete Formwork.
- .5 Do not place shores and mud sills on frozen ground.
- .6 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .7 Fabricate and erect formwork to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1.
- .8 Align form joints and make watertight.
  - .1 Keep form joints to minimum.
  - .2 All cast-in-place concrete work to be isolated from in-stream water and flows and shall be monitored by the Contractor's QEP.
- .9 Use 20 mm chamfer strips on internal and external corners of walls, curbs, bases and columns exposed to view
- .10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .11 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.
  - .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .12 Clean formwork in accordance with CSA-A23.1 before placing concrete.
- .13 Obtain DCC Representative's permission before framing openings not indicated in concrete slabs, walls, or columns.
- .14 Form windows for placing and consolidating concrete to be in inside form.
- .15 Form joint at base of wall forms to be sealed tight to the base slab to prevent leakage of cement paste.

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**3.2 REMOVAL**

- .1 Leave formwork in place for following minimum periods of time after placing concrete.
  - .1 For Walls : 7 days or when concrete has reached minimum 70% of its design compressive strength, whichever comes later.
  - .2 For slabs and footing : 3 days or when concrete has reached minimum 70% of its design compressive strength, whichever comes later.
- .2 Time intervals given to be the cumulative number of days or fractions thereof, not necessarily consecutive, during which the temperature of the air in contact with concrete is above 10°C and concrete has been damp or thoroughly sealed from evaporation and loss of moisture. Re-use of formwork and falsework subject to requirements of CSA-A23.1.

**END OF SECTION**

**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1       Section 03 10 00 – Concrete Forming and Accessories.
- .2       Section 03 30 00.1 – Cast-in-Place Concrete Short Form.

**1.2               REFERENCES**

- .1       American Concrete Institute (ACI)
  - .1       SP-66-04, ACI Detailing Manual 2004.
  - .2       ANSI/ACI 315, Details and Detailing of Concrete Reinforcement.
- .2       ASTM International
  - .1       ASTM A143/A143M-07, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
  - .2       ASTM A775/A775M-17, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- .3       CSA International
  - .1       CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2       CAN/CSA-A23.3-14, Design of Concrete Structures.
  - .3       CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

**1.3               QUALITY ASSURANCE**

- .1       Submit in accordance with Section 01 45 00 - Quality Control and as described in PART 2 - SOURCE QUALITY CONTROL.

**1.4               SUBSTITUTIONS**

- .1       Substitution of different size bars permitted only upon written approval of Consultant.

**1.5               DELIVERY, STORAGE AND HANDLING**

- .1       Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2       Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3       Storage and Handling Requirements:
  - .1       Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2       Replace defective or damaged materials with new.

**Part 2            Products**

**2.1                MATERIALS**

- .1        Reinforcing steel: 15M rebar, nominal diameter 16.0mm.
- .2        Cold-drawn annealed steel wire ties: to CSA G30.3

**Part 3            Execution**

**3.1                FIELD BENDING**

- .1        Do not field bend or field weld reinforcement except where indicated or authorized by Consultant.
- .2        When field bending is authorized, bend without heat, applying slow and steady pressure.
- .3        Replace bars, which develop cracks or splits.

**3.2                PLACING REINFORCEMENT**

- .1        Prior to placing concrete, obtain Consultant's approval of reinforcing material and placement.
- .2        Consultant to be informed minimum 48 hours prior to concrete placing.
- .3        Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CSA-A23.1.
- .4        Slab reinforcement to be supported at maximum 300 mm each way. Tie every bar intersection.
- .5        Ensure cover to reinforcement is maintained during concrete pour.

**3.3                CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

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

**1.2 REFERENCES**

- .1 ASTM International
- .2 CSA International
  - .1 CSA-A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Delivery and Acceptance Requirements:
  - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
    - .1 Do not modify maximum time limit without receipt of prior written agreement from DCC Representative and concrete producer as described in CSA A23.1.
    - .2 Deviations to be submitted for review by the DCC Representative.
- .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1.

**1.4 DEFINITIONS**

- .1 Structural Concrete: all other concrete not defined as watertight concrete.

**1.5 MEASUREMENT FOR PAYMENT**

- .1 No measurement will be made under this Section. Include costs for all other items in the applicable lump sum price, unless otherwise noted.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Portland cement: to CSA A3001, Type GU.
- .2 Water: to CSA-A23.1.
- .3 Aggregates: to CSA-A23.1. Coarse aggregates to be normal density.
- .4 Air entraining admixture: to ASTM C260.
- .5 Calcium chloride shall not be added to concrete.

## **2.2 CONCRETE MIXES**

### **.1 FOUNDATION CONCRETE**

Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1 to give following properties:

- .1 Cement: Type GU Portland cement.
- .2 Exposure Class: C-1 to Table 1 CAN/CSA A23.1/A23.2.
- .3 Minimum compressive strength at 28 days: 35 MPa.
- .4 Maximum water cement ratio: 0.40.
- .5 Nominal size of coarse aggregate: 25 mm.
- .6 Superplasticizer: NO
- .7 Slump at time and point of discharge and prior to addition of Superplasticizer:  $70 \pm 20$  mm.
- .8 Fine aggregate: Maximum 40% of total aggregate mass.

## **Part 3 Execution**

### **3.1 GENERAL**

- .1 Cast-in-place concrete work to be in accordance with CSA-A23.1.

### **3.2 WORKMANSHIP**

- .1 Pumping of concrete is permitted only after approval of equipment and mix.
- .2 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .3 Prior to placing of concrete obtain Engineer's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .4 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .5 Do not place load upon new concrete until authorized by Engineer.

### **3.3 SLAB FINISHES**

- .1 General:
  - .1 Finish slabs to CSA A23.1/A23.2 except as noted.
  - .2 Do not sprinkle dry cement or dry cement sand mixture over concrete surfaces.
  - .3 Tolerance to be by Straight Edge method to CSA A23.1/A23.2.
- .2 Finishes:
  - .1 Equipment pads : Provide smooth towelled surface

### **3.4 ANCHOR BOLTS**

- .1 Set anchor bolts to templates prior to placing concrete.

### **3.5 CURING**

- .1 Cure concrete to CSA-A23.1 except where specified otherwise. Curing compounds shall not be used without the written authorization of the Engineer.
- .2 During hot weather, provide additional initial curing for concrete slabs in accordance with recommendations of ACI 305R.

### **3.6 HOT WEATHER CONCRETING**

- .1 Hot weather concreting procedures to be followed when ambient air temperature exceeds 20°C during the placing period.
- .2 Temperature of concrete placed during hot weather not to exceed the following limits:
  - .1 All concrete = 30°C
- .3 During hot weather if the concrete temperature at placing exceeds the above limits the concrete shall be cooled by the addition of ice to the mixing water.

### **3.7 FIELD QUALITY CONTROL**

- .1 Assume responsibility for all cast-in-place concrete materials and construction. Sampling and testing will be at the expense of the Contractor.
- .2 The Consultant may monitor the mixing and handling of concrete, take additional strength and slump tests, and check all matters affecting quality control of the concrete. Extend full cooperation and assistance to the Consultant, including provision of access and samples for testing. Such additional sampling and testing will be at the expense of the Owner.

### **3.8 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Use trigger operated spray nozzles for water hoses.
- .3 Designate cleaning area for tools to limit water use and runoff.
- .4 Cleaning of concrete equipment to be done in accordance with Section 01 35 43 Environmental Procedures.
- .5 Waste Management:
  - .1 Divert unused concrete materials from landfill to local quarry after receipt of written approval from DCC Representative.
  - .2 Provide appropriate area on job site where concrete trucks can be safely washed.
  - .3 Divert admixtures and additive materials from landfill to approved official hazardous material collections site after receipt of written approval from DCC Representative.
  - .4 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

**END OF SECTION**



**Part 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

1. Not Used

**1.2 REFERENCE STANDARDS**

- .1 CSA Group
  - .1 [CSA C22.1-\[15\]](#), Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
  - .2 [CAN3-C235](#), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1 IEEE SP1122-[2000], The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

**1.3 DEFINITIONS**

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
  - .1 Submit drawings stamped by contractor.
  - .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 If changes are required, notify Consultant of these changes before they are made.
- .4 Certificates:
  - .1 Provide CSA certified equipment and material.
  - .2 Submit test results of installed electrical systems and instrumentation.
  - .3 Permits and fees: in accordance with General Conditions of contract.
  - .4 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative and Consultant.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

**1.6 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 PRODUCTS**

**2.1 DESIGN REQUIREMENTS**

- .1 Operating voltages: to [CAN3-C235](#).
- .2 Distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

**2.2 MATERIALS AND EQUIPMENT**

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified.

**2.3 WIRING TERMINATIONS**

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

**2.4 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates as follows:
  - .1 Nameplates: Permanent, white with black lettering, adhesively bonded.
  - .2 Sizes as follows:

Size 2	12 x 70 mm	1 line	5 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
- .2 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .3 Disconnects: indicate equipment being controlled and voltage.
- .4 Terminal cabinets and pull boxes: indicate system and voltage.
- .5 Transformers: indicate capacity, primary and secondary voltages.

**2.5 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings on both ends of phase conductors of feeders and branch circuit wiring.

- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to [CSA C22.1](#).

## **2.6 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>Type</u>	<u>Prime</u>	<u>Auxiliary</u>
up to 250 V	Yellow	
up to 600 V	Yellow	Green

## **Part 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Do complete installation in accordance with [CSA C22.1](#) except where specified otherwise.
- .2 Underground systems in accordance with [CAN/CSA-C22.3 No.1](#) except where specified otherwise.

### **3.2 NAMEPLATES AND LABELS**

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

### **3.3 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Panelboards: as required by Code or as indicated.

### **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 Ground System Verification

- .1 Arrange with a qualified agent, testing of existing ground system as soon as the utility service neutral is disconnected.
- .2 Perform ground resistance test via fall-of-potential method. Successful test result 5-ohms or less.
- .3 If ground resistance test result is greater than 5-ohms, notify this Consultant and Departmental Representative.
- .2 Provide upon completion of work phase and neutral currents on panelboards, dry-core transformers operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .3 Conduct following tests in accordance with Section [01 45 00 - Quality Control].
  - .1 Power generation system including phasing, voltage, grounding and load balancing.
  - .2 Insulation resistance testing:
    - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
    - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
    - .3 Check resistance to ground before energizing.
  - .3 Carry out tests in presence of Departmental Representative.
  - .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

### **3.6 SYSTEM STARTUP**

- .1 Instruct Departmental Representative in operation, care and maintenance of systems, system equipment and components.

**END OF SECTION**

**Part 1 GENERAL**

**1.1 SUMMARY**

- .1 This Section includes requirements for selective demolition and removal of electrical components including removal of conduit, junction boxes, and panels to source and incidentals required to complete work described in this Section.

**1.2 DEFINITIONS**

- .1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .2 Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .3 Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- .4 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .5 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
- .6 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by Federal Hazardous Products Act (RSC 1985) including latest amendments.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Action Submittals: Provide in accordance with Section 01 33 00 - Submittal Procedures before starting work of this Section:
  - .1 Construction Waste Management Plan (CWM Plan): Submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .2 Landfill Records: Indicate receipt and acceptance of selective demolition waste.

**1.4 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2 Scheduling: Account for Departmental Representative continued occupancy requirements during selective demolition.

## **1.5 QUALITY ASSURANCE**

- .1 Regulatory Requirements: Perform work of this Section in accordance with:
  - .1 Provincial/Territorial Workers' Compensation Boards

## **1.6 SITE CONDITIONS**

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition at date tender is accepted.
- .2 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in Work; immediately notify Departmental Representative if materials suspected of containing hazardous substances are encountered and perform following activities:
  - .1 Hazardous substances will be as defined in Hazardous Products Act.
  - .2 Stop work in area of suspected hazardous substances.
  - .3 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
  - .4 Hazardous substances will be removed by Departmental Representative under a separate contract or as a change to Work.
  - .5 Proceed only after written instructions have been received from Departmental Representative

## **1.7 SALVAGE AND DEBRIS MATERIALS**

- .1 Demolished items become Contractor's property and will be removed from Project site; except for items indicated as being reused, salvaged, or otherwise indicated to remain Departmental Representative property.
- .2 Carefully remove materials and items designated for salvage and store in a manner to prevent damage or devaluation of materials.

## **Part 2 PRODUCTS**

### **2.1 MATERIALS**

- .1 General Patching and Repair Materials: Repair wall openings after removal of generator with similar materials used for wall construction. Patch and paint to match existing appearance.
- .2 Electrical Repair Materials: Use only new materials, CSA or ULC labelled as appropriate and matching components remaining after work associated with components identified for removal or demolition are completed.

## **Part 3 EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; Departmental

Representative will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.

### **3.2 PREPARATION**

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
  - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
  - .2 Notify Departmental Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
  - .3 Prevent debris from blocking drainage inlets.
  - .4 Protect mechanical systems that will remain in operation.
- .2 Protection of Building Occupants: Sequence demolition work so that interference with the use of the building by the Departmental Representative and users is minimized and as follows:
  - .1 Prevent debris from endangering safe access to and egress from occupied buildings.
  - .2 Notify Departmental Representative and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

### **3.3 EXECUTION**

- .1 Disconnect electrical circuits and panel feeders; maintain electrical service and main distribution panel as is, ready for subsequent Work.
- .2 Remove existing electrical devices and equipment including associated conduits, boxes, wiring, and similar items.
- .3 Disconnect and remove communication systems including associated conduits, boxes, cabling, and similar items unless specifically noted otherwise.
- .4 Perform demolition work in a neat and workmanlike manner:
  - .1 Remove tools or equipment after completion of work and leave site clean and ready for subsequent renovation work.
  - .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.
- .5 Disconnect panel feeders back to main distribution panel and re label respective circuit breaker as "SPARE".
- .6 Place weatherproof blank cover plates on exterior outlet boxes remaining after demolition and removal activities.
- .7 Remove existing conduits, boxes, cabling and wiring associated with removed luminaires, electrical devices and equipment.
- .8 Grind off conduits and make flush with surface of concrete where conduits are cast into concrete; seal open ends of conduit with silicone sealant and leave in place.

- .9 Seal open ends of conduit with silicone sealant and leave in place where they are inaccessible or cannot be removed without damaging adjacent construction.

### **3.4 CLOSEOUT ACTIVITIES**

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except where explicitly noted otherwise for materials being salvaged for re use in new construction.

**END OF SECTION**



**Part 1 GENERAL**

**1.1 REFERENCE STANDARDS**

- .1 CSA Group (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 National Electrical Manufacturers Association (NEMA)

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground and in accordance with manufacturer's recommendations in a clean, dry, well-ventilated area.
  - .2 Replace defective or damaged materials with new.

**Part 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Pressure type wire connectors to: [CAN/CSA-C22.2 No.65](#), with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: [CAN/CSA-C22.2 No.65](#), with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

- .3 Clamps or connectors for armoured cable, TECK cable, and flexible conduit as required to:  
[CAN/CSA-C22.2 No.18.](#)

### **Part 3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and cables 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 [CAN/CSA-C22.2 No.65.](#)
  - .2 Install fixture type connectors and tighten to [CAN/CSA-C22.2 No.65.](#) Replace insulating cap.

#### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

**END OF SECTION**

**Part 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 20 - Wire and Box Connectors - (0-1000 V)
- .3 33 65 76 – Direct Buried Underground Cable Ducts.

**1.2 REFERENCE STANDARDS**

- .1 Not Used

**Part 2 PRODUCTS**

**2.1 BUILDING WIRES**

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Minimum size for aluminum conductors is #4 AWG.
- .3 Copper or Aluminum conductors: size as indicated, with thermoplastic insulation type TWU rated at:
  - .1 600V for system nominal voltages up to 300V
  - .2 1000V for system nominal voltages up to 750V

**2.2 WIRING IN CONDUIT**

- .1 Conductors:
  - .1 Circuit conductors: Copper RW90, size as indicated.
  - .2 Ground conductors: Copper RW90, size as required by code.
- .2 Insulation:
  - .1 Cross-linked polyethylene XLPE
  - .2 Rating:
    - .1 600V for system nominal voltages up to 300V
    - .2 1000V for system nominal voltages up to 750V
- .3 Use of aluminum wiring is not permitted.

**2.3 CONTROL CABLES**

- .1 Type: Generator Master Load Demand: RS-485: stranded, tinned copper conductors:
  - .1 Size: 22AWG
  - .2 Insulation: FHDPE – Foamed high-density polyethylene.

- .3 Inner Shield: aluminum/polyester, providing 100% coverage, and including stranded, 22AWG tinned copper drain wire.
- .4 Outer Shield: tinned copper braid, providing 65% coverage.
- .5 Outer jacket: PVC – polyvinyl chloride, 300V rated.
- .2 Type: Generator First Start: 1 x twisted pair, shielded, stranded, tinned copper conductors:
  - .1 Size: 16AWG
  - .2 Insulation: PE – Polyethylene.
  - .3 Shield: aluminum/polyester, providing 100% coverage, and including stranded, 18AWG tinned copper drain wire.
  - .4 Outer jacket: PVC – polyvinyl chloride, 300V rated.
- .2 Control cables run between ATS and generator control cabinet:
  - .1 Type: Control: 4 x wires, stranded, tinned copper conductors:
    - .1 Size: 16AWG
    - .2 Insulation: PE – Polyethylene.
    - .3 Outer Jacket: PVC – polyvinyl chloride, 300V rated.
  - .2 Type: Remote Start: 2 x wires, stranded, tinned copper conductors:
    - .1 Size: 16AWG
    - .2 Insulation: PE – polyethylene.
    - .3 Outer Jacket: PVC – polyvinyl chloride, 300V 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 insulation resistivity (megger) tests using method appropriate to site conditions and to approval of Consultant.
- .3 Perform tests before energizing electrical system.

### **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:
- .2 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .3 In underground ducts in accordance with Section 33 65 76 – Direct Buried Underground Cable Ducts.

**3.4 INSTALLATION OF CONTROL CABLES**

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

**3.5 INSTALLATION OF NON-METALLIC SHEATHED CABLE**

- .1 Install cables.
- .2 Install straps and box connectors to cables as required.

**END OF SECTION**

**Part 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

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

**1.2 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 [CSA C22.1](#), Canadian Electrical Code, Part 1, 23rd Edition.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

**Part 2 PRODUCTS**

**2.1 SPLITTERS**

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: main and branch lugs, connection blocks to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals (or lugs) on each connection or lug block sized less than 400 A.

**2.2 JUNCTION AND PULL BOXES**

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.

**2.3 CABINETS**

- .1 Construction: welded sheet steel, hinged door, and catch.

**Part 3 EXECUTION**

**3.1 SPLITTER INSTALLATION**

- .1 Mount plumb, true and square to 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 except where indicated otherwise.
- .3 Only main junction and pull boxes are indicated. Install additional pull boxes as required by [CSA C22.1](#).

**3.3 IDENTIFICATION**

- .1 Equipment Identification: to Section 26 05 00- Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name, voltage and phase.

**END OF SECTION**

**Part 1 GENERAL****1.1 RELATED REQUIREMENTS**

- .1 Section [\_\_\_\_\_].

**1.2 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 [CAN/CSA C22.2 No. 18-\[98\(R2003\)\]](#), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2 [CSA C22.2 No. 45-\[M1981\(R2003\)\]](#), Rigid Metal Conduit.
  - .3 [CSA C22.2 No. 83-\[M1985\(R2003\)\]](#), Electrical Metallic Tubing.
  - .4 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section [01 33 00 - Submittal Procedures].
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
  - .1 Submit cable manufacturing data.
- .3 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.

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling] in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

**Part 2 PRODUCTS****2.1 CABLES AND REELS**

- .1 Provide cables on reels or coils.
  - .2 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.
- .3 Identify cables for exclusively dc applications.



- .4 Reel and mark shielded cables rated [2,001] volts and above.

## 2.2 CONDUITS

- .1 Electrical metal tubing, to [CSA C22.2 No. 83](#)
- .2 PVC, DB2 conduit, to CSA C22.2 No. 211.2.

## 2.3 CONDUIT FASTENINGS

- .1 One hole straps to secure surface conduits 50 mm and smaller.
- .2 Two hole steel straps for conduits larger than 50 mm.
- .3 Beam clamps to secure conduits to exposed steel work.

## 2.4 CONDUIT FITTINGS

- .1 Fittings manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm] and larger conduits.
- .3 Watertight connectors and couplings for EMT.
  - .1 Set-screws are not acceptable.

## 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 conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Use electrical metallic tubing (EMT) for indoor applications.
- .3 Minimum conduit size for lighting and power circuits: NPS  $\frac{3}{4}$ , 19 mm.
- .4 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .5 Install fish cord in empty conduits.
- .6 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.

- .7 Dry conduits out before installing wire.

### 3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Run conduits in flanged portion of structural steel.
- .3 Group conduits wherever possible on surface channels.
- .4 Do not pass conduits through structural members except as indicated.
- .5 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### 3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
- .2 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .5 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .6 Organize conduits in slab to minimize cross-overs.

### 3.5 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.

### 3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .2 Section 26 28 16.02 - Moulded Case Circuit Breakers

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for service equipment and include product characteristics, performance criteria, physical size, finish and limitations.

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect service equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**Part 2 PRODUCTS**

**2.1 EQUIPMENT**

- .1 Utility wireway confirming to the requirements of the supply authority.
- .2 Main circuit breaker:
  - .1 600V, 400A rated, 25kAIC.
  - .2 In accordance with Section 26 28 16.02 - Moulded Case Circuit Breakers,
- .3 Main 600V distribution board, MLO, in accordance with Section 26 24 16 and equipped with circuit breakers as shown on drawing E02.
- .4 Cabinet for utility revenue metering in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets, and in accordance with the latest edition of the BC Hydro secondary metering guide.

- .5 Service equipment listed above is to be furnished as an integrated system from a single manufacturer.

### **Part 3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Install service equipment.
- .2 Connect to incoming service.
- .3 Connect to outgoing load circuits.
- .4 Verify existing ground impedance in accordance with 26 05 00 – Common Work Results Electrical
- .5 Re-install grounding connections to typical equipment included in, but not necessarily limited to following list; service equipment, transformers, switchgear, generators, distribution panels.
- .6 Make provision for power supply authority's metering.

#### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

**Part 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

1. Not Used

**1.2 REFERENCE STANDARDS**

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for switchboards and panelboards, and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide spare parts as recommended by manufacturer for maintenance period of 2 years minimum.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect switchboards from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal

**Part 2 PRODUCTS**

**2.1 PANELBOARDS**

- .1 PANEL H
  - .1 NEMA 1, 400A bus rating, industrial grade.
  - .2 Provides space for a minimum of 60 pole positions.

## **2.2 CIRCUIT BREAKERS**

- .1 Main circuit breaker: 400A rated three pole, 600V, Long time adjustable, Instantaneous. Interrupting AIC rating: 25kA
- .2 Subservice breakers (unless otherwise noted): Current ratings and poles as per design drawings. Interrupt rating specified by panelboard manufacturer based of fault current analysis using main breaker specified and assuming unlimited upstream fault current.
- .3 DG system breaker. Rated for reverse connection. Lockable. 250A with adjustable trip.
- .4 Use of snap in breakers is not permitted.

## **Part 3 EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that mounting condition is acceptable for switchboard installation in accordance with manufacturer's written instructions.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

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

### **3.3 INSTALLATION**

- .1 As indicated.

**END OF SECTION**

**Part 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

- .1 Section 26 24 13 – Switchboards and Panelboards.

**1.2 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with [UL 489](#), and NMX-J-266-ANCE-2010).

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for [circuit breakers] and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Include time-current characteristic curves for breakers with ampacity of 100A and over, with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

**Part 2 PRODUCTS**

**2.1 BREAKERS GENERAL**

- .1 Moulded-case circuit breakers to CSA C22.2 No. 5.
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

**2.2 THERMAL MAGNETIC BREAKERS**

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

**Part 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Install circuit breakers as indicated.

**3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**



**Part 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

1. Not Used

**1.2 PAYMENT**

- .1 Submit payment for services of Cummins factory diesel electric technician.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit verification of diesel electric technician qualification.
- .3 Submit commissioning report.

**1.4 QUALIFICATIONS**

- .1 Use qualified diesel electric technician.

**Part 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Include materials as follows:
  - .1 Conduits and boxes as required.
  - .2 Electrical components as indicated.
  - .3 Wiring material.
  - .4 Antifreeze, ethylene glycol.
  - .5 Diesel fuel; tank initial fill, plus top-up after testing.
  - .6 Wiring and materials, including necessary conduits and fittings for making connections.
  - .7 The control circuit cables will not be less than No. 14, RW90, colour coded, stranded.

**Part 3 EXECUTION**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of generator set foundation previously installed under this Contract are acceptable for generating equipment installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative
  - .2 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 LOCATING AND MOUNTING**

- .1 Locate unit as indicated.
- .2 Bolt mounting base to foundation.

### **3.3 ALIGNMENT CHECK**

- .1 Since Engine-generator shaft alignment is adjusted at factory, check to ensure that no change has occurred due to shipment and handling.

### **3.4 FUEL SUPPLY SYSTEM**

- .1 This generator features an integral fuel supply system.
- .2 Prior to starting unit inspect thoroughly fuel tank and lines to confirm that there are no leaks or drips.

### **3.5 BATTERIES AND CHARGER**

- .1 For wet batteries, inspect individually each battery cell and check electrolyte level.
  - .1 Check charge condition by measuring temperature and specific gravity of electrolyte.
  - .2 Consult manufacturer's instructions for recommended readings.
  - .3 If readings are lower, give batteries freshening charge until readings are reached.
- .2 Locate batteries as indicated and ensure batteries are accessible for service.
  - .1 Run and protect cables to starting motor using cables supplied with unit.
- .3 Connect battery charger to dedicated circuit from Panel H.
- .4 Clean connections and tighten securely.

### **3.6 EXHAUST SYSTEM**

- .1 Not applicable for outdoor installation.

### **3.7 COOLING AND VENTILATION**

- .1 Fill engine radiator with water/ethylene glycol antifreeze mix good for -40 degrees C.

### **3.8 CONTROL AND TRANSFER PANEL**

- .1 Make control and power circuit connections as indicated.
- .2 Identify cables at both ends.
- .3 Tag with slip-on wire maker, each wire end with number corresponding to number in panel.
- .4 Make terminations with self-insulated terminals of flanged fork or ring type.

### **3.9 ADDITIONAL WORKS**

- .1 Supply and install LED strip light with switch inside generator enclosure.
- .2 Supply and install duplex receptacle on dedicated circuit inside generator enclosure.
- .3 Connect block heater to dedicated circuit from panel H.
- .4 Complete any additional work as instructed by Departmental Representative or Consultant to:
  - .1 Ensure equipment is safe to operate.
  - .2 Provide complete and operating system.

### **3.10 FIELD QUALITY CONTROL**

- .1 Qualified diesel electric technician to: inspect and verify that installation of interruptible power unit is acceptable and complete. Provide inspection report to the Departmental Representative and Consultant.
- .2 Commissioning of diesel electric generator unit by qualified diesel electric technician.
- .3 Develop and submit commissioning report including time delay settings, operational set points and adjustment ranges.

### **3.11 SYSTEM STARTUP**

- .1 Preparation: before starting unit, carry out thorough mechanical and electrical inspection of equipment, and perform following checks and adjustments:
  - .1 Disconnect battery cables from batteries to prevent accidental starting.
  - .2 Turn engine several revolutions by means of hand-barring devices to ensure parts are free and there are no obstructions to its running.
  - .3 Check engine/generator alignment readings to ensure they match readings attained at time of manufacture.
  - .4 Check fluid levels and top up as necessary. Pre-lubricate engine and turbochargers as recommended by engine manufacturer. Install drip pan beneath engine.
  - .5 Confirm cooling system antifreeze is effective to at least minus 40 degrees C.
  - .6 Check belts for correct tension and adjust as necessary.
  - .7 Check and grease points.
  - .8 Check and tighten properly nuts, bolts.
  - .9 Confirm safety guards are in place and properly secured.
  - .10 Check linkages for damage and freedom of movement.
  - .11 Check fuel supply system for leakage.
  - .12 Ensure fuel supply and fuel injection systems are properly primed.
  - .13 Check and tighten properly electrical connections.
  - .14 Check starting battery electrolyte level specific gravity and for proper installation.
  - .15 Check battery charger for proper operation and adjust as necessary.
  - .16 Carry out generator winding insulation resistance test. If reading is unacceptable, carry out recognized drying procedure. Do not start unit until satisfactory reading has been achieved.

- .17 Check jacket coolant heater for proper operation.
- .18 Complete additional preparations deemed necessary.
- .2 Performance verification: on completion of start-up preparations, take following action:
  - .1 Have at hand, during initial start-up, means for choking off air supply to engine air induction manifold in event of engine run away or other emergency.
  - .2 Reconnect starting battery cables to starting battery.
  - .3 Start unit only in presence of Departmental Representative and allow to warm up. Stop unit if abnormal conditions are encountered.
  - .4 Check for and correct leakage from exhaust system, fuel system, cooling system, and lubricating oil system.
  - .5 Adjust vibration isolators.
  - .6 Observe and confirm lubricating oil pressure and coolant temperature are within limits and no harmful vibration or sounds are evident.
  - .7 Ensure voltage is within operating parameters and automatic voltage regulator is operating correctly.
  - .8 Ensure manual voltage control is operating correctly.
  - .9 Ensure frequency is within operating parameters and electronic governor is operating correctly.
  - .10 Check engine air ventilation system for proper operation.
  - .11 Check operation of engine-mounted protective sensing devices and adjust as necessary.
  - .12 Check phase sequence of normal power supply and ensure emergency power supply are in same sequence.
  - .13 Check operation of electronic controller protection, transfer, timing, metering, and annunciator functions and adjust as necessary.
  - .14 Check operation and calibration of analog metering and adjust as necessary.
  - .15 Apply electrical load, read the meters, and correlate these readings.
  - .16 Demonstrate:
    - .1 Unit start, transfer to load, retransfer to normal power, unit shutdown, on "automatic" control.
    - .2 Unit start, transfer to load, retransfer to normal power, unit shutdown, on "test control".
    - .3 Unit cranking, start, and shutdown by means of engine-mounted key switch.
    - .4 Run unit on building load for minimum period of 4 hours to show load-carrying capability, stability of voltage and frequency, and satisfactory performance of engine ventilating system to provide adequate cooling, exhaust system.
    - .5 Every 1/2 hour carry out and record readings on Test Chart.
  - .17 Perform additional tests as required by Departmental Representative or Consultant to confirm unit is operating satisfactorily.

### **3.12 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.13 DEMONSTRATION AND TRAINING**

- .1 In accordance with Section 01 79 00 - Demonstration and Training carry out demonstrations of complete interruptible power unit for Departmental representative and Consultant.
- .2 Deliver familiarization training of operating and maintenance staff.
  - .1 Include instruction to site operation and maintenance staff for proper care, operation, and maintenance of equipment.
  - .2 Maintain services for such period, and for as many visits as necessary to put equipment in operation, and confirm that operating personnel are conversant with aspects of its care and operation.
- .3 Include fuel required for performing diesel-generator site test and top-up after acceptance test completion.

### **3.14 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Protect fuel lines from mechanical damage.
- .3 Repair damage to adjacent materials caused by electric power generating equipment installation.

**END OF SECTION**

**Part 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

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

**1.2 REFERENCE STANDARDS**

- .1 UL 1008 Edition 7 Automatic Transfer Switches For Use in Emergency Systems
- .2 UL 869A Reference Standard Service Equipment
- .3 CSA- C22.2 No 178.1-12 Automatic Transfer Switches

**1.3 SUMMARY**

- .1 Section includes:
  - .1 Specification for an Automatic Transfer Switch (ATS) for installation and operation on legally required standby applications for emergency power systems as defined by the National Electrical Code (NEC) or Canadian Electrical Code (CEC).
  - .2 It is intended for the Automatic Transfer Switch to operate in the following modes:
    - .1 The ATS shall continually monitor the condition of the utility supply voltage/frequency and shall automatically respond to a utility power failure condition by issuing an engine start signal to the emergency standby generators(s) in the system.
    - .2 The ATS shall automatically transfer the emergency load to the generator supply in the event of a utility supply failure and return the load to the utility supply upon restoration.
    - .3 The ATS shall perform an open transition power transfer with a neutral delay period between operating generator and the utility supply once the utility power source has been restored.
    - .4 When an On-Load test mode is activated, the ATS shall automatically transfer the emergency load to the generator supply and return the load to the utility supply upon test completion.
    - .5 The ATS shall perform a closed transition fast transfer power transfer between operating generator and the utility supply once the utility power source has been restored.
  - .3 All work defined within this specification shall be the responsibility of the Automatic Transfer Switch manufacturer, unless specifically defined as provided and/or installed by others.
- .2 The automatic transfer switch shall be manufactured in accordance with this specification and applicable UL, CSA, NEMA, and ANSI standards.

- .3 Supplier shall be responsible for ensuring the compatibility of all components of the ATS.
- .4 The contractor shall furnish and install the Automatic Transfer Switch in accordance with local bylaws, the National Electrical Code (NEC) or Canadian Electrical Code (CEC) specification and contract drawings.
- .5 Include all components, commissioning and services specified or as required to provide and install a complete and operable automatic transfer switch.
- .6 The Automatic Transfer Switch package shall include the following main components:
  - .1 ATS Enclosure
  - .2 Power Switching Mechanism
  - .3 Automatic Transfer Switch Controller:
    - .1 Operator Interface Display
    - .2 Source Voltage & Frequency Sensors
    - .3 ATS control logic c/w Integrated Time Delays, Inputs & Outputs
    - .4 Engine Start Output Contact
    - .5 Load Bus Power Metering
    - .6 Remote Communication Modbus™ Port

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Two sets of the following information shall be supplied for ATS approval submittal:
  - .1 ATS Physical Layout (Plan view)
    - .1 ATS Ratings
    - .2 Anchoring Details
    - .3 Cable Entry/Exit Locations
    - .4 Cable Connection Sizes
    - .5 Nameplate Information
  - .2 ATS Schematic Drawings
    - .1 Customer Input/output Electrical Connections
    - .2 Device settings
  - .3 ATS Product Datasheets

#### **1.5 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

- .2 The following shall be shipped with the equipment:
  - .1 Two sets of As - Built Drawings
  - .2 Hard copy of all Installation Guides Technical data:

## **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirement.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location.
  - .2 Store and protect from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management in accordance with Section 01 74 19 - Waste Management and Disposal.

## **Part 2 PRODUCTS**

### **2.1 RATINGS & CONSTRUCTION**

- .1 Rating of the automatic transfer switch shall be 400 AMP, 600 VAC, 60 Hz, 3 PHASE, 4 WIRE.
- .2 The transfer switch shall comprise of 3 switching poles plus a solid neutral.
- .3 The automatic transfer switch assembly shall be rated for 100% continuous load without de-rating. The automatic transfer switch shall be suitable for control of motors, electric discharge lamps, tungsten filament lamps, and electric heating equipment where the sum of motor full-load ampere ratings and the ampere ratings of other loads do not exceed the ampere rating of the switch and the tungsten load does not exceed 30 percent of the switch rating.
- .4 Fault withstand current rating (WCR) of the complete assembly shall be 35 Kamps RMS. The interrupting and closing rating shall be equal to or exceed the required withstand rating. This rating shall be obtained with standard upstream over current protection devices.
- .5 The automatic transfer switch must be listed or certified to the following safety standards:
  - .1 UL 1008 Edition 7 - Automatic Transfer Switches for Use in Emergency Systems
  - .2 CSA- C22.2 No 178.1-12 - Automatic Transfer Switches
- .6 The complete ATS assembly shall be mounted in a NEMA 1 type enclosure for indoor use.
- .7 All materials and parts used in the unit shall be new, of current manufacture, of best industrial grade, and free from defects and imperfections.



- .8 The transfer switch mechanism shall provide a simple means of manual operation.
- .9 All internal control devices used in the automatic transfer switch shall be capable of being de-energized and isolated from the system by use of an accessible isolation plug for servicing procedures as required.
- .10 The automatic transfer switch design shall provide front accessible components and wiring for easy serviceability. Power or control connections, which are not readily serviceable while the transfer switch is mounted in its enclosure, are not acceptable.
- .11 All power contacts used shall operate in a quick-make / quick-break manner, the speed of which shall be independent of supply voltage and / or speed of operation by manual means.
- .12 The enclosure shall consist of a 14-gauge steel angle or channel framework and be of adequate strength and rigidity to endure normal conditions of use and to support all equipment mounted within. Bolt-on steel panels and hinged doors shall form the outer shell of the enclosure.

## **2.2 SEISMIC ANCHORING**

- .1 The Transfer Switch shall be designed and constructed to withstand seismic events when correctly anchored to the building structure.
- .2 The Transfer Switch assembly shall comply with the relevant section of the International Building code standard IBC 2012 and shall be type tested on a shaker table to ACC 156 Standard.
- .3 The Transfer Switch shall successfully withstand a seismic event with a spectral acceleration of minimum 200%.
- .4 Specific Transfer Switch anchoring detail drawings shall be furnished by the Transfer Switch supplier to the contractor for compliance of seismic ratings.
- .5 Transfer Switch supplier shall provide a seismic certificate of compliance upon request.

## **2.3 ENCLOSURE FINISH**

- .1 The surface shall be free of nicks and abrasions and all sharp edges broken in preparation for painting the surface. The surface shall then be prepared with iron phosphate treatment and primer. The final coat to be UL approved electrostatically applied powder coat ASA 61 Grey.

## **2.4 AUTOMATIC TRANSFER SWITCH FEATURES**

- .1 The transfer switch shall be supplied with multi-voltage capability to allow use on a variety of standard system voltage levels without replacement of components. The transfer switch shall be field configurable to operate on the following nominal system voltages; 208V, 240V, 380V, 480V, 600V.
- .2 Transfer switch control power shall be obtained from the source being transferred to. The controls shall not require any connection to external power sources for normal automatic operation. Transfer switches requiring control power solely from the engine starting (or other) batteries are not acceptable.

- .3 A control circuit isolation plug shall be provided to isolate all control circuitry inside the transfer switch to facilitate maintenance procedures. When isolated, there shall be no voltage present on the control circuitry.
- .4 The transfer switch shall have control plugs for all interconnection to provide superior serviceability. Separate plugs shall be provided for voltage sensing, ATS controller, engine start outputs, programmable I/O and communications. All plugs shall be keyed to prevent incorrect installation.
- .5 The automatic transfer switch shall include a fully integrated microprocessor-based Transfer Switch Controller which shall provide the following key features:
  - .1 Graphical 7" Color Touch Screen Operator Interface Display
  - .2 Open and/or Closed Transition Transfer Control
  - .3 Utility/Gen Voltage and Frequency Metering
  - .4 Load Bus 3 Phase Power Metering (Optional)
  - .5 Modbus<sup>TM</sup> RTU Serial Communication
  - .6 Modbus<sup>TM</sup> TCP/IP Ethernet Communication (Optional)
  - .7 8 Programmable Relay Output Contacts
  - .8 16 Programmable Digital Inputs
  - .9 Engine Start Output Contact
- .6 The transfer switch controller shall include an operator interface graphical color touch screen display which shall be door mounted. The display shall contain the following features:
  - .1 7.0-inch Diagonal Color Display Screen
  - .2 Capacitive Touchscreen
  - .3 Resolution 800 x 480 (WVGA)
  - .4 Wide Viewing Angle
  - .5 Serial, Ethernet, USB Ports
  - .6 SD Card Memory Card
- .7 The transfer switch controller display shall provide easy to navigate software menu screens for all ATS system information and control. The following information shall be displayed within the software menuing system:
  - .1 System Time/Date
  - .2 ATS Power Mimic Bus
  - .3 Source Available/ATS Position Indication

- .4 Utility supply metering – 3 phase voltage and frequency
  - .5 Generator supply metering – 3 phase voltage and frequency
  - .6 ATS Load metering – 3 phase voltage
  - .7 Timer countdown display
  - .8 ATS Control Modes (Auto/Off/Manual/Engine Start)
  - .9 Data Logging of Events
  - .10 Alarm Summary
  - .11 Alarm Logs
  - .12 Event Logs
  - .13 Virtual Synchroscope
  - .14 Calendar-Based Exercise Scheduler
- 
- .8 The Transfer Switch Controller shall be an Intelligent Electronic Device (IED) which shall have a unique Internet Protocol (IP) Address for programming/configuring and remote communication.
  - .9 The Transfer Switch Controller shall be capable of operating in conjunction with other ATS controllers on a common Ethernet communication network.
  - .10 Password Security: The transfer switch controller software program shall include a three (3) level security password system for access to all programming functions. Specific password levels shall be provided for “read only”, “read/write” and “administrator”. Password security shall allow for users to be named with individual user names and login passwords.
  - .11 All programming/configuring of the transfer switch controller set points including voltage, frequency and time delays shall be software programmable from the front door mounted graphical display screen.
  - .12 Utility/Gen Metering: Digital and Analog (i.e. graphical representative) metering shall be provided by the transfer switch controller for the Utility and Generator supplies. The transfer switch controller shall have an accuracy of  $\pm 0.5\%$  (Full Scale) for all voltage and frequency readings. The following standard metering features shall be provided for the utility and generator supplies;
    - .1 Digital and graphical analog display of AC voltages
    - .2 Three phase or single-phase voltages (Line to Line & Line to Neutral)
    - .3 Phasor diagram showing graphical phase relationship and voltage magnitude
    - .4 Symmetrical Component Diagrams (Positive, Negative & Zero sequence display)
    - .5 Voltage phase rotation indication
    - .6 Frequency display to 0.1Hz resolution

- .13 Voltage/Frequency Sensing: The ATS controller shall provide the following voltage and frequency sensing control features for the utility and generator supplies:
- .1 The Transfer Switch controller shall have fully integrated 120-600V, 3 phase true RMS AC voltage sensing on the Utility Supply, generator supply and ATS Load bus for operation and monitoring. Programmable set points shall be provided for utility/generator source under voltage, overvoltage and phase unbalance.
  - .2 AC voltage sensing shall utilize advanced symmetrical component algorithms to determine positive, negative and zero sequence voltages. This shall provide the capability to detect true phase loss/unbalance (i.e. single phasing) protection on 3 phase systems where re-generative phase voltages maybe present due to failed 3 phase transformers or motor loads.
  - .3 AC Voltage sensing shall be fully configurable to allow operation on 3 phase 3 wire or 3 phase 4 wire systems without use of additional potential transformers on systems 600VAC or below.
  - .4 Phase Sequence & Phase Reversal Protection: Phase Sequence/Phase reversal protection shall be provided to inhibit transfer between alternate sources should an incorrect phase sequence condition exist between connected sources. The Transfer Switch controller shall provide capability to program either A-B-C or C-B-A phase rotation.
  - .5 Under Voltage Sensing: Three phase under voltage sensing shall be provided for both utility and generator supplies. Activation of an abnormal under voltage condition on any phase shall initiate a load transfer to the alternate source or shall inhibit a transfer to a source until its voltage levels are within normal limits. The under-voltage sensor shall be user adjustable from 70-100% of nominal and shall be based on a falling (i.e. drop-out) voltage. The under-voltage sensor shall be factory set for drop-out at 85% nominal voltage. The under-voltage sensor shall reset (i.e. pick-up) 5% above the dropout setting and shall be adjustable. The under-voltage sensor shall include an adjustable transient time delay feature.
  - .6 Over Voltage Sensing: Three phase over voltage sensing shall be provided for both utility and generator supplies. Activation of an abnormal over voltage condition on any phase shall initiate a load transfer to the alternate source or shall inhibit a transfer to a source until its voltage levels are within normal limits. The over voltage sensor shall be user adjustable from 100-130% of nominal and shall be based on a rising (i.e. pick-up) voltage. The over voltage sensor shall be factory set for pick-up at 115% nominal voltage. The over voltage sensor shall reset (i.e. drop-out) 5% below the pick-up setting and shall be adjustable. The over voltage sensor shall include an adjustable transient time delay feature.
  - .7 Phase Unbalance/Phase Loss Sensing: Voltage phase unbalance/phase loss sensing shall be provided for the generator and utility supplies. Activation of an abnormal utility phase unbalance condition shall initiate the generator to start and to transfer on load. The voltage phase unbalance sensor shall be user adjustable from 3-30% of nominal and shall be factory set for pick-up at 5% nominal voltage. The voltage phase unbalance sensor shall include an adjustable transient time delay feature.
  - .8 Under Frequency Sensing: Under frequency sensing shall be provided for both utility and generator supplies. Activation of an abnormal under frequency condition shall initiate a load transfer to the alternate source or shall inhibit a transfer to a source until its frequency levels are within normal limits. The under-frequency sensor shall be user adjustable from 70-100% of nominal and shall be based on a falling (i.e. drop-out) frequency. The under-frequency sensor shall be factory set for drop out at 80% nominal frequency. The under-frequency sensor shall reset (i.e. pick-up) 10% above the dropout setting and shall be adjustable. The under-frequency sensor shall include an adjustable transient time delay feature.

- .9 Over Frequency Sensing: Over frequency sensing shall be provided for both utility and generator supplies. Activation of an abnormal over frequency condition shall initiate a load transfer to the alternate source or shall inhibit a transfer to a source until its frequency levels are within normal limits. The over frequency sensor shall be user adjustable from 100-130% of nominal and shall be based on a rising (i.e. pick-up) frequency. The over frequency sensor shall be factory set at 115% nominal voltage. The over frequency sensor shall reset (i.e. drop-out) 5% below the pick-up setting and shall be adjustable. The over frequency sensor shall include an adjustable transient time delay feature.
- .14 Time Delays: The following time delay functions shall be provided within the transfer switch controller:
- .1 Engine Start - A time delay on engine start shall be provided to delay the engine start signal after failure of the utility source. The time delay shall be user adjustable 0 - 60 seconds, factory set at three (3) seconds.
  - .2 Engine Warmup - A time delay for engine warm up shall be provided which permits transfer to the generator supply after generator voltage and frequency have reached acceptable limits. The time delay shall be user adjustable 0 - 60 minutes, factory set at two (2) seconds.
  - .3 Utility Return - A time delay for return to utility shall be provided which permits a re-transfer back to the utility supply only after stable voltage and frequency condition exists for the specified time period. The time delay shall be user adjustable 0 - 60 minutes, factory set at two (2) minutes.
  - .4 Engine Cooldown - A time delay for engine cooldown shall be provided which delays the engine stop signal after load has re-transferred back to the utility source. The time delay shall be user adjustable 0 - 60 minutes, factory set at two (2) minutes.
  - .5 Neutral Delay - A time delay for neutral position shall be provided in the open transition mode to minimize the effect of out-of-phase transfer due to connected motor load. The time delay shall be user adjustable 0 - 120 seconds, factory set at three (3) seconds.
  - .6 Gen Commit to Transfer Delay - A time delay for Gen Commit to Transfer position shall be provided. Should the generator fail to transfer on load with the "commit to transfer" feature enabled, the ATS shall automatically re-transfer back to the utility supply if within nominal limits following expiry of the "Gen Commit to Transfer" timer. The time delay shall be user adjustable 0 - 600 seconds, factory set at three hundred (300) seconds.
  - .7 Transfer Fail Delay - A time delay for Transfer Fail delay shall be provided. The timer shall activate a fail alarm condition if the transfer switch fails to successfully transfer within the transfer fail time delay setting. The time delay shall be user adjustable 0 - 600 seconds, factory set at thirty (30) seconds.
- .15 Timer Bypass: The transfer controller shall provide a timer bypass function to automatically bypass unwanted delays during testing or maintenance procedures. The timers shall automatically reset on the next operation sequence to their original setting. The following time delays shall have a user-initiated bypass feature:
- .1 Engine Warmup Delay
  - .2 Utility Return Timer
  - .3 Engine Cooldown Timer

- .4 Neutral Delay Timer
- .16 Real-Time Clock: The transfer controller shall provide a real-time clock to display system time and date for use by event logging and the ATS exercise scheduler. The real-time clock shall have automatic shifting of date/time for daylight savings and leap year occurrences. The real-time time clock shall be powered by an independent 10-year life battery to maintain all time/date settings upon loss of control power.
- .17 ATS Status Indication: The transfer switch controller shall provide the following indication lights/icons on a common screen for simple visual indication of ATS status:
  - .1 Utility/Gen Source available
  - .2 Load Bus Energized
  - .3 ATS Position: Utility or Generator Source Connected to Load
  - .4 Engine Start Signal Initiated
  - .5 ATS in TEST or Exercise Mode
  - .6 Load Shed is active
  - .7 Current ATS Operating Mode (Auto/Off/Man/Test)
  - .8 Common alarm (Flashing Icon)
  - .9 Security Access Locked/Unlocked
- .18 Alarm Annunciation: The transfer switch controller shall provide an alarm annunciation screen to indicate the status of all individual alarm conditions on the ATS. The alarm screen shall have an alarm reset function.
- .19 Alarms Log: The transfer switch controller shall provide an alarm log screen to indicate a history of recent alarms. All alarm logs shall be provided with a time/date stamp and the name of user who reset the alarm. Alarm logs can be filtered by calendar date.
- .20 Events Log: The transfer switch controller shall provide an event log screen to indicate a history of recent events. All event logs shall be provided with a time/date stamp and the name of user who activated/deactivated a specific event. Event logs can be filtered by calendar date.
- .21 Virtual Synchroscope: For transfer switches equipped with open transition -fast transfer or closed transition transfer mechanisms, the transfer controller display shall indicate the operating status of the "in-sync" transfer operation. Operating status shall include the following display features:
  - .1 Virtual Synchroscope showing graphical phase degree and speed (slow-fast) representation between the two sources prior to transfer operation.
  - .2 Voltage Difference meter displayed in % system voltage
  - .3 Slip Frequency meter displayed in % of system frequency
  - .4 Generator and Utility Phase A-N voltage

- .5 Generator and Utility frequency
- .22 ATS Control Mode: The transfer switch controller shall provide 7 selectable operating modes available from the main operating screen. The following operating modes shall be provided:
  - .1 Auto: ATS shall operate automatically during a utility power failure
  - .2 Off: ATS shall not start engine or transfer load during a utility power failure
  - .3 Manual: ATS can be operated manually to the desired source.
  - .4 On Load Test: ATS shall be selected to operate in On-Load test mode and permit load transfer
  - .5 Off Load Test: ATS shall be selected to operate in Off-Load test mode and shall not permit load transfer
  - .6 Timed Test: ATS shall be selected to operate in a Timed test mode
  - .7 Closed Transition: ATS shall be selected to operate in a Closed Transition Transfer mode
- .23 Utility Retransfer Operation Selection: The operator interface display shall provide a selection for Utility Re-transfer operation. The utility re-transfer operation shall be user selectable for Automatic, or Manual re-transfer operation. When Manual re-transfer mode is selected, the user can initiate when the re-transfer to utility power shall occur.
- .24 Test Modes: The transfer switch controller shall provide the following user selectable test modes and features:
  - .1 On Load/Off Load: The operator interface shall provide selection of “OFF-LOAD” testing (i.e. load does not transfer to generator) or “ON-LOAD” testing (i.e. load transfers to generator) modes.
  - .2 Automatic Timed Test Modes: Automatic timed test mode shall be provided to allow for tests to be manually initiated and automatically terminated. Timed test modes shall be user adjustable (0-999 minutes). The load shall automatically re-transfer back to the utility supply should the generator fail on load.
  - .3 Automatic Gen Exerciser: A calendar based automatic exercise time function shall be provided for generator testing. The Exercise scheduler shall be fully programmable for; start/stop date & time, duration of the test and type of test mode (i.e. On-Load or Off-Load). The exercise timer shall utilize the transfer controller’s internal time clock for referencing all timing functions. The transfer switch shall automatically re-transfer back to the utility supply if the generator set fails during an exercise period.
- .25 Scheduler: A calendar-based scheduler shall be provided by the transfer switch controller. The scheduler shall operate based on the transfer switch controller real-time clock. The scheduler shall allow users to program over 25 specific event schedules to be added. Each event can be edited individually, and its operating status can be monitored. The scheduler shall allow the following programming functionality:
  - .1 Schedule Event Start Date/Time
  - .2 Event Period (Day/Week/Month/Year)

- .3 Schedule Event Stop Date/Time
- .4 Event Duration (mins/hours)
- .5 Event Operation Type (Off-Load Test, On-Load Test)
- .6 Number of Re-occurring Events (one-time or number of events)
- .26 Transfer to Generator Inhibit: The transfer controller shall provide a programmable digital input to inhibit transfer to generator until external signal is removed. Transfer to Generator inhibit shall be automatically bypassed should the utility source fail, and the generator source is available within normal limits.
- .27 Transfer to Utility Inhibit: The transfer controller shall provide a programmable digital input to inhibit transfer to utility until external signal is removed. Transfer to Utility inhibit shall be automatically bypassed should generator source fail, and the utility source is available within normal limits
- .28 Generator Source Trip Inhibit: The transfer controller shall provide a programmable digital input to inhibit opening of the generator power switching device until external input signal is removed. Trip inhibit shall be automatically bypassed should generator source fail, and utility source is available and/or max parallel time is exceeded.
- .29 Transfer Switch Fail Logic: The following transfer switch failure logic and alarming shall be provided during open or closed transition transfer sequences
  - .1 Transfer Fail: Control logic shall be provided for sensing a transfer switch failure in open or closed transition mode. When an alarm condition is activated, the transfer controller shall automatically force a transfer to the alternate source if available.
  - .2 Power Switching Device Fail: Control logic shall be provided to detect if a power switching device fails to close or open during an open or closed transition operating sequence. Should a power switching device fail to close or open for any reason within a pre-set time period (adjustable), an alarm light and alarm relay contact shall be activated.
  - .3 Gen Failure: Control logic shall be provided for immediate transfer to the utility supply (if within acceptable limits) should the generator set fail during any activated test mode.
- .30 Gen Commit to Transfer Logic: Programmable control logic shall be provided to select whether or not the load shall be transferred to the generator (following a utility power failure) if the utility supply is restored immediately before the generator transfers on load. With the feature programmed as NO (DISABLED), the transfer switch shall not commit a transfer to the generator after the engine start delay has expired, but shall return to the utility supply if immediately restored. With the feature programmed as YES (ENABLED), the transfer switch shall commit a transfer to the generator after the engine start delay has expired. This feature shall be automatically cancelled after expiry of the Gen Commit to Transfer timer (5 mins adjustable) should the generator fail to start.
- .31 Load Disconnect Contact (LDC): Control logic shall be provided to signal an external load (e.g. elevator) of an impending transfer to and from the generator supply. A single normally open output contact shall be supplied and shall be rated 2A, 120VAC, 28Vdc resistive. The contact shall close prior to a transfer and remain closed until the transfer is completed and the post



transfer delay time has expired. A pre-transfer delay function shall be provided, programmable 0 - 30 seconds. A post transfer delay function shall be provided, programmable 0 - 30 seconds.

- .32 Engine Start Contacts: Two (2) engine start contacts shall be provided which shall close to initiate starting of the engine. The engine start contact shall be rated 7A, 120/240VAC, 28Vdc resistive.
- .33 Load Shed: The transfer controller shall have provisions to provide a load shed output contact via assignment of one of the programmable output contacts. The Load shed output shall be activated whenever the generator transfers on load and shall reset once the utility supply retransfers back on load. If the ATS is equipped with ATS Load bus power metering option, the Load shed feature shall be programmable based on a generator kW load set point.
- .34 User Programmable Digital Inputs: Sixteen (16) user programmable digital inputs shall be provided by the transfer controller. The digital inputs shall accept a dry (isolated) logic contact to switch to DC negative (ground). Each input shall allow mapping to over 30 different control or monitoring functions as available within the transfer controller database. The following inputs shall be mapped as factory defaults:
  - .1 Remote Test - Utility Power Fail Simulate (Close to Test)
  - .2 Remote Alarm Reset (Momentary Close to Reset)
  - .3 Service Disconnect Mode Activated (External Control Switch)
  - .4 Utility Power Switching Device (USD) Tripped
  - .5 Generator Power Switching Device (GSD) Tripped
  - .6 Transfer Control in Manual (External Control Switch)
  - .7 Transfer Control in Closed Transition Mode (External Control Switch)
  - .8 Utility Power Switching Device (USD) Open
  - .9 Generator Power Switching Device (GSD) Open
  - .10 Generator Bypass Switch (GB) Closed
  - .11 Utility Bypass Switch (NB) Closed
  - .12 Load Isolate Switch (LI) Closed
  - .13 Generator Isolate Switch (GI) Closed
  - .14 Utility Isolate Switch (NI) Closed
  - .15 Inhibit Transfer to Utility (Source 1)
  - .16 Inhibit Transfer to Generator (Source 2)
- .35 User Programmable Output Contacts: Eight (8) user programmable output contacts shall be provided by the transfer controller. The contacts shall be rated 2A, 120/240VAC, 28Vdc resistive, Form C. Each output contact shall be user programmable. The following outputs shall be mapped as factory defaults:

- .1 Load on Utility (AUX U)
  - .2 Load on Generator (AUX G)
  - .3 Load Disconnect Contact (LDC)
  - .4 Fail to Transfer (FTT)
  - .5 ATS Not in Auto
  - .6 ATS in Auto
  - .7 Utility Power Available (UPA)
  - .8 Generator Power Available (GPA)
- .36 In-Sync Transfer Sensor: For transfer switches equipped to operate in a fast “open” or “closed” transition transfer sequence, the transfer switch controller shall provide an integrated “in-sync” transfer sensor to safely permit in-sync transfers to occur when both sources are available. The in-sync transfer sensor shall provide adjustable voltage and frequency thresholds to only permit transfers when the two sources are safely in phase. The in-sync sensor shall also provide a zero-degree closing angle target by utilization of anticipatory closing angle control logic for different levels of slip frequency.
- .37 Closed Transition-Fast Transfer: The transfer controller shall provide integrated closed transition control logic to allow the following operating conditions;
- .1 The transfer controller shall be capable of either open or closed transition operation as selected by operator interface control switch.
  - .2 Closed transition transfer shall only be permitted if both sources are available and the sources are in synchronism (via in-sync sensor permissive signal) prior to interconnection of the two sources.
  - .3 Should an “in-sync” condition not be achieved within a pre-selected time period, an alarm condition shall be activated.
  - .4 If only one source of power is available, and the transfer switch is called to transfer, it shall automatically revert to open transition mode.
  - .5 Under normal operation, both sources of supply shall be inhibited from staying interconnected (in parallel) for longer than 100 milliseconds.
  - .6 Circuitry shall be provided to detect an extended parallel operation time greater than 100 milliseconds. Should the two sources stay interconnected in parallel for longer than 100 milliseconds due to an abnormal condition and independent supervisory circuit shall separate the two sources via alternate tripping signals to ensure the two sources are not interconnected in parallel for longer than a maximum of 500 milliseconds.
- .38 Modbus TCP Ethernet Communication: The transfer switch controller shall provide a 100BaseT Ethernet port for customer connection to a remote data monitoring device such as PLC, building automation system or desktop PC. The Ethernet Port shall provide Modbus TCP protocol with data registers defined in the Modbus Communication Manual. The Modbus port shall provide the following main data register information:

- .1 ATS Position Status
  - .2 ATS Source and Load Status
  - .3 Alarm status
  - .4 Utility/Generator 3 Phase Voltage
  - .5 ATS Load Bus voltage
  - .6 ATS Load Bus Power Metering (kW, kVA, kVAR, PF) when power metering option is provided).
  - .7 Event logging data
- .39 Data Logging Memory: The transfer controller shall provide data logging and shall store the data in non-volatile memory on a removable SD memory card. The following events shall be recorded and stored:
- .1 Total Number of Transfers
  - .2 Total Number of Transfers due to source failure
  - .3 Number of Hours Controller is energized
  - .4 Number of Hours Load is on Utility
  - .5 Number of Hours Load is on Generator

## **2.5 SYSTEM DESCRIPTION**

- .1 Automatic load transfer equipment to:
- .2 Monitor voltage on phases of normal power supply.
- .3 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.
- .4 Transfer load from normal supply to standby unit [when standby unit reaches rated frequency and voltage pre-set adjustable limits].
- .5 Transfer load from standby unit to normal power supply [when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period].
- .6 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

## **2.6 EQUIPMENT IDENTIFICATION**

- .1 Identify equipment in accordance with Section [26 05 00 - Common Work Results for Electrical.

## **2.7 SOURCE QUALITY CONTROL**

- .1 The Transfer Switch shall be designed and manufactured in a facility, which is registered to an ISO 9001:2008 quality system. The supplier shall have a minimum of 30 years experience designing and manufacturing automatic transfer switches.
- .2 Only new materials and components shall be used and of current manufacture.

- .3 The unit shall be manufactured in accordance with this specification and applicable UL, CSA, and NEMA standards.

### **Part 3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Locate, install and connect transfer equipment as indicated.

#### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Energize transfer equipment from normal power supply.
- .3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.
- .4 Set selector switch in "Manual" position and check to ensure proper performance.
- .5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.
- .6 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for [10] minutes, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.
- .7 Repeat, at 1-hour intervals, 2 times, complete test with selector switch in each position, for each test.

**END OF SECTION**

**Part 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

- .1 Not used.

**1.2 REFERENCE STANDARDS**

- .1 Not used.

**Part 2 PRODUCTS**

**2.1 PVC DUCTS AND FITTINGS**

- .1 Rigid PVC duct: Type DB2, with fabricated fittings, for direct burial.
- .2 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make a complete installation.
- .3 Rigid PVC 90 degrees, 45 degrees bends, and 5 degrees angle couplings as required.

**2.2 SOLVENT WELD COMPOUND**

- .1 Solvent cement for PVC duct joints.

**2.3 CABLE PULLING EQUIPMENT**

- .1 6 mm stranded nylon pull rope tensile strength 5kN.

**2.4 WARNING TAPE**

- .1 Standard 4-mil polyethylene 76 mm wide tape, yellow with black letters, imprinted with "CAUTION BURIED ELECTRIC CABLE BELOW".

**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 duct in accordance with manufacturer's instructions and at elevations as indicated.
- .2 Clean inside of ducts before laying.
- .3 Install plastic duct spacers and ensure full, even support every 1.5 m and smooth transition throughout duct length.

- .4 Slope ducts with 1 to 400 minimum slope.
- .5 Install plugs and cap both ends of ducts to prevent entrance of foreign materials during and after construction.
- .6 Pull through each duct mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign material.
  - .1 Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .7 Install a pull rope continuous throughout each duct run with 3 m spare rope at each end.
- .8 Place continuous strip of warning tape 300 mm above duct before backfilling trenches.
- .9 Install markers as required.
- .10 Notify Consultant for field review upon completion of direct buried ducts and obtain acceptance prior to backfill.

### **3.3 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**