



Fisheries and Oceans
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DRAWINGS & SPECIFICATIONS FOR:

3300 CHATHAM, RICHMOND, BC – STEVESTON GULF

NEW ELECTRICAL INDEPENDENT POWER SOURCE – 800A SERVICE

September 2021

FISHERIES AND OCEANS CANADA

SMALL CRAFT HARBOURS – PACIFIC REGION

200 – 401 Burrard Street

Vancouver, British Columbia

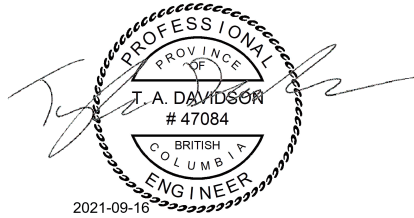
V6C 3S4

CONSULTANTS – SEAL & SIGNATURE

Discipline

Electrical
(Prime)

Seal / Signature / Date



END OF SECTION

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END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 The following shall be deemed to be part of all Sections of the Specifications and shall be read in conjunction therewith:
 - .1 Drawings and Specifications
 - .2 Addenda and Appendices
- .2 In addition, the following shall be deemed to be part of all Specifications and shall be read in conjunction therewith the Electrical Drawings.
- .3 Perform work to CURRENT Codes, Construction Standards and Bylaws, including Amendments up to the TENDER closing date.

1.2 DEFINITIONS

- .1 The following terminology is used in these specifications and the intent of their meaning and use is as follows:
 - .1 The words ***Engineer*** or ***Consultant*** and their derivatives shall be taken to mean the person or persons with a professional designation registered in the Province of B.C. and in good standing. The Engineer acts on behalf of and in the best interests of the Departmental Representative. The primary consultant on this project is ***WSP***.
 - .2 The words ***Departmental Representative*** and their derivatives shall be taken to mean the person or persons in the employ of the Departmental Representative who oversees the project and has final decision-making power with respect to the project and the contract.
 - .3 The words ***Contractor*** or ***Subcontractor*** and their derivatives shall be taken to mean the company that tenders and is subsequently contracted to provide the equipment and services required as defined in these Tender documents, including the assumption of all contracts necessary for the completion of the Work described. ***Contractor*** or ***Subcontractor*** also includes those persons directly or indirectly employed or contracted or responsible to the company or companies involved in the execution of this project.
 - .4 The words ***Person-in-Charge*** or ***PIC*** and their derivatives shall be taken to mean the person who is assigned by the Contractor as the on-site project supervisor and who is qualified with the requirements of the Electrical Safety Act, in good standing and approved to perform the duties of an Class A Accredited Representative in the Province of BC.
 - .5 The words ***Authorities Having Jurisdiction*** or ***AHJ*** and their derivatives shall be taken to mean those persons or organizations that are responsible for approving equipment, procedures, and installation methods and can enforce requirements necessary for the safe use, procedures, installation and documentation of work.
 - .6 The words ***provide, supply, or supply and install*** and their derivatives shall be taken to mean the procurement, supply, delivery, receipt, storage, placement, fit, connection, installation, seismically fastening, testing and commissioning of the

equipment and all miscellaneous work, equipment and materials required to complete the project as stated in the contract documents.

- .7 The words ***remove*** and their derivatives shall be taken to mean electrical isolation of the device(s) following all safety procedures to ensure de-energization of the device, notification to Departmental Representative working on the project or in the area, disconnecting all connections, proper termination & labelling of disconnected conduit/cables/boxes, detaching the isolated device from the circuit, and proper disposal to an Departmental Representative -approved depot.
- .8 The word ***replace*** and its derivatives shall be taken to mean to provide new and remove existing devices as required to complete the project.
- .9 The words ***work*** or ***contract*** or ***project*** and their derivatives shall be taken to mean all the work required to plan, permit, manage, execute and sign-off the work as stated in the contract documents.
- .10 The words ***feed, feeder, conduit/cable*** and their derivatives shall be taken to mean the conduit and cable system complete with all necessary fittings, boxes, seismic attachments, fastenings, grounding and bonding requirements, roofing penetration requirements, fire ratings, and firestopping approved and rated for continuous use in the electrical system as described in the project.
- .11 The word ***kiosk*** and its derivatives shall be taken to mean a complete cabinet including its transformer, panels, receptacles, luminaire, fixture, and all conduit, wiring, cabling, fasteners, fittings, attachments and labels.
- .12 The words ***Receptacle Cabinet*** or ***RC*** and/or ***pedestal*** or ***kiosk*** and their derivatives shall be taken to mean the complete cabinet including its panel, receptacles, luminaire, fixture, and all conduit, wiring, cabling, fasteners, fittings, attachments and labels

1.3 BACKGROUND

- .1 Fisheries and Oceans Canada, will be replacing the existing underground power source fed from South Shore Power electrical room at 3300 Chatham, Richmond, V7E 3K1, with permanent, independent fully rated normal power distribution system at 120/208/347/600V, 3-phase, 4-wire. The scope of work includes BC Hydro coordination, and installation of underground duct power and communication distribution and connections throughout the 3300 Chatham site to Buildings 61, 60, 44, 5, and future building.
- .2 The new independent normal power distribution system fed from BC Hydro Service to be installed consists of:
 - .1 Low Voltage Main Distribution Center '**MDC-Gulf**' Kiosk at 800A Main Service
 - .2 BC Hydro 25kV:600/347V, 3 Phase Transformer
- .3 Work includes but not limited to installation and modification of existing and new underground ducts and pullboxes for power and communication, installation of BC Hydro metering system, installation of precast concrete for the BC Hydro transformer, grounding, bonding of the electrical systems per CSA and BC Hydro standards; additional electrical work as specified within the electrical drawings.

1.4 SUMMARY OF WORK

- .1 Notwithstanding the scope of work stated within the drawings and all sections of this contract, the contractor is not exempt from and is fully responsible for details omitted or forgotten that contribute to the safe preparation, execution and completion of the Work to a fully functioning, safe, and permanently operational electrical system.
- .2 Provision of any temporary power if required by SCH during the project.
- .3 BC Hydro coordination, and installation of all required equipment, enclosures, underground ducts, connections, and devices as per BC Hydro's ES54 standards for a fully functional permanent power distribution system.
 - .1 Installation on precast concrete provided by BCH.
 - .2 Installation of all grounding and counterpoise for the BCH transformer
 - .3 Installation of precast bollards provided by BCH.
 - .4 Provision of a fully functional BCH metering system and metering instrumentation.
 - .5 Provision of required enclosures, connections as required.
- .4 Shutdowns may be required when installing the 3-phase electrical equipment. Coordinate with BC Hydro, the existing tenants and SCH personnel prior to shutdowns.
- .5 Provide shop drawings of all new equipment to be provided, for review by Departmental Representative 5 working days prior to procurement.
- .6 Provide MDC-Gulf enclosures complete with all components and wiring, installed and located as indicated on the drawings and specifications, and as required for a safe and fully functioning MDC-Gulf kiosks.
- .7 Reinforced concrete pads for MDC-Gulf kiosk.
- .8 Power and communication stub-ups as per electrical drawings.
- .9 Provide new equipment within the new MDC-Gulf kiosks.
- .10 Provide digital metering system as per electrical drawings and Section 26 09 23.01 Metering and Switchboard Instruments.
- .11 Connect new feeder cables from electrical kiosk MDC-Gulf to specified loads as per the Single Line Diagrams.
- .12 Provide ground rods, grounding and bonding as per electrical drawings and CSA.
- .13 Provide conduit stub-ups in RGS along the exterior wall C/W LB fitting(s) and weather seal for each building.
- .14 Provide all new lighting fixtures, heating, receptacles, and wiring for electrical kiosk MDC-Gulf.
- .15 Provide one (1) set of up to date Arc Flash Study test report and one (1) fuse coordination test report for approval by the Departmental Representative:
 - .1 Provide a summary sheets of the reports and final as-built single-line diagram for the low voltage substation within the kiosk plexiglass pocket.
 - .2 Coordinate all test schedules with the Departmental Representative prior to testing.

- .16 Disconnection of existing underground connections to the old shore power is within the scope of work.
- .17 Disconnection of the existing BCH meter within Building 44 electrical room, and removal of overhead transformers east of Building 44 as indicated.

1.5 WORK IN PROGRESS

- .1 Coordination with Departmental Representative operations and other construction work in progress may be required during the execution of this Work.
- .2 Shutdowns shall require the authorization of the Departmental Representative and shall be scheduled 5 working days in advance with the Departmental Representative. The Departmental Representative reserves the right to re-schedule shutdowns at any time due to their operations.

1.6 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract includes, but is not limited by:
 - .1 All precautions necessary to ensure that preparation and shutdown work shall be safely executed while other equipment is energized in the vicinity.
 - .2 Provision of all required equipment materials and services for this project as described to properly manage, schedule and coordinate the work in a manner that minimizes the risk of unplanned outages to Departmental Representative and ensures the safety of Departmental Representative personnel, equipment and the public.
 - .3 Provision of a Schedule and Work Plan for the execution of the work in a phased manner such as to minimize the disruption of operations and use by the public and Departmental Representative staff at the site.
 - .4 Provision of electrical Kiosk MDC-Gulf enclosures and components, and install components inside enclosures, as required for a safe and fully functioning electrical Kiosk MDC-Gulf as per BC Hydro's requirements. The components include internal transformers, BC Hydro Meter and socket enclosure, BC Hydro CT/PT cabinet, digital metering system and DMS panel, panelboards, main and branch breakers, locking receptacles, luminaire, photocell and all internal wiring, connections, fittings, etc.
 - .5 Provision of Seismic Engineering services including Engineered shop drawings showing seismic anchoring and bracing required for mounting of MDC-Gulf kiosk.
 - .6 Provision of approved seismic attachments, fittings and fasteners as described by the Contractor's Seismic Engineer.
 - .7 Installation of BC Hydro housekeeping concrete pad, bollards, meter, CT/PT, metering instrumentation; provision of grounding, bonding, underground ducts, conduits, enclosure(s), and other connections as per but not limited to electrical drawings, CSA, and BCH ES54.
 - .8 Handle all products at site, including uncrating and storage. Protect from damage and exposure to elements during the project.
 - .9 Repair or replace items damaged by Contractor or Others during pick-up, delivery, off-loading, storage, or installation on site during project duration.

- .10 Install all interior and exterior devices to fit in drawings showing seismic anchoring and bracing required for mounting of MDC kiosk as per this Contract, including all fittings, wiring, connections, fasteners, finishes, adjustments, etc., as required for a safe and continuously energized unit.
- .11 Submit shop drawings and product data of interior and exterior devices assembled in drawings showing seismic anchoring and bracing required for mounting of MDC kiosk for approval by Departmental Representative prior to purchase.
- .12 Allow inspections as required by Departmental Representative.
- .13 Provision of all distribution feeder junction and/or pull boxes as required.
- .14 Provision of all required testing, commissioning and training services.
- .15 Provision of all shop drawings, O&M manuals and As Built drawings.
- .16 Provision for tool lockups and job site security.
- .2 Work of the Contract comprises the provision of all permits, approvals, written instructions, schedules, plans and submitting of same to the Departmental Representative and to the AHJ as required, prior to, during and after the execution of the work.

1.7 WORK BY OTHERS

- .1 Cooperate and coordinate Work with that of other Contractors on-site. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Departmental Representative in writing, any defects which may interfere with proper execution of Work.
- .2 Installation of the BC Hydro transformer not within the scope of work and is done by BC Hydro. Contractor shall coordinate pre-transformer installations and requirements with BC Hydro.
- .3 Items below are provided by BC Hydro; contractor to install these items as per electrical drawings and BCH-ES54 standards:
 - .1 One (1) BC Hydro revenue meter
 - .2 Three (3) CTs.
 - .3 Three (3) PTs.
 - .4 6 precast bollards.
 - .5 One (1) BC Hydro precast transformer concrete pad.
 - .6 Grounding Kit

1.8 CONTRACTOR USE OF PREMISES

- .1 Contractor must adhere to security arrangements as required by the Departmental Representative.
- .2 Limit use of premises for Work, for storage and for access, to allow
 - .1 Departmental Representative occupancy;
 - .2 Work by other contractors;
 - .3 Public usage.

- .3 Construct work in stages if necessary to provide for continuous public and staff usage. Do not close off public or staff usage of facilities. Coordinate with Departmental Representative any work that may interfere with public usage or staff operations.
- .4 Obtain and pay for use of additional storage or work areas off-site if needed for operations under this Contract.
- .5 Remove or alter Work to prevent injury or damage to portions of existing premises which remain.
- .6 Repair or replace portions of existing premises which have been altered during construction to match adjoining Work, as directed by Departmental Representative.
- .7 At completion of operations the condition of original premises shall be equal to or better than that which existed before Work started.

1.9 TIME OF COMPLETION

- .1 Start work immediately upon official notification of acceptance of offer.

1.10 WORK SCHEDULE

- .1 Within 7 working days after Contract award, provide a schedule showing anticipated progress stages and final completion of the work within the time period required by Contract documents.
- .2 Interim reviews of work progress based on work schedule will be conducted as decided by Departmental Representative and schedule updated by Contractor in conjunction with and to approval of Departmental Representative.

1.11 COST BREAKDOWN

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

1.12 SAFETY REGULATIONS AND MEASURES

- .1 Construction safety:
 - .1 Observe and enforce construction safety measures required by the following:
 - .1 NBC 2015, Part 8 - Safety Measures at Construction and Demolition Sites.
 - .2 B.C. Provincial Government.
 - .3 Workers' Compensation Board of B.C.
 - .4 Municipal statutes and authorities.
 - .2 In event of conflict between any provisions of the above authorities, the most stringent provision will apply.
 - .3 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.
- .2 Workers' Compensation Board coverage:

- .1 Comply fully with the Workers' Compensation Act, regulations and orders made pursuant thereto, and any amendments up to the completion of the work.
- .2 Maintain Workers' Compensation Board coverage during the term of the Contract, until and including the date that the Final Certificate of Completion is signed.
- .3 Compliance with regulations:
 - .1 Small Craft Harbours may terminate the Contract without liability to SCH where the Contractor, in the opinion of SCH, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.
 - .2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety codes, standards and regulations.
- .4 Electrical safety requirements:
 - .1 Comply with local authorities and ensure that, when installing new facilities or modifying existing facilities, all electrical personnel are completely familiar with existing and new electrical circuits and equipment and their operation.
 - .2 Before undertaking any work, coordinate required energizing and de-energizing of new and existing circuits with the Departmental Representative.
 - .3 Maintain electrical safety procedures and take necessary precautions to ensure safety of all personnel working under this Contract, as well as safety of other personnel on site.
- .5 Electrical lock-out:
 - .1 Develop, implement and enforce use of established procedures to provide electrical lock-out and to ensure the health and safety of workers for every event where work must be done on any electrical circuit or facility.
 - .2 Prepare lock-out procedures in writing, listing step-by-step processes to be followed by workers, including how to prepare and issue the request/authorization form. Have the procedures available for review upon request by Departmental Representative.
 - .3 Keep documents and lock-out tags at the site and list in a logbook for the full duration of the Contract. Upon request, make such data available for viewing by the Departmental Representative or by any authorized safety representative.

1.13 PERSON-IN-CHARGE (PIC)

- .1 Provide a full-time on-site qualified and experienced Person-in-Charge (PIC) who is an employee of the Contractor and is acceptable to the Departmental Representative for the duration of the Project. The PIC shall be tasked with:
 - .1 Overall responsibility for site planning, coordination, and execution of the Project Work, including shutdowns;
 - .2 Site coordination with the Departmental Representative, Contractors, and others as necessary to complete the Work in an orderly and timely fashion;

- .3 Provision of shop drawings in a timely manner to the Departmental Representative for approval prior to equipment purchase.
- .4 Attend all Project Meetings and inspections as required by the Departmental Representative.
- .2 The Contractor shall:
 - .1 Provide their PIC with support personnel and services as necessary to enable the Project Work to be completed within a reasonable time;
 - .2 Not replace or substitute their PIC with another PIC during the execution of the Work. Should replacement be required under extraneous circumstances, request to do so shall be made in writing and shall be approved by the Departmental Representative prior to replacement.

1.14 SHUTDOWN WORK

- .1 For all Shutdown work, the Contractor shall assign a “Person-in-Charge (PIC)” for the shutdown:
 - .1 The PIC shall hold a Safety meeting immediately prior to scheduled Shutdown and obtain signatures of those present.
 - .2 The PIC shall be on site at the scene of the work during the entire shutdown and shall be the focal point for communications among the Departmental Representative, the Contractor, Subcontractors, BC Hydro, other Contractors on site, and other AHJs.
 - .3 The PIC shall explain the work to be executed to all present including other Contractors on site, and ensure all safety procedures are followed by those working on-site including lock & tag-out procedures.
 - .4 Only those present and signed-in during the safety meeting shall be allowed in the vicinity of the shutdown work to be executed;
 - .5 The signed safety meeting agenda shall be submitted to the Departmental Representative prior to the shutdown being executed.

1.15 CONSTRUCTION TIME, SEQUENCE AND PERFORMANCE

- .1 The Contractor shall provide and maintain in full operation at all times during the Work, a sufficient crew of labourers, trades people, and foremen to execute the Work with dispatch.
- .2 All Work shall be performed by skilled certified trades people, experienced in their trade, according to the rules and customs for best trade practices for first class work and according to the various trade standards.
- .3 During Work maintain fire extinguisher and fire hose bib connections access/control. Notify the Departmental Representative of all Work that impacts the access or operation of the existing fire system.
- .4 The Work may be deemed substantially complete when the following are completed, submitted and accepted as such by the Departmental Representative:
 - .1 All shop drawings and equipment manuals;
 - .2 All deficiency list items completed;

- .3 All related documentation.

1.16 DRAWINGS

- .1 The drawings listed in Section 00 01 15 List of Drawing Sheets shall be considered part of this contract. These drawings shall be used as a reference; the Contractor shall ensure correct dimensions.
- .2 The Departmental Representative may furnish additional drawings to assist proper execution of the work. These drawings will be issued for clarification only and have the same meaning and intent as if they were included with plans referred to in Contract Documents.

1.17 AS-BUILT DRAWINGS

- .1 As work progresses, maintain accurate records to show all deviations from the Contract Drawings. Note on as-built drawings as changes occur, and, at completion, supply one (1) set of all drawings and specifications with all deviations clearly marked.

1.18 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:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements
- .4 Submit site-specific and Work Plan Health and Safety Planning accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.19 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- .1 Submit shop drawings, product data and samples specified to Departmental Representative for review.
- .2 Shop drawings:
 - .1 Prepared by Contractor, subcontractor, supplier, or distributor.
 - .2 Illustrate appropriate portion of work, showing fabrication, layout, setting, or erection details as specified in appropriate sections.
- .3 Product data:
 - .1 Certain specification sections specify that manufacturer's standard schematic drawings, catalogue sheets, diagrams, schedules, performance charts, illustrations and other standard descriptive data will be accepted in lieu of shop drawings, provided that product concerned is clearly identified.
 - .2 Submit in sets, not as individual submissions.
- .4 Samples: submit in sizes and quantities specified.
- .5 Submission requirements:

- .1 Schedule submissions at least 5 days before dates reviewed submissions will be needed.
- .2 Submit number of copies of product data and shop drawings which Contractor requires for distribution plus copies which will be retained by Departmental Representative.
- .3 Accompany submissions with transmittal letter in duplicate.
- .6 Coordination of submissions:
 - .1 Review shop drawings, product data, and samples before submission.
 - .2 Coordinate with field construction criteria.
 - .3 Verify catalogue numbers and similar data.
 - .4 Coordinate each submittal with requirements of the work of all trades and the Contract documents.
 - .5 Responsibility for errors and omissions in submittals is not relieved by Departmental Representative's review of submittals.
 - .6 Responsibility for deviations in submittals from requirements of Contract documents is not relieved by Departmental Representative's review of submittals, unless Departmental Representative gives written acceptance of specified deviations.
 - .7 Notify Departmental Representative in writing, at time of submission, of deviations in submittals from the requirements of the Contract documents.
 - .8 After Departmental Representative's review, distribute copies.

1.20 ENVIRONMENTAL PROTECTION

- .1 Fires and burning of rubbish on site not permitted.
- .2 Do not bury rubbish and waste materials on site unless approved by Departmental Representative.
- .3 Do not dispose of waste or volatile materials such as oil, paint thinner or mineral spirits into waterways, storm, or sanitary sewers.
- .4 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.
- .5 Control the disposal of run-off of water containing suspended materials or other harmful substances in accordance with local authority requirements.
- .6 Protect trees and plants on site and adjacent properties as designated by the Departmental Representative.
- .7 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.

1.21 CLEANING

- .1 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.

1.22 REGULATORY REQUIREMENTS

- .1 Pay all fees and obtain all permits.

- .2 Provide inspection authorities with such plans and information as may be required for issue of acceptance certificates.
- .3 Furnish inspection certificates in evidence that work installed conforms with requirements of the authority having jurisdiction.

1.23 TEMPORARY FACILITIES

- .1 Access:
 - .1 Provide and maintain adequate access to project site.
 - .2 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract. Make good any damage resulting from Contractor's use of roads.
- .2 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .3 Electrical power: available on site.
- .4 Scaffolding:
 - .1 Construct and maintain in a rigid, secure, and safe manner.
 - .2 Erect independent of walls.
 - .3 Remove promptly when no longer required.
- .5 Remove temporary facilities from site when directed by the Departmental Representative.

1.24 DEPARTMENTAL REPRESENTATIVE OCCUPANCY

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

1.25 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to Departmental Representative's staff, public and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.

1.26 EXISTING SERVICES

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, provide 5 working days notice to Departmental Representative 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 Departmental Representative operations.
- .3 Where Work impacts existing entrance and egress routes, provide alternative routes for personnel, pedestrian and vehicular traffic.

- .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .5 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Provide temporary services as directed by Departmental Representative to maintain critical building and marina systems.
- .7 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic. Provide safety barricades as necessary to prevent public from access to areas under construction.
- .8 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .9 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by the AHJ.
- .10 Record locations of maintained, re-routed and abandoned service lines.

1.27 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 11 00 Summary of Work.

1.2 ACCESS AND EGRESS

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

1.3 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work provide temporary means to maintain security.
- .4 Departmental Representative will assign sanitary facilities for use by Contractor's personnel. Keep facilities clean.
- .5 Use only designated elevators existing in building for moving workers and material.
 - .1 Protect walls of elevators, to satisfaction of Departmental Representative.
 - .2 Accept liability for damage, safety of equipment and overloading of existing equipment.
- .6 Closures: protect work temporarily until permanent enclosures are completed.
- .7 Contractor must follow work permit and access to site restrictions, security access, as outlined in Departmental Representative requirements (available from Project Manager).

1.4 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to building operations, occupants, and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.

1.5 EXISTING SERVICES

- .1 Notify, Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 14 days' advance of notice for necessary interruption of electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.
- .3 Provide for personnel, pedestrian and vehicular traffic.
- .4 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.6 SPECIAL REQUIREMENTS

- .1 Submit schedule in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart.
- .2 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.

1.7 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions. Smoking is not permitted.

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 ADMINISTRATIVE

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

1.2 PRECONSTRUCTION MEETING

- .1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Departmental Representative, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.
- .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work: in accordance with Section 01 32 16.19 - Construction Progress Schedules - Bar (GANTT) Chart.
 - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
 - .5 Site security in accordance with Section 01 14 00 - Work Restrictions.
 - .6 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
 - .7 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .8 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
 - .9 Closeout procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
 - .10 Health and Safety warranties in accordance with Section 01 35 29.06 - Health and Safety Requirements.
 - .11 Progress claims, administrative procedures, photographs, hold backs.
 - .12 Appointment of inspection and testing agencies or firms.

1.3 PROGRESS MEETINGS

- .1 During course of Work and 2 weeks prior to project completion, schedule progress meetings as required.
- .2 Contractor, major Subcontractors involved in Work, Departmental Representative are to be in attendance.
- .3 Notify parties minimum 5 days prior to meetings.
- .4 Agenda to include the following:

- .1 Review, acceptance of minutes of previous meeting.
- .2 Review of Work progress since previous meeting.
- .3 Field observations, problems, conflicts.
- .4 Problems which impede construction schedule.
- .5 Review of off-site fabrication delivery schedules.
- .6 Corrective measures and procedures to regain projected schedule.
- .7 Revision to construction schedule.
- .8 Progress schedule, during succeeding work period.
- .9 Review submittal schedules: expedite as required.
- .10 Maintenance of quality standards.
- .11 Review proposed changes for effect on construction schedule and on completion date.
- .12 Other business.

END OF SECTION

Part 1 General**1.1 DEFINITIONS**

- .1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.
- .2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally, Bar Chart should be derived from commercially available computerized project management system.
- .3 Baseline: original accepted plan (for project, work package, or activity), plus or minus accepted 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 another project element. Usually expressed as workdays or workweeks.
- .6 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .7 Milestone: significant event in project, usually completion of major deliverable.
- .8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .9 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

1.2 REQUIREMENTS

- .1 Schedule and execute work with least possible interference or disturbance to the normal use of premises.
- .2 On award of contract submit bar chart construction schedule for work, indicating anticipated progress stages within time of completion. When the Departmental Representative have reviewed schedule, take necessary measures to complete work within scheduled time. Do not change schedule without notifying Departmental Representative.
- .3 Give the Departmental Representative 14 days' advance notice for work to be carried out during "off hours".

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Submit to Departmental Representative within 14 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.

1.4 PROJECT MILESTONES

- .1 Project milestones form interim targets for Project Schedule.

1.5 MASTER PLAN

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).
- .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.

1.6 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 Backfill.
 - .6 Lighting.
 - .7 Electrical.
 - .8 Equipment Order.
 - .9 Equipment Delivery.
 - .10 Equipment Installation.
 - .11 Testing and Commissioning.
 - .12 Supplied equipment long delivery items.

1.7 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.

1.8 PROJECT MEETINGS

- .1 Discuss Project Schedule at regular project 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.

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 11 00 Summary of Work, Section 26 05 00 Common Work Results for Electrical.

1.2 ADMINISTRATIVE

- .1 This Section specifies general requirements and procedures for the Contractor's submissions of shop drawings, product data, samples and other requested submittals to Departmental Representative for review. Additional specific requirements for submissions are specified in individual technical sections.
- .2 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.
- .3 Do not proceed with Work affected by submittal until review is complete.
- .4 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .5 Where items or information is not produced in SI Metric units converted values are acceptable.
- .6 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .7 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .8 Verify field measurements and affected adjacent Work are co-ordinated.
- .9 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .10 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .11 Keep one reviewed copy of each submission on site.
- .12 **Do not proceed with work until relevant submissions are reviewed and approved by the Departmental Representative.**

1.3 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 Coordinate each submission with the requirements of the work and the Contract documents. Individual submissions will not be reviewed until all related information is available.

- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow 10 ten days for Departmental Representative's review of each submission, unless noted otherwise.
- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price.
- .6 Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .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.
 - .6 After Departmental Representative's review, distribute copies.

- .8 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .9 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .10 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
- .11 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .12 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Safety Data Sheets concerning impedances, hazards and safety precautions.
- .13 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .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 Departmental Representative.
- .16 Supplement standard information to provide details applicable to project.
- .17 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .18 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that Departmental Representative approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.

- .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.4 SAMPLES

- .1 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.
- .2 Samples: examples of materials, equipment, quality, finishes and workmanship.
- .3 Where colour, pattern or texture is a criterion, submit a full range of samples.
- .4 Reviewed and accepted samples will become the standard of workmanship and material against which installed work will be verified.

1.5 PROGRESS SCHEDULE

- .1 Submit work schedule and cost breakdown as required in Section 01 11 55.

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

Departmental Representative Update on Asbestos Use

Effective April 1, 2016, Departmental Representative contracts for new construction and major rehabilitation will prohibit use of asbestos-containing materials.

COVID 19

All contractors shall follow Canadian Construction Association COVID-19 - Standardized Protocols for All Canadian Construction Sites, Provincial and Federal Regulations.

1.1 REFERENCES

- .1 Government of Canada.
 - .1 Canada Labour Code - Part II (as amended)
 - .2 Canada Occupational Health and Safety Regulations. (as amended)
- .2 National Building Code of Canada (NBC): (as amended)
 - .1 Part 8, Safety Measures at Construction and Demolition Sites.
- .3 The Canadian Electrical Code (as amended)
- .4 Canadian Standards Association (CSA) as amended:
 - .1 CSA Z797-2018 Code of Practice for Access Scaffold.
 - .2 CSA S269.1-2016 Falsework for Construction Purposes.
CSA S350-M1980 (R2003) Code of Practice for Safety in Demolition of Structures.
 - .3 CSA Z1006-10 Management of Work in Confined Spaces.
 - .4 CSA Z462-18 Workplace Electrical Safety Standard
- .5 American National Standards Institute (ANSI): (as amended)
 - .1 ANSI/ASSP A10.3-2013, Operations – Safety Requirements for Powder-Actuated Fastening Systems.
- .6 Province of British Columbia:
 - .1 Workers Compensation Act Part 3-Occupational Health and Safety. (as amended)
 - .2 Occupational Health and Safety Regulation (as amended)

1.2 RELATED SECTIONS

- .1 Refer to the following current NMS sections as required:
 - .1 Section 01 11 00 Summary of Work.

1.3 WORKERS' COMPENSATION BOARD COVERAGE

- .1 Comply fully with the Workers' Compensation Act, regulations and orders made pursuant thereto, and any amendments up to the completion of the work.
- .2 Maintain Workers' Compensation Board coverage during the term of the Contract, until and including the date that the Certificate of Final Completion is issued.

1.4 COMPLIANCE WITH REGULATIONS

- .1 Departmental Representative may terminate the Contract without liability to Departmental Representative where the Contractor, in the opinion of Departmental Representative, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.
- .2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations.

1.5 SUBMITTALS

- .1 Submit to Departmental Representative submittals listed for review in accordance with Section 01 33 00.
- .2 Work affected by submittal shall not proceed until review is complete.
- .3 Submit the following:
 - .1 Organizations Health and Safety Plan.
 - .2 Site Specific Safety Plan or Health and Safety Plan (SSSP or HASP)
 - .3 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.
 - .4 Copies of incident and accident reports.
 - .5 Complete set of Material Safety Data Sheets (SDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
 - .6 Emergency Response Procedures.
- .4 The Departmental Representative will review the Contractor's Site Specific Safety Plan or Health and Safety Plan (SSSP/HASP) and emergency response procedures, and provide comments to the Contractor within 5 days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.
- .5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.
- .6 Submission of the Site Specific Safety Plan or Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:
 - .1 Be construed to imply approval by the Departmental Representative.
 - .2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.
 - .3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

1.6 RESPONSIBILITY

- .1 Assume responsibility as the Prime Contractor for work under this contract.
- .2 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .3 Comply with and enforce compliance by employees with safety requirements of Contract documents, applicable Federal, Provincial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.7 HEALTH AND SAFETY COORDINATOR

- .1 Assign a competent and qualified Health and Safety Coordinator who shall:
 - .1 Be responsible for completing all health and safety training, and ensuring that personnel that do not successfully complete the required training are not permitted to enter the site to perform work.
 - .2 Be responsible for implementing, daily enforcing, and monitoring the Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP)
 - .3 Have minimum two (2) years' site-related working experience
 - .4 Have working knowledge of the applicable occupational safety and health regulations.

1.8 GENERAL CONDITIONS

- .1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.
- .2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.
 - .1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.
 - .2 Secure site at night time or provide security guard as deemed necessary to protect site against entry.

1.9 PROJECT/SITE CONDITIONS

- .1 Work at site will involve contact with:
 - .1 Multi-employer work site.
 - .2 Federal employees and general public.
 - .3 Energized electrical services.

1.10 UTILITY CLEARANCES

- .1 The Contractor is solely responsible for all utility detection and clearances prior to starting the work.
- .2 The Contractor will not rely solely upon the Reference Drawings or other information provided for Utility locations.

1.11 REGULATORY REQUIREMENTS

- .1 Comply with specified codes, acts, bylaws, standards and regulations to ensure safe operations at site.
- .2 In event of conflict between any provision of the above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Departmental Representative will advise on the course of action to be followed.

1.12 WORK PERMITS

- .1 Obtain specialty permit(s) related to project before start of work.

1.13 FILING OF NOTICE

- .1 The General Contractor is to file Notice of Project with Provincial authorities prior to commencement of work. (All construction projects require a Notice of Work)
- .2 Provide copies of all notices to the Departmental Representative.

1.14 SITE SPECIFIC HEALTH AND SAFETY PLAN

- .1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.
- .2 Prepare and comply with the Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP) based on the required hazard assessment, including, but not limited to, the following:
 - .1 Primary requirements:
 - .1 Contractor's safety policy.
 - .2 Identification of applicable compliance obligations.
 - .3 Definition of responsibilities for project safety/organization chart for project.
 - .4 General safety rules for project.
 - .5 Job-specific safe work, procedures.
 - .6 Inspection policy and procedures.
 - .7 Incident reporting and investigation policy and procedures.
 - .8 Occupational Health and Safety Committee/Representative procedures.
 - .9 Occupational Health and Safety meetings.
 - .10 Occupational Health and Safety communications and record keeping procedures.
 - .11 COVID 19 Protocols and Procedures
 - .2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.
 - .3 List hazardous materials to be brought on site as required by work. SDS required for all products.

- .4 Indicate Engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.
- .5 Identify personal protective equipment (PPE) to be used by workers.
- .6 Identify personnel and alternates responsible for site safety and health.
- .7 Identify personnel training requirements and training plan, including site orientation for new workers.
- .3 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.
- .4 Revise and update Site Specific Safety Plan (SSSP) and/or Health and Safety Plan (HASP) as required, and re-submit to the Departmental Representative.
- .5 Departmental Representative's review: the review of Site Specific Safety Plan and/or DFO shall not relieve the Contractor of responsibility for errors or omissions in final Site Specific Safety Plan and/or Health and Safety Plan of responsibility for meeting all requirements of construction and Contract documents and legislated requirements.

1.15 EMERGENCY PROCEDURES

- .1 List standard operating procedures and measures to be taken in emergency situations. Include an emergency response and emergency evacuation plan and emergency contacts (i.e. Names/telephone numbers) of:
 - .1 Designated personnel from own company.
 - .2 Regulatory agencies applicable to work and as per legislated regulations.
 - .3 Local emergency resources.
 - .4 Departmental Representative.
 - .5 A route map with written directions to the nearest hospital or medical clinic.
- .2 Include the following provisions in the emergency procedures:
 - .1 Notify workers and the first-aid attendant, of the nature and location of the emergency.
 - .2 Evacuate all workers safely.
 - .3 Check and confirm the safe evacuation of all workers.
 - .4 Notify the fire department or other emergency responders.
 - .5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
 - .6 Notify Departmental Representative.
- .3 Provide written rescue/evacuation procedures as required for, but not limited to:
 - .1 Work at high angles.
 - .2 Work in confined spaces or where there is a risk of entrapment.
 - .3 Work with hazardous substances.
 - .4 Underground work.
 - .5 Work on, over, under and adjacent to water.
 - .6 Workplaces where there are persons who require physical assistance to be moved.
- .4 Design and mark emergency exit routes to provide quick and unimpeded exit.

- .5 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.
- .6 Contractors must not rely solely upon 911 for emergency rescue in a confined space, working at heights, etc.

1.16 HAZARDOUS PRODUCTS

- .1 System (WHMIS 2015) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of Safety Data Sheets (SDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.
- .2 Where use of hazardous and toxic products cannot be avoided:
 - .1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable SDS and WHMIS 2015 documents.
- .3 The contractor shall ensure that the product is applied as per manufacturers recommendations.
- .4 The contractor shall ensure that only pre-approved products are bought onto the work site in an adequate quantity to complete the work.

1.17 ASBESTOS HAZARD

- .1 Carry out any activities involving asbestos in accordance with current applicable Federal and Provincial Regulations.
- .2 Removal and handling of asbestos will be in accordance with current applicable Provincial / Federal Regulations.

1.18 REMOVAL OF LEAD-CONTAINING PAINT

- .1 All paint containing TCLP lead concentrations above 5 ppm are classified as hazardous.
- .2 Carry out demolition and/or remediation activities involving lead-containing paints in accordance with current applicable Provincial / Territorial Regulations.
- .3 Work with lead-containing paint shall be completed as per Provincial and Federal regulations.
- .4 Dry Scraping/Sanding of any materials containing lead is strictly prohibited.
- .5 The use of Methylene Chloride based paint removal products is strictly prohibited.

1.19 ELECTRICAL SAFETY REQUIREMENTS

- .1 Comply with authorities and ensure that, when installing new facilities or modifying existing facilities, all electrical personnel are completely familiar with existing and new electrical circuits and equipment and their operation.
- .2 Before undertaking any work, coordinate arc flash protection, required energizing and de-energizing of new and existing circuits with Departmental Representative.
- .3 Maintain electrical safety procedures and take necessary precautions to ensure safety of all personnel working under this Contract, as well as safety of other personnel on site.

1.20 ELECTRICAL LOCKOUT

- .1 Develop, implement and enforce use of established procedures to provide electrical lockout and to ensure the health and safety of workers for every event where work must be done on any electrical circuit or facility.
- .2 Prepare the lockout procedures in writing, listing step-by-step processes to be followed by workers, including how to prepare and issue the request/authorization form. Have procedures available for review upon request by the Departmental Representative.
- .3 Keep the documents and lockout tags at the site and list in a log book for the full duration of the Contract. Upon request, make such data available for viewing by Departmental Representative or by any authorized safety representative.

1.21 OVERLOADING

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

1.22 CONFINED SPACES

- .1 Carry out work in compliance with current Provincial / Territorial regulations.

1.23 FIRE SAFETY AND HOT WORK

- .1 Obtain Departmental Representative's authorization before any welding, cutting or any other hot work operations can be carried out on site.
- .2 Hot work includes cutting/melting with use of torch, flame heating roofing kettles, or other open flame devices and grinding with equipment which produces sparks.
- .3 Hot Work permits are a mandatory requirement for any hot work activities.

1.24 UNFORESEEN HAZARDS

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

1.25 POSTED DOCUMENTS

- .1 Post legible versions of the following documents on site:
 - .1 Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP)
 - .2 Sequence of work.
 - .3 Emergency procedures.
 - .4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station, and the emergency transportation provisions.
 - .5 Notice of Project.
 - .6 Notice as to where a copy of the Workers' Compensation Act and Regulations are available on the work site for review by employees and workers.
 - .7 Workplace Hazardous Materials Information System (WHMIS 2015) documents.

- .8 Material Safety Data Sheets (SDS).
- .9 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.
- .2 All Hazardous Material and Substance Reports including Lab Analysis Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.
- .3 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

1.26 MEETINGS

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

1.27 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance with health and safety issues identified.
- .3 The Departmental Representative may issue a "stop work order" if noncompliance of health and safety regulations is not corrected immediately or within posted time. The General Contractor/subcontractors will be responsible for any costs arising from such a "stop work order".

1.28 POWDER-ACTUATED DEVICES

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

1.29 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

- .1 Not used.

Part 3 EXECUTION

- .1 Not used.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-0121-M1978 (R2003), Douglas Fir Plywood.
 - .3 CAN/CSA-S269.2-M1987 (R2003), Access Scaffolding for Construction Purposes.
 - .4 CAN/CSA-Z321-96 (R2001), Signs and Symbols for the Occupational Environment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 INSTALLATION AND REMOVAL

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Identify areas which have to be gravelled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 Remove from site all such work after use.

1.4 SCAFFOLDING

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain ladders, ramps, platforms.

1.5 HOISTING

- .1 Provide, operate and maintain hoists required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.
- .2 Hoists to be operated by qualified operator.

1.6 SITE STORAGE/LOADING

- .1 Refer to CCDC 2, GC 3.12.
- .2 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .3 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.7 CONSTRUCTION PARKING

- .1 Parking will not be permitted on site, unless permitted by the Departmental Representative on site.
- .2 Provide and maintain adequate access to project site.

1.8 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

1.9 CONSTRUCTION SIGNAGE

- .1 Provide and erect project sign, within three weeks of signing Contract, in a location designated by Departmental Representative.
- .2 Indicate on sign, name of Contractor and Subcontractor, of design style established by Departmental Representative.
- .3 No other signs or advertisements, other than warning signs, are permitted on site.
- .4 Locate project identification sign as directed by Departmental Representative and construct as follows:
 - .1 Build concrete foundation, erect framework, and attach signboard to framing.
 - .2 Paint surfaces of signboard and framing with one coat primer and two coats enamel. Colour white on signboard face, black on other surfaces.
 - .3 Apply vinyl sign face overlay to painted signboard face in accordance with installation instruction supplied.
- .5 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.
- .6 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Departmental Representative.

1.10 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental Representative.
- .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.

- .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .7 Construct access and haul roads necessary.
- .8 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.
- .9 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .10 Dust control: adequate to ensure safe operation at all times.
- .11 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
- .12 Provide snow removal during period of Work.
- .13 Remove, upon completion of work, haul roads designated by Departmental Representative.

1.11 CLEAN-UP

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

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 26 27 16 Electrical Cabinets and Enclosures.

1.2 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
- .2 CSA Group (CSA)
 - .1 CSA-O121-M1978 (R2003), Douglas Fir Plywood.

1.3 INSTALLATION AND REMOVAL

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

1.4 WEATHER ENCLOSURES

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure and snow loading.

1.5 ACCESS TO SITE

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

1.6 PUBLIC TRAFFIC FLOW

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

1.7 FIRE ROUTES

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

1.8 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for 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 PRODUCTS/MATERIAL AND EQUIPMENT

- .1 Use NEW products/material and equipment unless otherwise specified. The term “products” is referred to throughout the specifications.
- .2 Use products of 1 manufacturer for material and equipment of the same type or classification unless otherwise specified.
- .3 Unless otherwise specified, comply with manufacturer’s latest printed instructions for materials and installation methods.
- .4 Notify Departmental Representative in writing of any conflict between these specifications and manufacturer’s instructions. Departmental Representative will designate which document is to be followed.
- .5 Provide metal fastenings and accessories in the same texture, colour and finish as base metal in which they occur.
 - .1 Prevent electrolytic action between dissimilar metals.
 - .2 Use non-corrosive fasteners, anchors and spacers for securing exterior work.
- .6 Fastenings which cause spalling or cracking are not acceptable.
- .7 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .8 Use heavy hexagon heads, semi-finished unless otherwise specified.
- .9 Bolts may not project more than 1 diameter beyond nuts.
- .10 Types of washers as follows:
 - .1 Plain type washers: use on equipment and sheet metal.
 - .2 Soft gasket lock type washers: use where vibrations occur.
 - .3 Resilient washers: use with stainless steel.
- .11 Deliver, store and maintain packaged material and equipment with manufacturer’s seals and labels intact.
- .12 Prevent damage, adulteration and soiling of products during delivery, handling and storage. Immediately remove rejected products from site.
- .13 Store products in accordance with suppliers’ instructions.
- .14 Touch up damaged factory finished surfaces to Departmental Representative’s satisfaction:
 - .1 Use primer or enamel to match original.
 - .2 Do not paint over nameplates.

1.2 QUALITY

- .1 Products, materials and equipment (referred to as products) incorporated into work shall be new, not damaged or defective, and of the best quality (compatible with the specifications) for the purpose intended. If requested, furnish evidence as to type, source and quality of the products provided.
- .2 Defective products will be rejected regardless of previous inspections.
 - .1 Inspection does not relieve responsibility but is precaution against oversight or error.
 - .2 Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Retain purchase orders, invoices and other documents to prove that all products utilized in this Contract meet the requirements of the specifications. Produce documents when requested by the Departmental Representative.
- .4 Should any dispute arise as to quality or fitness of products, the decision rests strictly with the Departmental Representative based upon the requirements of the Contract documents.
- .5 Unless otherwise indicated in the specifications, maintain uniformity of manufacture for any particular or like item throughout the building.
- .6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 AVAILABILITY

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

1.4 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.

- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .9 Touch-up damaged factory finished surfaces to Departmental Representative'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.

1.6 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in the specifications, install or erect products in accordance with the manufacturer's instructions.
 - .1 Do not rely on labels or enclosures provided with products.
 - .2 Obtain written instructions directly from the manufacturer.
- .2 Notify Departmental Representative in writing of conflicts between the specifications and the manufacturer's instructions so that the Departmental Representative may establish the course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Departmental Representative to require removal and re-installation at no increase in either the Contract price or the 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 Departmental Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, 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 LOCATION OF FIXTURES

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

1.10 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.

1.11 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.

1.12 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 Departmental Representative.

1.13 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 pedestrian and vehicular traffic and/or building occupants.
- .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 EXISTING SERVICES

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
- .2 Examine existing conditions, including elements subject to damage or movement during cutting and patching.
- .3 After uncovering, examine conditions affecting performance of Work.
- .4 Beginning of cutting or patching means acceptance of existing conditions.
- .5 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
 - .1 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.
- .6 Start of construction or any part thereof constitutes acceptance of existing conditions and implies dimensions have been considered, verified and are acceptable.

1.2 EXISTING CONDITIONS RECORD

- .1 Before commencing Work, document existing conditions of building materials and surfaces in areas of Work.
- .2 Format: digital photography, minimum image pixel dimension 2048 x 1536.
- .3 Number of viewpoints: sufficient views and proximity to clearly indicate condition of existing building subject to damage from work under this Contract.
- .4 Submit files to Departmental Representative prior to proceeding with Work.

1.3 LOCATION OF EQUIPMENT AND FIXTURES

- .1 Location of equipment indicated or specified are to be considered as approximate.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Departmental Representative of impending installation and obtain approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

1.4 SUBSURFACE CONDITIONS

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

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

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 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit written request in advance of cutting or alteration which affects:
 - .1 Structural integrity of elements of project.
 - .2 Integrity of weather-exposed or moisture-resistant elements.
 - .3 Efficiency, maintenance, or safety of operational elements.
 - .4 Visual qualities of sight-exposed elements.
 - .5 Work of Departmental Representative or separate contractor.
- .3 Include in request:
 - .1 Identification of project.
 - .2 Location and description of affected Work.
 - .3 Statement on necessity for cutting or alteration.
 - .4 Description of proposed Work, and products to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Effect on Work of Departmental Representative or separate contractor.
 - .7 Written permission of affected separate contractor.
 - .8 Date and time work will be executed.

1.2 MATERIALS

- .1 Unless otherwise specified, materials for removal become the Contractor's property and shall be taken from site.
- .2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

1.3 PREPARATION

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.

1.4 EXECUTION

- .1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.
- .2 Fit several parts together, to integrate with other Work.

- .3 Uncover Work to install ill-timed Work.
- .4 Remove and replace defective and non-conforming Work.
- .5 Remove samples of installed Work for testing.
- .6 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .7 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .8 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .9 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .10 Restore work with new products in accordance with requirements of Contract Documents.
- .11 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .12 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

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 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 Provide on-site containers for collection of waste materials and debris.
- .4 Provide and use marked separate bins for recycling. Refer to Section 01 74 19 - Waste Management and Disposal.
- .5 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .6 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .7 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .8 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.2 FINAL CLEANING

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work. Make good defects noted at this stage.
- .2 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .3 Clean areas under contract to condition equal to what previously existed and to satisfaction of Departmental Representative.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Clean lighting reflectors, lenses, and other lighting surfaces.
- .6 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for 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 RELATED WORK

- .1 Refer to every technical section for waste management and disposal.

1.2 DEFINITIONS

- .1 Waste Audit (WA): relates to projected waste generation. Involves controlled separation of waste.
- .2 Waste Reduction Workplan (WRW): a written report which addresses opportunities for reduction, re-use or recycling of materials.
- .3 Materials Source Separation Program (MSSP): consists of a series of ongoing activities to separate re-usable and recyclable waste material into material categories from other types of waste at point of generation.

1.3 MATERIALS SOURCE SEPARATION

- .1 Before project start-up, prepare Materials Source Separation Program. Provide separate containers for re-usable and/or recyclable materials of the following:
 - .1 Metals.
 - .2 Wood.
 - .3 Plastics
 - .4 Other materials as indicated in technical sections.
- .2 Implement Materials Source Separation Program for waste generated on project in compliance with approved methods and as approved by Departmental Representative.
- .3 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .4 Locate separated materials in areas which minimize material damage.

1.4 DIVERSION OF MATERIALS

- .1 Create a list of materials to be separated from the general waste stream and stockpiled in separate containers, to the approval of the Departmental Representative and consistent with applicable fire regulations.
 - .1 Mark containers.
 - .2 Provide instruction on disposal practices.

1.5 STORAGE, HANDLING AND APPLICATION

- .1 Do work in compliance with Waste Reduction Workplan.
- .2 Handle waste materials not re-used, salvaged, or recycled in accordance with appropriate regulations and codes.
- .3 Materials in separated condition: collect, handle, store on site, and transport off-site to an approved and authorized recycling facility.
- .4 Materials must be immediately separated into required categories for re-use or recycling.
- .5 Unless specified otherwise, materials for removal become the Contractor's property.

- .6 On-site sale of salvaged/recyclable material is not permitted.
- .7 **Provide Departmental Representative with receipts** indicating quantity of material delivered to landfill.
- .8 **Provide Departmental Representative with receipts** indicating quantity and type of materials sent for recycling.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 91 13 General Commissioning (Cx) Requirements.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- .2 Revise content of documents as required before final submittal.
- .3 2 weeks before substantial performance of the work for construction, submit to Departmental Representative 4 final copies of supplements to operation and maintenance manuals.
- .4 Ensure spare parts, maintenance materials and special tools provided are new, neither damaged nor defective, and of same quality and manufacture as products provided in work.
- .5 If requested, furnish evidence as to type, source and quality of products provided.
- .6 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

1.3 FORMAT

- .1 Organize data in the form of an instructional manual.
- .2 Binders: vinyl, hard covered, 3 “D” ring, loose leaf 219x279 mm with spine and face pockets.
- .3 Cover: identify each binder with typed or printed title “Project Record Documents”; list title of project and identify subject matter of contents.
- .4 Arrange content by systems under section numbers and sequence of Table 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 Text: manufacturer’s printed data, or typewritten data.
- .7 Drawings: provide with reinforced punched binder tab. 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;
 - .1 Date of submission; names.
 - .2 Addresses, and telephone numbers of Departmental Representative and Contractor with name of responsible parties.
 - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:

- .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Training: refer to Section 01 79 00 - Demonstration and Training.

1.5 AS -BUILT DOCUMENTS AND SAMPLES

- .1 Maintain, in addition to requirements in General Conditions, 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 Store record documents and samples in field office apart from documents used for construction.
 - .1 Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
 - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.
 - .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Departmental Representative.

1.6 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of blue line opaque drawings, and in copy of Project Manual, provided by Departmental Representative.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:

- .1 Measured depths of elements of foundation in relation to finish first floor datum.
- .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
- .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
- .4 Field changes of dimension and detail.
- .5 Changes made by change orders.
- .6 Details not on original Contract Drawings.
- .7 Referenced Standards to related shop drawings and modifications.
- .5 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.
- .6 Other Documents: maintain field test records, manufacturer's certifications, inspection certifications, required by individual specifications sections.
- .7 Provide digital photos, if requested, for site records.

1.7 EQUIPMENT AND SYSTEMS

- .1 For each item of equipment and each system include description of unit or system, and component parts.
 - .1 Give function, normal operation characteristics and limiting conditions.
 - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 MONTHLY TESTING PROCEDURES
 - .2 YEARLY TESTING PROCEDURES
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

- .11 Include test and balancing reports as specified in 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.
- .12 Additional requirements: as specified in individual specification sections.

1.8 MAINTENANCE MATERIALS

- .1 Spare Parts:
 - .1 Provide spare parts, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to location as directed ; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .2 Extra Stock Materials:
 - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to location as directed; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 Special Tools:
 - .1 Provide special tools, in quantities specified in individual specification section.
 - .2 Provide items with tags identifying their associated function and equipment.
 - .3 Deliver to location as directed; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.

1.9 DELIVERY, STORAGE AND HANDLING

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review by Departmental Representative.

1.10 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 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to Departmental Representative for approval prior to each monthly pay estimate.
- .6 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.
- .7 Except for items put into use with Departmental Representative's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint 4 month and 9 month warranty inspection, measured from time of acceptance, by Departmental Representative.
- .9 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, to include transformers, panelboards, kiosks, lightning protection systems, commissioned systems.
 - .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.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.
 - .1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

1.11 COMPLETION

- .1 Submit a written certificate that the following have been performed:
 - .1 Work has been completed and inspected for compliance with the Contract documents.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested, adjusted and balanced, and are fully operational.
 - .4 Operation of systems has been demonstrated to the personnel indicated by the Departmental Representative.
 - .5 Work is complete and ready for final inspection.

1.12 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Departmental Representative.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
 - .1 Type of product/material.

- .2 Model number.
- .3 Serial number.
- .4 Contract number.
- .5 Warranty period.
- .6 Inspector's signature.
- .7 Construction 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 ADMINISTRATIVE REQUIREMENTS

- .1 Demonstrate operation and maintenance of equipment and systems to Departmental Representative's personnel two weeks prior to date of substantial performance.
- .2 Departmental Representative: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.
- .3 Preparation:
 - .1 Verify conditions for demonstration and instructions comply with requirements.
 - .2 Verify designated personnel are present.
 - .3 Ensure equipment has been inspected and put into operation in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.
- .4 Demonstration and Instructions:
 - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times at the equipment location.
 - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
 - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
 - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.
- .5 Time Allocated for Instructions: ensure amount of time required for instruction of each item of equipment or system. Allow for 4 sessions with 6 people per training session.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Departmental Representative's approval.
- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4 Give time and date of each demonstration, with list of persons present.
- .5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.3 QUALITY ASSURANCE

- .1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
 - .1 Instruct Departmental Representative 's personnel.
 - .2 Provide written report that demonstration and instructions have been completed.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section Includes:
 - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
- .3 Acronyms:
 - .1 Cx - Commissioning.
 - .2 O&M - Operation and Maintenance.
 - .3 PI - Product Information.
 - .4 PV - Performance Verification.
 - .5 TAB - Testing, Adjusting and Balancing.
 - .6 BCH – BC Hydro
- .4 BC Hydro coordination is within the scope of work. Ensure all BCH requirements are coordinated, and fully completed prior to commissioning.

1.2 GENERAL

- .1 Provide demonstration and instruction sessions to familiarize the Departmental Representative operation and maintenance personnel with electrical systems and their operation and maintenance.
- .2 Cx is performed during and after systems and integrated systems are completely installed. Functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
 - .2 Ensure appropriate documentation is compiled into the O&M Manual.
 - .3 Effectively train O&M staff.
- .3 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
 - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.

- .4 Design Criteria: as per Departmental Representative's requirements or determined by designer. To meet Project functional and operational requirements.

1.3 COMMISSIONING OVERVIEW

- .1 Cx to be a line item of Contractor's cost breakdown.
- .2 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .3 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the Work is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .4 Departmental Representative will issue Interim Acceptance Certificate when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and accepted by Departmental Representative.
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies and re-verify equipment and components within the un-functional system, including related systems as deemed required by Departmental Representative to ensure effective performance.
- .2 Costs for corrective work to be borne by Contractor to include additional tests and inspections to determine acceptability and proper performance of such items. Above costs to be in form of progress payment reductions or hold-back assessments.

1.5 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review contract documents confirm by writing to Departmental Representative.
 - .2 Adequacy of provisions for Cx.
 - .3 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
 - .1 Coordinate provision, location, and installation of provisions for Cx.
- .3 Before start of Cx:
 - .1 Ensure installation of related components, equipment, sub-systems, systems are complete.
 - .2 Fully understand Cx requirements and procedures.
 - .3 Have Cx documentation shelf-ready.
 - .4 Understand completely design criteria and intent and special features.

- .5 Submit complete start-up documentation to Departmental Representative.
- .6 Have Cx schedules up-to-date.
- .7 Ensure systems have been cleaned thoroughly.
- .8 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and acceptance.
- .9 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

- .1 Report conflicts between requirements of this section and other sections to Departmental Representative before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 10 - Submittal Procedures.
 - .1 Submit no later than 2 weeks after award of Contract:
 - .1 Name of Contractor's Cx Agent.
 - .2 Draft Cx documentation.
 - .3 Preliminary Cx schedule.
 - .2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 2 weeks prior to start of Cx.
 - .3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 2 weeks prior to start of Cx.
 - .4 Provide additional documentation relating to Cx process required by Departmental Representative.

1.8 COMMISSIONING DOCUMENTATION

- .1 Departmental Representative to review and approve Cx documentation.
- .2 Provide completed and approved Cx documentation to Departmental Representative.

1.9 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training.

1.10 COMMISSIONING MEETINGS

- .1 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .2 At 80% construction completion stage, Departmental Representative to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
 - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .3 Ensure subcontractors and relevant manufacturer representatives are present at 80% and subsequent Cx meetings and as required.

1.11 STARTING AND TESTING

- .1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

1.12 WITNESSING OF STARTING AND TESTING

- .1 Provide 14 days notice prior to commencement.
- .2 Departmental Representative to witness 100% of equipment start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.13 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing: manufacturer to:
 - .1 Coordinate time and location of testing.
 - .2 Provide testing documentation for review by Departmental Representative.
 - .3 Arrange for Departmental Representative to witness tests.
 - .4 Obtain written confirmation of test results and documentation from Departmental Representative before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative:
 - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
 - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
 - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:

- .1 Experienced in design, installation and operation of equipment and systems.
- .2 Ability to interpret test results accurately.
- .3 To report results in clear, concise, logical manner.

1.14 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .2 Start-up: follow accepted start-up procedures.
 - .3 Operational testing: document equipment performance.
 - .4 System PV: include repetition of tests after correcting deficiencies.
 - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Departmental Representative after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
 - .1 Minor equipment/systems: implement corrective measures as directed by Departmental Representative.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures as directed by Departmental Representative.
 - .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
 - .1 Rejected equipment to be remove from site and replace with new.
 - .2 Subject new equipment/systems to specified start-up procedures.
- .6 Provide demonstration and instruction seminars for the following equipment and systems identified. Include in demonstrations and instruction seminars, the information specified for each piece of equipment and system.
- .7 Some systems may require two independent seminars, one for the maintenance staff and on seminar for the user groups. Accommodate split seminars as required.
- .8 Normal Power Distribution:
 - .1 Distribution Switchgear:
 - .1 Torquing procedures and values.
 - .2 Circuit breaker or disconnect switch operation.
 - .3 Protective features on breakers.

- .4 Protective relaying - calibration and operation.
- .5 Metering - calibration and operation.
- .6 Safety procedures.
- .7 Troubleshooting procedures.
- .8 Visual maintenance inspections.
- .9 Maintenance procedures.
- .10 Testing requirements and procedures.
- .11 Spare parts.
- .2 Dry Type Transformers:
 - .1 Tap adjustment procedures.
 - .2 Drying and cleaning requirements.
 - .3 Temperature and alarm devices.
 - .4 Safety procedures.
 - .5 Visual maintenance inspections.
 - .6 Maintenance procedures.
 - .7 Testing requirements and procedures.
- .3 Panelboards:
 - .1 Types and sizes of breakers.
 - .2 Spare capacity.
 - .3 Visual maintenance inspections.
 - .4 Maintenance procedures.
 - .5 Testing requirements and procedures
 - .6 Spare parts.
- .4 Branch Circuits:
 - .1 Power receptacle system
 - .2 Miscellaneous wiring devices
 - .3 Miscellaneous equipment
 - .4 Heat tracing.
- .5 Outdoor Equipment enclosures:
 - .1 Load Testing
 - .2 Thermographic
 - .3 Communication
 - .4 Panelboards
 - .5 Transformer
 - .6 Branch circuits.
 - .7 Safety procedures
 - .8 Maintenance procedures.
- .6 Lighting:
 - .1 Troubleshooting procedures
 - .2 Lighting Controls

- .3 Line voltage switching
- .4 Sensor operation and adjustments.
- .5 Maintenance procedures
- .6 Spare parts
- .9 Tests: in accordance with Section 26 11 10 - Short Circuit Protective Device Coordination & Arc Flash Analysis.

1.15 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of commissioning.
- .2 Start-up documentation to include:
 - .1 Factory and on-site test certificates for specified equipment.
 - .2 Pre-start-up inspection reports.
 - .3 Signed installation/start-up check lists.
 - .4 Start-up reports,
 - .5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit Departmental Representative for approval before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.17 TEST RESULTS

- .1 Submit for review summary of Arc Flash Study report, and fuse coordination test report.
 - .1 Tests: in accordance with Section 26 11 10 - Short Circuit Protective Device Coordination & Arc Flash Analysis.
- .2 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .3 Provide manpower and materials, assume costs for re-commissioning.

1.18 START OF COMMISSIONING

- .1 Notify Departmental Representative at least 21 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.19 INSTRUMENTS/EQUIPMENT

- .1 Submit to Departmental Representative for review and approval:
 - .1 Complete list of instruments proposed to be used.
 - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide the following equipment as required:
 - .1 2-way radios.
 - .2 Ladders.
 - .3 Equipment as required to complete work.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 Under accepted operating conditions, over entire operating range, in all modes.
 - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.

1.21 WITNESSING COMMISSIONING

- .1 Departmental Representative to witness 100% of commissioning activities and verify results.

1.22 AUTHORITIES HAVING JURISDICTION

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to Departmental Representative within 5 days of test and with Cx report.

1.23 EXTENT OF VERIFICATION

- .1 Extent of verification: 100% verification is required for all equipment and systems installed in this project.
- .2 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .3 Perform additional commissioning until results are acceptable to Departmental Representative.

1.24 SUNDRY CHECKS AND ADJUSTMENTS

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

1.25 DEFICIENCIES, FAULTS, DEFECTS

- .1 Correct deficiencies found during start-up and Cx to satisfaction of Departmental Representative.
- .2 Report problems, faults or defects affecting Cx to Departmental Representative in writing. Stop Cx until problems are rectified. Proceed with written direction from Departmental Representative.

1.26 COMPLETION OF COMMISSIONING

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Departmental Representative.

1.27 ACTIVITIES UPON COMPLETION OF COMMISSIONING

- .1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

1.28 TRAINING

- .1 In accordance with Section 01 79 00 - Demonstration and Training.

1.29 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

- .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

1.30 OCCUPANCY

- .1 Cooperate fully with Departmental Representative during stages of acceptance and occupancy of facility.

1.31 INSTALLED INSTRUMENTATION

- .1 Use instruments installed under Contract for TAB and PV if:
 - .1 Accuracy complies with these specifications.
 - .2 Calibration certificates have been deposited with Departmental Representative.

1.32 PERFORMANCE VERIFICATION TOLERANCES

- .1 Application tolerances:
 - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 5% of specified values.
- .2 Instrument accuracy tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:

- .1 Unless otherwise specified actual values to be within +/- 2 % of recorded values.

1.33 DEPARTMENTAL REPRESENTATIVE'S PERFORMANCE TESTING

- .1 Performance testing of equipment or system by Departmental Representative will not relieve Contractor from compliance with specified start-up and testing procedures.

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 The General Conditions, Supplements and Amendments shall govern this Section (read in conjunction with Instructions to Tenderers / Bidders). This section covers items common to all Electrical sections and is intended only to supplement the requirements of Division 01.
- .2 Reference to "Electrical Divisions" shall mean all sections of Divisions 26 in the Master Format or the Canadian Master Specifications.
- .3 The word "Provide" shall mean "Supply and Install" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.
- .4 Provide materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available. Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, ensure coordination, and establish orderly completion and the delivery of a fully commissioned installation.
- .5 The most stringent requirements of this and other electrical sections shall govern.
- .6 All work shall be in accordance with the PROJECT Drawings and Specifications and their intent, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.
- .7 Provide seismic restraints for all required fixtures, devices, equipment, pathway, and wiring systems as required by the BC Building Code.
- .8 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Departmental Representative. Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA)
- .2 BC Hydro ES-54 Underground-Civil-Manual-2016
- .3 CSA C22.1-18, (current adopted edition) Canadian Electrical Code (CEC)
- .4 CAN/CSA-C22.3 No.1-10, Overhead Systems (current adopted edition) – except where specified otherwise.
- .5 CAN3-C235-83, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .6 British Columbia Building Code (BCBC)
- .7 National Building Code (NBC)
- .8 National Fire Code of Canada (NFCC)
- .9 WorkSafe BC Regulations
- .10 Applicable NFPA Regulations

- .11 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
- .12 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.
- .13 Refer to NBCC Table 1.3.1.2 for applicable codes and the related revisions.
- .14 Comply with Local Electrical Bulletins and by-laws relating to the Authority having Jurisdiction.
- .15 All materials shall bear the approval of the Canadian Standards Association and where applicable, the Underwriters' Laboratories of Canada or alternately shall bear local approval from the Electrical Inspection Department having jurisdiction. Include in the Tender all costs associated with obtaining local approvals.

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 PERMITS

- .1 Submit to the Electrical Inspection Authority having jurisdiction the necessary number of drawings and specifications for review and approval prior to commencement of the project.
- .2 Pay all associated fees and obtain all permits, licenses etc. to complete the project.
- .3 Arrange for inspection of all Work by the authorities having jurisdiction. Obtain a Certificated of Acceptance from the Inspection Authority having jurisdiction upon completion of the project and include in the O&M manual.

1.5 SCOPE OF WORK

- .1 Refer to Section 01 11 00 Summary of Work for project background and details.
- .2 The work includes but is not limited to:
 - .1 Provision and installation of one (1) low voltage kiosks, underground power and communication distribution, and not limited to general electrical work as indicated within the Electrical Drawings.
 - .2 The provision of shop drawings for approval prior to the purchase of electrical equipment to be installed.
 - .3 The provision and assembly of all components required for safe and continuous operation of the power distribution throughout the site.
 - .4 All planning, organizing, scheduling, managing and coordinating as required.
 - .5 Completion of the deficiency list as required.
 - .6 BC Hydro coordination, provision, and/or installation of all BCH components as per the Electrical drawings, Section 01 11 00 Summary of Work, and BCH ES-54 standards.
- .3 Electrical Services:

- .1 To be provided as required by latest Canadian Electrical Code (CEC)
- .2 Assure all works are in compliance with Canadian Electrical Code, BC Hydro standards and guidelines and other applicable codes and standards.
- .4 Normal Power Distribution System:
 - .1 The normal power distribution system will be provided at 120/208/347/600V, 3-phase, 4-wire.
 - .2 Contractor to make sure it is a fully rated systems. Include the calculations on fault current in the report. Vendor to provide detailed arc flash sticker on every single equipment upon confirmation of a fully rated systems.
 - .3 Provide as-built single line diagram within the kiosk(s).
 - .4 Provide appropriate warning signs and labels as per the CSA throughout the site once they have been approved by the Departmental Representative.
 - .5 120/208V, 3-phase, 4-wire distribution boards and branch circuit panel boards will be provided as necessary for power distribution to equipment.
 - .6 120V power supply will be provided to receptacles and other kiosk devices as required.
 - .7 Power supply at the appropriate voltage and phase will be provided to Departmental Representative's equipment as required.
 - .8 Provide temporary power as necessary for power distribution to equipment.
- .5 Provide all necessary electrical wiring including conduit, wire, and cable. Refer to the drawings for details and the specifications.
- .6 Coordinate all new equipment in terms of layout and location before ordering. All equipment shall be accepted and confirmed by the Departmental Representative prior to ordering in accordance with Section 01 61 10 – Common Product Requirements.
- .7 Review all shop drawings of other divisions to ensure electrical services are properly provided.
- .8 Provide seismic anchoring of all new equipment and services. Engage the services of a registered B.C. Professional Engineer for this work.
- .9 Provide Record drawings and O&M manuals and spare parts in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

1.6 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235- current edition
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 All electrical work to be installed with common work practices and methods.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals to be in accordance with Division 01.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for all equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit for review single line electrical diagrams under plexiglass in glazed frames and locate on MDC-Gulf centre door.
- .4 Shop drawings:
 - .1 The term “shop drawing” means drawings, diagrams, illustrations, schedules, performance characteristics, brochures and other data which are to be provided by the contractor to illustrate details of a portion of the work.
 - .2 Prior to submitting the shop drawings to the Departmental Representative, the contractor shall review the shop drawings to determine that the equipment complies with the requirements of the specifications and drawings.
 - .3 Submit shop drawings, product data and samples for all electrical equipment and materials in accordance with Division 01. The submission shall be reviewed, signed and processed as described in Division 01.
 - .4 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
 - .5 Where applicable, include wiring, line and schematic diagrams. Include wiring drawings or diagrams showing interconnection with work of other Sections.
 - .6 Manufacturer of products shall conform to revised shop drawings.
 - .7 Keep one [1] copy of shop drawings and product data, on site, available for reference.
- .5 Certificates:
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and/or material is not available, submit such equipment and/or material to the authority having jurisdiction for special approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .6 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.8 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for all equipment into manual in accordance with Division 01.
 - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
 - .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
 - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
 - .4 Post instructions where directed.
 - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
 - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.9 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions 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 indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect equipment and materials from nicks, scratches, and damage. Protect from dust where applicable.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan/Waste Reduction Workplan related to Work of this Section and in accordance with Section 01 74 19 - Waste Management and Disposal.

1.10 SYSTEM START-UP

- .1 Refer to Division 01 and as follows.
- .2 Instruct Departmental Representative and operating personnel in the operation, care and maintenance of equipment.

- .3 Arrange and pay for services of manufacturer's factory service Departmental Representative to supervise start-up of installation, check, adjust, balance and calibrate components, where required in these specifications.
- .4 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.11 OPERATING INSTRUCTIONS

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.12 DRAWINGS AND MEASUREMENTS

- .1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings. Obtain accurate dimensions from the Architectural and Structural drawings.
- .2 Consult the architectural drawings and details for exact locations of fixtures and equipment. Obtain this information from the Departmental Representative where definite locations are not indicated.
- .3 Take field measurements, where equipment and material dimensions are dependent upon building dimensions.
- .4 The SI units shall govern for this project.

1.13 PROJECT COORDINATION

- .1 Project coordination to be in accordance with Division 01.
- .2 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost to the Departmental Representative, without the Departmental Representative's written approval.
- .3 The drawings indicate the general location and route to be followed by the electrical services. Where details are not shown on the drawings or only shown diagrammatically, the services shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All services in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All electrical services shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.
- .4 Work out jointly all interference problems on the site and coordinate all work before fabricating, or installing any material or equipment. Where necessary, produce interference/coordination drawings showing exact locations of electrical systems or equipment within service areas, shafts and the ceiling space. Distribute copies of the final interference/coordination drawings to the Departmental Representative and all affected parties.
- .5 Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Departmental Representative of space problems before installing any material or equipment. Demonstrate to the Departmental Representative on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

1.14 PROVISION FOR FUTURE EQUIPMENT AND CONSTRUCTION

- .1 Leave clear spaces designated for future equipment or building expansion where indicated. Plan for the installation under this contract and ensure clear accessible, unhindered access to the space is allowed for.
- .2 Were contract documents don't clearly indicate the future expansion requirements, but known services are required, provide written "request for information" to the Departmental Representative before making assumptions as to intent.

1.15 PHASED CONSTRUCTION

- .1 See Civil and Electrical specifications and drawings for construction phasing. Make all allowances to phase the work in accordance with the project phasing.
- .2 All trades in this Division shall make allowance for the implications of having to totally complete all work in the new addition before proceeding with work in the existing building.

1.16 WARRANTY

- .1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the Division 01.

- .2 Take note of any extended warranties specified in other sections of this Division.
- .3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance and include in O&M manual.
- .4 Promptly investigate any electrical or control malfunction, and repair or replace all such defective work and all other damages thereby which becomes defective during the time of the warranty.

1.17 RESPONSIBILITIES

- .1 Provide temporary lighting, power and systems for construction services and remove after construction is complete.
- .2 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practice.
- .3 Protect equipment and material from the weather, moisture, dust and physical damage.
- .4 Cover equipment openings and open ends of conduit, piping and pullboxes as work progresses. Failure to do so will result in the Trade being required to adequately clean or replace materials and equipment at no extra cost to the Departmental Representative.
- .5 Refinish damaged or marred factory finish to factory finish.
- .6 The specifications and drawings form an integral part of the Contract Documents. Neither the drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirement of either plans or specifications shall not relieve this Contractor of the responsibility of properly completing his trade to the approval of the Departmental Representative.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235- current edition
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 All electrical work to be installed with common work practices and methods.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance with Division 01 and as follows.
- .2 Material and equipment to be CSA certified. Where CSA certified material or equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval.

- .3 Where equipment or materials are specified by technical description only, they are to be of the best quality available for the application for which it is to be installed.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Provide all power and control wiring, conduit, wire, fittings, disconnect switches, motor starters, for all mechanical equipment unless otherwise specified.
- .2 Bond all motors to conduit system with separate bonding conductor in flexible conduit or bonding conductor in the flexible conduit.
- .3 Connections shall be made with watertight flexible conduit with watertight connectors.

2.4 WARNING SIGNS

- .1 Provide warning signs, as specified or to meet the requirements of Inspection Department, Authority having Jurisdiction and Departmental Representative.
- .2 Use decal signs, minimum 175 x 250 mm size

2.5 WIRING TERMINATIONS

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

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify all electrical equipment including but not limited to starters, disconnects, remote ballasts and controls with nameplates and labels as follows:
- .2 Nameplates:

- .1 Lamicoid 3 mm thick plastic engraving sheet, white face, black core, self adhesive unless specified otherwise. Provide white face, red core for all essential distribution equipment.

- .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .3 Typical Labelling:
 - .1 Panelboard & CDP – 5 lines
 - .1 Line 1 – Panel/CDP designation – Size 4 lettering
 - .2 Line 2 – eg 225A, 120/208V, 3 phase 4W – Size 2 lettering
 - .3 Line 3 – Feeder: eg 4#3 – 35mm C – Size 2 lettering
 - .4 Line 4 – Origin eg: Main Elect. Room – Size 2 lettering
 - .2 Distribution Circuit Breakers – 4 lines
 - .1 Line 1 – Main Circuit Breaker – Size 4 lettering
 - .2 Line 2 – Feeder: eg 4#3 – Size 2 lettering
 - .3 Line 3 – Origin: eg K1 Sub-station – Size 2 lettering
 - .3 Label colours unless otherwise indicated:
 - .1 Normal Power: white letters on black base.
 - .4 Wording on nameplates to be approved prior to manufacture.
 - .5 Allow for average of twenty-five (25) letters per nameplate.
 - .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage and CCT.
 - .7 Terminal cabinets and pull boxes: indicate system and voltage and source.
 - .8 Transformers: indicate capacity, primary and secondary voltages, source and lead.
- .3 Labels:
 - .1 Identify each outlet, starter, disconnect and all items of fixed equipment with the appropriate panel and circuit number origin by means of a small but good quality vinyl, self-laminating label such as T & B E-Z Code WSL, Dymo Letratag or Brother P-Touch equivalent printable markers. Embossed Dymo or any labels with edges and corners that are prone to lift will be rejected. Confirm location of labels with Departmental Representative before installing. Circuit number to agree with Record Drawings.
- .4 Provide plastic covered panel directory with circuits and areas served typed in, and mounted on inside of door. Directory to conform to Record Drawings.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, metallic sheathed cables, pullboxes and junction boxes.
- .2 Identify all feeders with coloured tags having 4 slotted tie holes and secured with 2 plastic tag ties as follows:

- .1 Minimum of 1 tag for each feeder in each manhole, pull box, or building.
- .2 Minimum of one tag on each side of every connector, splice assembly, or junction box.
- .3 Size 150 mm x 50 mm.
- .4 Material: 3-ply lamicoid, minimum 5 mm thick
- .3 Identify all other cables with plastic tie-tags. Markings to be indelible and shall identify cable end destinations and service description.
- .4 Identify the phasing by colour coding and phase designation letter ("A," "B," "C") at each and every set of 600V, and 208 V conductors at each termination (both Line and Load ends) and at both sides of each intermediate connector and splice point, with adhesive cable markers. Maintain phase sequence and colour coding throughout.
- .5 Identify concrete duct banks, service ducts and conduits for communication and power and other spare raceways where they enter or leave buildings, with engraved stainless steel marker plates indicating the type of raceway and buried depth. Install marker plates on the exterior wall immediately above point of entry. Obtain prior approval of the Departmental Representative for method of attachment to the building surface.
- .6 Code with 25 mm plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor and at 15 m intervals.
- .7 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Type	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 25 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.9 FINISHES

- .1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside and at least two coats of finish enamel.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original finish.

2.10 EQUIPMENT SUPPORTS

- .1 Provide stands and supports for equipment and materials supplied.
- .2 Lay out concrete bases and curbs required under Electrical Divisions. Coordinate with Concrete Divisions.
- .3 Concrete bases shall be a minimum of 100 mm thick, or as noted and shall project at least 150 mm outside the equipment base, unless otherwise directed. Bases and curbs shall be

keyed to the floor and incorporate reinforcing bars and/or steel mesh. Chamfer edges of bases at 45 degrees.

- .4 Equipment with bedplates shall have metal wedges placed under the edges of the bedplates to raise them 25mm above the base after levelling. The wedges shall be left permanently in place. Fill the space between the bedplate and the base with non-shrink grout - Embeco or In-Pakt.
- .5 Construct equipment supports of structural steel. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.
- .6 Support ceiling hung equipment with rod hangers and/or structural steel.

2.11 MISCELLANEOUS METAL

- .1 Be responsible for all miscellaneous steel work relative to Electrical Divisions of the Specifications, including but not limited to:
 - .1 Support of equipment.
 - .2 Hanging, support, anchoring, guiding and relative work as it applies to wiring raceways and electrical equipment.
 - .3 Earthquake restraint devices - refer also to “Seismic Restraint” sections
 - .4 Bridle rings - secure to structure or steel supports.
- .2 All steel work shall be prime and undercoat painted ready for finish under the related Division.

2.12 MAINTENANCE MATERIALS AND CABINET

- .1 Provide maintenance materials in accordance with Division 01 and specified in appropriate Sections.
- .2 Provide a finished painted sheet steel “spare equipment cabinet”. Cabinet to have a continuous hinge and complete with shelves and hasp to suit padlock. Minimum size 600 x 900 x 200 mm deep. Mount on wall in the Electrical Room. Provide a plastic covered typewritten list of spare parts and affix to the inside of the door.

2.13 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into maintenance manual specified in Division 01 and as follows.
- .2 Include in operations and maintenance data:
 - .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
 - .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
 - .3 Wiring and schematic diagrams.
 - .4 Names and addresses of local suppliers for items included in maintenance manuals.

- .3 Include in the manual the following major sections:
 - .1 Title page (in plastic cover).
 - .2 Comprehensive description of the operation of the systems, including the function of each item of equipment within the system.
 - .3 Detailed instructions for the normal maintenance of all systems and equipment installed including procedures and frequency of operational checks and service and troubleshooting instructions.
 - .4 Local source of supply for each item of equipment.
 - .5 Wiring and control diagrams.
 - .6 Spare parts list.
 - .7 Copies of guarantees and certificates.
 - .8 Manufacturer's maintenance brochures and shop drawings.

2.14 PROJECT RECORD DRAWINGS

- .1 Provide project record documents as specified in Division 01 as further called for in this Division.
- .2 The contractor shall keep a complete set of white prints at the site office, including all addendums, change orders, site instructions, clarifications and revisions for the purpose of record drawings. As the work on site proceeds, the contractor shall clearly record in Red all as-built conditions which deviate from the original contract documents. Record drawings to include cable runs (complete with number of cables and ID number) and locations of all telecommunications equipment.
- .3 Prior to substantial performance, the Contractor shall submit completed red-line record drawings to the Departmental Representative. The Contractor shall certify, in writing that the as-built record drawings are complete and that they accurately indicate all electrical services and electrical pathway, including exposed as well as concealed items.
- .4 Preparation of record drawings in AutoCAD shall be performed by the Contractor based on the red-line record drawings submitted by the Contractor.

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with 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 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.

- .2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .3 All cables and conduits to be installed concealed in finished areas.

3.4 LOCATION OF OUTLETS

- .1 Do not install outlets back-to-back or in the same stud space in wall; allow minimum 400mm horizontal clearance between boxes.
- .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm and information is given before installation.
- .3 Locate light switches on latch side of doors unless otherwise indicated.
- .4 Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

3.5 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1400 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .4 In mechanical rooms: 1400 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Telephone and interphone outlets: 300 mm.
 - .5 Wall mounted telephone and interphone outlets: 1500 mm.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.7 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure voltage and phase & neutral currents to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase and neutral currents to dry-core transformers and motor control centres, operating under normal load,
 - .3 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

- .2 Conduct and pay for the following tests:
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Arc Flash Study report with required PPE for the switchgear.
 - .3 Circuits originating from branch distribution panels.
 - .4 Lighting and its control.
 - .5 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .6 Systems: communications
 - .7 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
 - .4 Main ground resistance (at all grounding locations).
- .3 Provide Departmental Representative with at least one week's notice prior to testing.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Carry out tests in presence of Departmental Representative.
- .6 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .7 Reports:
 - .1 Arc Flash Study report with required PPE for the switchgear as per Division 01 and Section 26 11 10 - Short Circuit Protective Device Coordination & Arc Flash Analysis.
 - .2 Provide written reports in a timely manner upon completion of the testing and load balance. Indicate test hour and date.

3.8 SYSTEM STARTUP

- .1 Startup: in accordance with Division 01.
- .2 Instruct Departmental Representative in operation, care and maintenance of systems, system equipment and components.

- .3 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .4 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.9 WORKMANSHIP

- .1 Workmanship shall be in accordance with well-established practice and standards accepted and recognized by the Departmental Representative and the Trade.
- .2 The Departmental Representative shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.
- .3 Employ only tradesmen holding valid Provincial Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Departmental Representative.

3.10 PROTECTION OF WORK

- .1 Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage.
- .2 Mask machined surfaces. Secure covers over equipment openings and open ends of equipment and conduit, as the installation work progresses.
- .3 Equipment having operating parts, bearings or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.
- .4 Refinish damaged or marred factory finish.
- .5 All communication rooms shall be dust free at the time of installation of cabling and equipment. Communication rooms shall remain dust free during construction.

3.11 PROTECTION OF ELECTRICAL EQUIPMENT

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts, e.g. "LIVE 120 VOLTS".
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

3.12 CONCEALMENT

- .1 Conceal wiring and conduit in partitions, walls, crawlspaces and ceiling spaces, unless otherwise noted.
- .2 Do not install wiring and conduit on outside walls or on roofs unless specifically directed.

3.13 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

- .1 All cabling, wiring, conduits, cable trays, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the

separation with caulking or silicon sealant to prevent the passage of smoke and/or transmission of sound.

3.14 CONDUIT SLEEVES

- .1 Provide conduit sleeves for all conduit and wiring passing through rated walls and floors. Sleeves to be concentric with conduit or wiring.
- .2 Except as otherwise noted conduit sleeves are not required for holes formed or cored in interior concrete walls or floors.
- .3 Conduit sleeves shall extend 50 mm above floors in unfinished areas and wet areas and 6 mm above floors in finished areas.
- .4 Conduit sleeves shall extend 25 mm on each side of walls in unfinished areas and 6 mm in finished areas.
- .5 Conduit sleeves shall extend 25mm beyond exterior face of building. Caulk with flexible caulking compound.
- .6 Sleeve Size: 12 mm clearance all around, between sleeve and conduit or wiring.
- .7 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.
- .8 Packing of Sleeves:
 - .1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and conduit shall be caulked with waterproof fire retardant non-hardening mastic.
 - .2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.
- .9 Locate equipment and junction boxes in service areas wherever possible.

3.15 EQUIPMENT INSTALLATION

- .1 Provide means of access for servicing equipment.
- .2 CSA identification and equipment labels to be clearly visible after installation.

3.16 CUTTING, PATCHING, DIGGING, CANNING, CORING & CONCRETE

- .1 Lay out all cutting, patching, digging, canning and coring required to accommodate the electrical services. Coordinate with other Divisions. The performance of actual cutting, patching, digging, canning and coring is specified under other Divisions.
- .2 The Electrical Contractor shall be responsible for all cutting, patching, digging, canning and coring required to accommodate the electrical services.
- .3 The Electrical Contractor shall be responsible for correct location and sizing of all openings required under Electrical Divisions, including piped sleeves.
- .4 Verify the location of existing and planned service runs and structural components within concrete floor and walls prior to core drilling and/or cutting.
- .5 Openings through structural members of the building shall not be made without the approval of the Departmental Representative.

- .6 Openings in Concrete:
 - .1 Be responsible for the layout of all openings in concrete, where openings are not left ready under previous contract.
 - .2 All openings shall be core drilled or diamond saw cut.
 - .3 Refer to structural drawings for permissible locations of openings and permissible opening sizes in concrete floors and walls.
 - .4 Refer to structural drawings for locations of steel reinforcing.
 - .5 Be responsible for repairing any damage to steel reinforcing.
- .7 Openings in building surfaces other than concrete:
 - .1 Lay out all openings required.
- .8 Poured concrete for duct encasements, pole bases, transformer pads and housekeeping pads shall be provided by other Divisions, coordinated and supervised by the Electrical Divisions.
- .9 Excavation and backfilling will be provided by other Divisions. This Division to supervise the work and provide all layouts and parameters.

3.17 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.

3.18 PAINTING

- .1 Outdoor enclosures shall be painted to match the BC Hydro transformer's enclosure paint.
- .2 Clean exposed bare metal surfaces supplied under the Electrical Divisions removing all dirt, dust, grease and millscale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.
- .3 Repaint all marred factory finished equipment supplied under the Electrical Divisions, to match the original factory finish.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 TERMS OF REFERENCE

- .1 Typically use insulated 98% conductivity copper conductor wiring enclosed in RPVC conduit for the general wiring systems unless otherwise indicated.
- .2 All conductor sizes indicated on drawings are based on copper conductors unless otherwise noted.
- .3 Teck cable may only be used where specifically indicated on the drawings or in the specifications. Where permitted, Teck wiring up to 750 system volts to be PVC jacketed armoured cable, multi-copper conductor type Teck90 1000 volt having a PVC jacket with FT-4 flame spread rating.
- .4 Flexible armoured cabling (BX) shall not be used for the general wiring system.
- .5 Provide all control wiring except mechanical equipment controls.
- .6 Refer to Equipment Schedule(s) for detailed responsibilities.
- .7 Non-metallic sheathed wiring is not to be used on this project.

1.3 REFERENCE STANDARDS

- .1 Wires and Cables
 - .1 CSA C22.2 No. 0.3, Test Methods for Electrical Wires and Cables
 - .2 CSA C22.2 No. 65, Wire Connectors
 - .3 CAN/CSA C22.2 No. 131, Type Teck 90 Cable
- .2 Wire and Box Connectors
 - .1 CAN/CSA-C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .2 CSA C22.2 No. 65, Wire Connectors.

1.4 PRODUCT DATA

- .1 Provide product data in accordance with Division 01

Part 2 Products

2.1 WIRE AND CABLE - GENERAL

- .1 Unless specifically indicated otherwise, all wiring and connections for BC Hydro metering, instrumentation, and wireway, shall be as per BC Hydro ES54 requirements.

- .2 No splices, other than those shown, will be permitted. All splices must be made in junction boxes above water level.
- .3 All cables and cords shall be adequately supported to avoid strain on connections. Where cords and cables are suspended vertically, use stainless steel cable grips (Kellums or equal).
- .4 Conductors: stranded for 10 AWG and larger. Minimum size #12 AWG.
- .5 Insulation to be 600 volt RW90XLPE (X link) for the general building wiring in conduit.
- .6 Site services sub-circuits, including site lighting, to be minimum #10 AWG for power and #12 AWG for controls. Increase wiring size for lengthy and/or loaded circuits so that system will not exceed the maximum voltage drop as recommended by the Canadian Electrical Code CSA 22.1.
- .7 Main feeders to be conduit and copper insulated wiring unless otherwise noted on drawings. Provide bond wiring for all conduits. Increase conduit size as required.
- .8 TBS75 #14 AWG stranded shall be used in all switchgear assemblies. Current transformer secondary wiring shall be #12 AWG stranded. Current transformer leads shall incorporate ring type tongues for termination purposes
- .9 Conductors to be colour-coded. Conductors #10 AWG and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size #8 AWG and larger may be colour-coded with adhesive colour coding tape, but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible. Where colour-coding tape is utilized, it shall be applied for a minimum of 50 mm at terminations, junctions and pullboxes and conduit fittings. Conductors shall not be painted.

2.2 LOW VOLTAGE CONTROL CABLES

- .1 Type LVT: soft annealed copper conductors, with thermoplastic insulation, outer covering of thermoplastic jacket. Minimum size #18 AWG. FT-6 Rated.
- .2 Unless otherwise specified wiring to be multicore individually identified and colour coded with grey sheath enclosed in conduit or (EMT).

2.3 WIRE & BOX CONNECTORS

- .1 Unless specifically indicated otherwise, all wire and connectors for BC Hydro equipment and devices shall be as per BC Hydro ES54 requirements.
- .2 Pressure type wire connector current carrying parts to be copper and sized to fit conductors used.
- .3 Fixture type splicing connector current carrying parts to be copper sized to fit conductors 10 AWG or less.
- .4 Bushing stud connectors to EEMAC 1Y-2 and suitable for stranded copper conductors
- .5 Clamps or connectors for armoured cable, flexible conduit, as required.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Install cable in trenches in accordance with Section 33 71 73.02 - Underground Electrical Service.
- .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 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 VOLTAGE REGULATION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No.41-13, Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and UL 467).
 - .3 CSA C22.2 No.65-13, Wire connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

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 connectors and terminations and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

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

- .1 Copper compression connectors to CSA C22.2 No.65 as required sized for conductors.
- .2 Contact aid for aluminum cables where applicable.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for connectors and terminations installation in accordance with manufacturer's written instructions.

3.2 INSTALLATION

- .1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2No.41.

3.3 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 – Electrical
- .2 BC Hydro ES-54 Underground-Civil-Manual-2016.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837-02, Qualifying Permanent Connections Used in Substation Grounding.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal: in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 BC Hydro grounding kit provided by BC Hydro.
- .2 Rod electrodes: copper clad steel, 19 mm diameter by 3 m long.
- .3 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.
- .4 Wire connectors and terminations: as indicated.

- .5 Cable sheath isolating sleeves.

Part 3 Execution

3.1 INSTALLATION

- .1 Install BC Hydro grounding kit in accordance with ES-54 standards.
 - .1 Coordinate grounding installation with BC Hydro prior to work.
- .2 Install continuous grounding system including, electrodes, conductors, connectors and accessories as indicated and to requirements of local authority having jurisdiction.
- .3 Install connectors and cadweld in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors during and after construction.
- .5 Make buried connections, and connections to electrodes, structural steel work, using copper welding by thermit process.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Use BC Hydro grounding kit cable for main ground bus of substation and taps on risers from main ground bus to equipment.
- .8 Use tinned copper conductors for aluminum structures.
- .9 Do not use bare copper conductors near un-jacketed lead sheath cables.

3.2 ELECTRODE INSTALLATION

- .1 Install ground plate electrodes. Make grounding connections to station equipment.
- .2 Install ground rod electrodes at transformer and switchgear locations.
- .3 Install gradient control mats. Connect mats to station ground electrode and switch mechanism operating rods.
- .4 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.
- .5 Provide with ground rod electrode inspection wells to access for testing and inspecting of ground rods and ground wire connection to ground rods.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections as indicated to typical station equipment including: metallic water main, line sky wire, neutral, gradient control mats. Non-current carrying parts of: transformers, generators, motors, circuit breakers, reclosers, current transformers, frames of gang-operated switches and fuse cutout bases, cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers, meter and relay cases, any exposed building metal, within or forming part of station enclosure. Substation fences, pothead bodies and outdoor lighting.
- .2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.

- .3 Connect metallic piping (water, oil, air, etc.) inside station to main ground bus at several locations, including each service location within station. Make connections to metallic water pipes outside station to assist in reduction of station ground resistance value.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Engage an independent testing agent to inspect grounding and perform ground resistance test and submit to Departmental Representative before backfill.
- .3 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction.
- .4 Perform test before energizing electrical system.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
- .2 All grounding conductors to be stranded soft annealed copper unless otherwise noted.
- .3 Install complete grounding and bonding system in accordance with Canadian Electrical Code and local inspection authority requirements.
- .4 CSA Group (CSA)
 - .1 CSA Z32-09, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

1.3 TESTING REQUIREMENTS

- .1 Any third party testing agency costs for the testing and reporting shall be included in the Electrical Division base tender and shall be carried out by a pre-approved testing agency.

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 grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor, size as required.

- .2 Rod electrodes, copper clad steel 20mm [3/4"] dia by 3m [10'] long or as indicated.
- .3 Grounding conductors: bare stranded copper size as indicated.
- .4 Insulated grounding conductors: green, copper conductors, size as indicated.
- .5 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .6 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

3.2 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.
- .2 Provide ground wire in conduits as per electrical drawings, installed in grade or below slabs.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury.
- .5 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process or permanent mechanical connectors approved for the use.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Soldered joints not permitted.
- .8 Install bonding wire for flexible conduit, connected at both end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit. Provide a ground conductor in all flexible conduit and secure to system grounding lugs at both the equipment and source.

- .9 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .10 Connect building structural steel and metal siding to ground by welding copper to steel.
- .11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .12 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.
- .13 Ground secondary service pedestals.
- .14 Coordinate ground rod installation with local soil conditions to assure proper grounding system.
- .15 Provide a bonding conductor appropriately sized within each raceway routed within the building.
- .16 All bonding and grounding connections to be compression type unless noted otherwise.
- .17 Bond bonding bus of switchboard to the grounding grid with a #2/0 AWG copper conductor.
- .18 Ground the secondary winding of potential and current transformers.
- .19 Supply and install complete grounding and bonding system as indicated and as required by Canadian Electrical Code and the local electrical inspection authorities.
- .20 Provide grounding/bonding bus bars mounted on standoff insulators or as shown on the drawings.
- .21 All components shall be securely and adequately bonded and where required to accomplish this, bonding jumpers, grounding studs and bushings shall be used.
- .22 Ensure that all raceways, terminal panels, etc. for fire alarm, etc. are securely and adequately bonded and provide grounding conductor to main ground bus where called for or when required.
- .23 All interior metallic gas piping which may become energized to be made electrically continuous and to be bonded in accordance with requirements of Canadian Electrical Code.
- .24 Bond all structural steel, all concrete reinforcing steel and all metal systems with a #2/0 AWG copper bonding conductor. Connect to closest ground bus or bonding point.
- .25 All metallic conduits longer than 1m in length, containing a single grounding or bonding conductor, shall be bonded as per the Canadian Electrical Code.

3.3 MAINTENANCE HOLES

- .1 Install conveniently located grounding stud, electrode, size as indicated stranded copper conductor in each maintenance hole.
- .2 Install ground rod in each maintenance hole so that top projects through bottom of maintenance hole. Provide with lug to which grounding connection can be made. Confirm ground resistance meets or exceeds Canadian Electrical Code minimum requirements.

3.4 ELECTRODES

- .1 Provide additional grounding as necessary to meet the ground resistance specified.
- .2 Make ground connections to continuously conductive underground water pipe on street side of water meter.
- .3 Install rod and make grounding connections as indicated.
- .4 Bond separate, multiple electrodes together.
- .5 Use size 4/0 AWG copper conductors for connections to electrodes.
- .6 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.5 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.

3.6 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.
- .2 Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections size #2/0 AWG.

3.7 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Carry out all tests required by the Electrical Inspection Authority and provide all required reports and copied to the Departmental Representative. Include all associated costs.
- .3 Provide “Arc Flash” test calculations for the MDC-Gulf installations. Confirm test results in writing to the Departmental Representative.
- .4 Ensure test results are satisfactory before energizing the electrical system.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

- .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 SUPPORT CHANNELS

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

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.

- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
 - .1 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
 - .2 Leave space for 2 future conduits for future on support channels.
- .8 For surface mounting of two or more conduits use channels at 1 m oc spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Departmental Representative.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 - 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 Division 01 - Cleaning.
- .3 Waste Management: Remove waste and recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.1-06, Canadian Electrical Code, Part 1, 20th Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

Part 2 Products

2.1 SPLITTERS

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

2.2 JUNCTION AND PULL BOXES

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

2.3 CABINETS

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

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

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Coordinate all conduits for primary and secondary BC Hydro transformer with BC Hydro and the Departmental Representative.

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. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83M1985 (R2003), Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2-M1984 (R2003), Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.3 LOCATION OF CONDUIT

- .1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.

1.4 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.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products**2.1 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No.45 Galvanized Steel.
- .2 Epoxy coated conduit: to CSA C22.2 No.45 with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical Metallic Tubing (EMT): to CSA C22.2 No.83.
- .4 Rigid PVC conduit: to CSA C22.2 No.211.2.
- .5 Flexible metal conduit: to CSA C22.2 No.56 liquid-tight flexible metal conduit.

2.2 CONDUIT FASTENINGS

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

2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Fittings manufactured for use with conduits specified. Coating same as conduit.
- .3 Provide factory "ells" where 90 degree bends are required for 25 mm and larger conduits.

2.4 CONDUIT BOXES

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

2.5 PULL CORD

- .1 For 25 mm or larger trade size conduit: 6 mm diameter nylon or polypropylene cord or other approved product.

2.6 EXPANSION FITTINGS FOR RIGID CONDUIT

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

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 Generally, and where permitted by the Canadian Electrical Code, use rigid PVC conduit for all wiring unless otherwise noted.
- .2 Do not install PVC where it may be subject to mechanical injury.
- .3 For any one conduit section, use the maximum possible conduit length. Installations which use partial lengths and/or excessive number of couplings shall not be acceptable and shall be replaced at Contractor's expense.
- .4 Install exposed conduits in close parallel groups wherever two or more conduits running in the same direction would otherwise be within 1800 mm of each other.
- .5 Install all conduits parallel or at right angles to structure lines, as the case directs.
- .6 Do not install conduit through structural members unless specific instructions are given.
- .7 Install a pull cord in all empty conduits.
- .8 Use epoxy coated conduit underground/in corrosive areas.
- .9 Use electrical metallic tubing (EMT) above 2.4 m not subject to mechanical injury except in cast concrete.
- .10 Install conduit sealing fittings in hazardous areas.
 - .1 Fill with compound.
- .11 Minimum conduit size for lighting and power circuits: 21 mm [NPS 3/4].
- .12 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .13 Mechanically bend steel conduit over 19 mm diameter.
- .14 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .15 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .16 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on surface channels.

- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

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

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
 - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits [25 mm] NPS 1 and larger below slab and encase in 75 mm concrete envelope.
 - .1 Provide 50 mm of sand over concrete envelope below floor slab.

3.7 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

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

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No.26-1952 (R2009), Construction and Test of Wireways, Auxiliary Gutters and Associated Fittings.

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 wireways and auxiliary gutters and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.

Part 2 Products

2.1 WIREWAYS

- .1 Wireways and fittings: to CSA C22.2 No.26.
- .2 Sheet steel with bolted cover to give uninterrupted access.
- .3 Finish: baked grey enamel.
- .4 Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wireways and auxiliary gutters installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

3.2 INSTALLATION

- .1 Install wireways and auxiliary gutters in accordance with manufacturer's written recommendations.
- .2 Keep number of elbows, offsets, connections to minimum.
- .3 Install supports, elbows, tees, connectors, fittings.
- .4 Install barriers where required.
- .5 Install gutter to full length of equipment.
- .6 Ground metallic wireways and gutters as required.

3.3 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 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Coordinate and install all primary and secondary BC Hydro transformer ducts and trenches with BC Hydro.
- .3 Section 26 05 00 Common Work Results - Electrical
- .4 Section 26 05 21 Wires and Cables (0-1000 V)

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
- .2 BC Hydro ES-54 Underground-Civil-Manual-2016
- .3 Insulated Cable Engineers Association, Inc. (ICEA)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products**2.1 CABLE PROTECTION**

- .1 38 x 140 mm planks treated with coloured or copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.

2.2 MARKERS

- .1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for cable installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 DIRECT BURIAL OF CABLES

- .1 After sand bed in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling, is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable.
 - .1 Do not pull cable into trench.
- .2 Include offsets for thermal action and minor earth movements.
 - .1 Offset cables 150 mm minimum for each 60 m run, maintaining minimum cable separation and bending radius requirements.
- .3 Make termination and splice only as indicated leaving 0.6 m minimum of surplus cable in each direction.
 - .1 Make splices and terminations in accordance with manufacturer's written recommendations using approved splicing kits.
- .4 Underground cable splices not acceptable.
- .5 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable or in accordance with manufacturer's written recommendations; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.
- .6 Cable separation:
 - .1 Maintain 75 mm minimum separation between cables of different circuits.
 - .2 Maintain 300 mm minimum horizontal separation between low and high voltage cables.
 - .3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.
 - .4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.
 - .5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.

- .6 Install treated planks on lower cables 0.6 m minimum in each direction at crossings.

3.3 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound.

3.4 MARKERS

- .1 Mark cable every 150 m along duct runs and changes in direction.
- .2 Mark underground splices.
- .3 Where markers are removed to permit installation of additional cables, reinstall existing markers.
- .4 Install concrete cable markers within 180 m from each side of runway centreline; 45 m from each side of taxi way centreline; 50 m from edge of taxi ramps or aprons.
- .5 Install cedar post type markers.
- .6 Lay concrete markers flat and centred over cable with top flush with finish grade.

3.5 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using qualified personnel.
 - .1 Include necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds.
 - .1 Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance tests:
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

- .6 Acceptance Tests:
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
 - .3 High Potential (Hipot) Testing.
 - .1 Conduct hipot testing in accordance with manufacturer's recommendations.
 - .4 Leakage Current Testing:
 - .1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.
 - .2 Hold maximum voltage for specified time period by manufacturer.
 - .3 Record leakage current at each step.
- .7 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.6 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.

3.7 PROTECTION

- .1 Repair damage to adjacent materials caused by cables installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This section of the Specifications forms part of the contract documents and shall be read, interpreted and coordinated with all other parts.
- .2 All BC Hydro metering equipment, devices, connections, and meter socket shall be in accordance with BC Hydro ES54-Underground-Civil-Manual-2016. Contractor shall coordinate and provide all miscellaneous items for BC Hydro meter, unless otherwise specified by BC Hydro.

1.2 REFERENCE STANDARDS

- .1 International Electrotechnical Commission (IEC) – most recent version
 - .1 IEC 62053-22 - Electricity metering equipment (a.c.) Particular requirements Part 22: Static meters for active energy (classes 0,2 S and 0,5 S).
 - .2 IEC 61010-1 - Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements
- .2 International Standards; Institute of Electrical and Electronics Engineers (IEEE), Underwriters Laboratories (UL), European Committee for Standardization (CEN), National Electrical Manufacturers Association (NEMA) – most recent versions
 - .1 IEEE C.37-90.1 - Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
 - .2 UL 61010-1 UL Standard for Safety Electrical Equipment For Measurement, Control, and Laboratory Use; Part 1: General Requirements
 - .3 CEN - EN61000-6-2 - Electromagnetic compatibility (EMC) -- Part 6-2: Generic standards
 - .4 NEMA C12.20 - Electricity Meters 0.2 and 0.5 Accuracy Classes
- .3 Canadian Standards Association (CSA) – most recent version
 - .1 CAN/CSA-C22.2 No. 61010-1-12 - Safety requirements for electrical equipment for measurement, control, and laboratory use — Part 1: General requirements
- .4 BC Hydro ES54-Underground-Civil-Manual-2016

1.3 SECTION INCLUDES

- .1 Furnishing all equipment, Materials, labor, and services for the detailed design, supply, delivery, installation, testing, commissioning, demonstration, operations training, and warranty for a complete system.
- .2 Provide all detail design documentation to produce a complete operating system meeting the intent and performance of the systems concepts presented in these Specifications.
- .3 Supply and install all wiring and cabling, whether rated conduit, tray, plenum, or surface-mounted enclosures
- .4 All appropriate programming software provided and specified by the vendor.

- .5 Testing, documentation, and commissioning of the completed system
- .6 Demonstrate completion and compliance
- .7 Train personnel on system operation and maintenance

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide CSA approved revenue, multi-point, wireless digital metering system for MDC-Gulf. Provide CSA NEMA 3R enclosure type meter and instrument cabinets and miscellaneous as per electrical drawings, and Part 2 of this section.
- .2 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metering and switchboard instruments and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Include meter, outline dimensions, panel drilling dimensions and installation cut-out template.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions 01 61 00 - Common Product Requirements.

Part 2 Products

2.1 BC HYDRO METER

- .1 Main BC Hydro metering system shall be in accordance with BC Hydro ES54-Underground-Civil-Manual-2016 and electrical drawings. Contractor to coordinate BC Hydro meter pick-up prior to installation of the MDC-Gulf.
- .2 All required ES-54 metering dimensions, and connections need to be coordinated with section 26 23 00 Low Voltage Switchgear and electrical drawings prior to installation.

2.2 DIGITAL METER

- .1 The electronic Power Monitoring system shall be fully automated microprocessor-based electrical energy measurement system for Measurement and Verification purposes. The system shall incorporate complete metering, communications, reporting functions, including a web based software package; energy monitoring and threshold limit capabilities.
- .2 Provide and install CSA approved revenue meters as required on the Drawings; PowerHawk 6112 or equivalent approved by the Departmental Representative. Provide and install current and potential transformers, fuses, cabinets, meters and miscellaneous accessories as required for a fully functional metering center as detailed on the drawings.
- .3 Combination energy and revenue demand meter: IEC 62053-22 .1%, and Measurement Canada NOAs: AE-1665, AE-1919.

- .4 To Utility's requirements and standards. It is the electrical contractor's responsibility to coordinate and follow the Utility's standards.
- .5 All input and output voltages within the potential transformers module(s) shall be fused, unless otherwise specified.
- .6 Register: instrument transformer operated, pulse contacts for transmitting signal.
- .7 Allow for remote sensing, with IP-based communication (wireless).
- .8 Multi-point metering with minimum of twenty-four (24) meter elements of 1 phase, and eight (8) 3 phase configurations.
- .9 Digital meters supporting 120V, 230V, 240V by itself, and shall be able to accept 600VAC LL/ 347VAC LN with external potential transformers module with step down voltage output of 120V, +/-0.3% accuracy. External potential transformer modules used shall be from the same manufacturer as the digital meter, unless approved by the Departmental Representative prior to purchase.
- .10 Shall support current ratings of 1A up to 2000A with current transformers.
- .11 60 Hz, and minimum +/-0.5% accuracy.
- .12 Operating temperature: -40 to 50°C
- .13 Operating Humidity: 0 to 90% non-condensing
- .14 Maximum size: 33.7cm(h) x 34.3cm(w) x 6.4cm(d)
- .15 Must be BTL listed and test to the requirements based on ASHRAE Standard 135.1 - 2016 for BACnet products
- .16 To consist of electronic multi-meters with embedded communications capability, and solid or split-core current transformer technology. The current transformers shall have a full scale output of 330mV, 80mA or 5A outputs for safety purposes.
- .17 Meters to be used for Power Measurement applications or Billing requiring a Measurement Canada seal.
- .18 The meters will be capable of remote communication from each metering device. A data aggregator or collecting device shall not be used. Each device shall have multiple IP and Modbus sockets to accommodate data transmission via Modbus TCP and standard Ethernet. Data shall be transmitted by one or a combination of the following:
 - .1 Single 10/100BASE-T Ethernet Port
 - .2 TCP/IP: HTTP, FTP, PPP, SNMP, DHCP
 - .3 On board V90 modem capable of data transmission up to 56k baud rate.
 - .4 MODBUS® - TCP/IP, MODBUS®-RTU over RS-485, BACnet® IP
 - .5 Ethernet connection to PC or laptop via crossover cable.
 - .6 Wireless communication module
- .19 Meters to be complete with a Liquid Crystal Display (LCD) to access all energy measurements and phase diagnostics when needed. Measured Values:
 - .1 Phase Diagnostics: Parameters to be displayed for each individual phase of each metered load:
 - .1 Voltage Phase to neutral or phase to phase

- .2 Amps Instantaneous amperage for each phase
 - .3 kW Instantaneous real energy
 - .4 kVA Instantaneous apparent energy
 - .5 KVAR Instantaneous reactive energy
- .2
- .1 Power Factor- Displacement (Per-Phase, 3-Phase Total)
- .3 Digital Meter shall provide at minimum the following energy values:
 - .1 kWh real consumption delivered
 - .2 kWh received real consumption received (net metering)
 - .3 kW instantaneous consumption
 - .4 kVAh apparent consumption
 - .5 kVA apparent power
 - .6 kVARh reactive consumption
 - .7 kVAR reactive power
- .20 Reporting Capabilities:
 - .1 Interval configuration (1 to 60 min)
 - .2 Data storage (up to 2.4 years)
 - .3 CSV/TR3 file (via FTP push)
 - .4 Scheduled push reporting (FTP)
 - .5 Config report schedule (hr, day)
 - .6 Data polling (MODBUS, BACnet)
 - .7 Real-time data viewing (e.g. HTTP)
 - .8 On-Board Display: Liquid Crystal with button scroll
 - .9 On-Board Memory: Non-volatile flash memory is unaffected by power outages; holds up to 2.4 years of meter data
 - .10 1-hour intervals for 20 years
 - .11 On-Board real-time clock with battery back-up (holds time up to 10 years)

2.3 METER CABINET

- .1 Meter Cabinet: Sheet steel CSA NEMA 3R enclosures to accommodate meters, test terminal block and associated equipment, factory installed and wired.
- .2 Metering Instrumentation Cabinet: Sheet steel CSA NEMA 3R enclosures to accommodate potential and current transformers.
- .3 Mechanically and electrically built to bolt-up with the meter modules.
- .4 Three phase feed through cable connection tap box.

2.4 METER SOFTWARE

- .1 The Software supplied shall be web based and provide reporting capabilities for energy consumption. Separate web accounts for each stakeholder shall be provided.
- .2 Must have Modbus TCP or BACnet/IP capabilities and an open architecture type protocol for easy data transfer and simple interfacing options.

2.5 SHOP INSTALLATION

- .1 Install meters and instrument transformers in separate compartment of switchboard.
- .2 Install instruments on panel.
- .3 Ensure adequate spacing between current transformers installed on each phase.
- .4 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources, electrical supplies.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metering and switchboard instruments installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 METERING INSTALLATION

- .1 Install meters in location free from vibration and shock.
- .2 Make connections in accordance with diagrams.
- .3 If applicable, ensure power factor corrective equipment connected on load side of meter.
- .4 Connect meter and instrument transformer cabinets to ground.
- .5 Locate meters within 9 m of instrument transformers.
 - .1 Use 32 mm conduit for interconnections.
 - .2 Use separate conduit for each set of current transformer connections, exclusive for metering.
- .6 Provide a non-dedicated analog telephone line or Ethernet drop for remote meter reading and diagnostics of the system.
- .7 Perform all necessary system calibration, testing, commissioning, and demonstrations as required.

3.3 FIELD QUALITY CONTROL

- .1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical and in accordance with manufacturer's recommendations.
- .2 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.

- .3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources and electrical supplies.
- .4 Perform tests to obtain correct calibration.
- .5 Do not dismantle meters and instruments.
- .6 Manufacturer's representative shall verify, adjust and test the system. Verification of the energy monitoring system is to be carried out with the assistance of an electrical contractor at all times. Upon completion, the manufacturer shall issue a "CERTIFICATE OF ACCEPTANCE" to the Departmental Representative and the contractor.
- .7 Manufacturer's representative shall demonstrate operation of the system as follows:
 - .1 Local and Remote Meter readings
 - .2 Phase Diagnostics
 - .3 Provide manual of the chosen installed system.
- .8 Setup of system software as directed by Departmental Representative.

3.4 CLEANING

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

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by metering and switchboard instrument installation.

END OF SECTION

PART 1 General

1.1 RELATED WORK

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

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 26 05 00.

1.3 COORDINATION OF PROTECTIVE DEVICES AND SHORT CIRCUIT STUDY

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

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

PART 2 Products

2.1 WARNING LABELS

- .1 Produce an Arc Flash Warning label for each piece of electrical equipment with a specific equipment ID. Also include the system operating voltage and date of issue. Labels shall be printed in colour on adhesive backed nylon labels.

PART 3 Execution

3.1 ANALYSIS OF SHORT CIRCUIT CALCULATIONS

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

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

3.2 ARC FLASH ANALYSIS STUDY

- .1 Present the data determined by the Arc Flash Analysis Study in a tabular format summary sheet. Include the following for each bus analyzed:
 - .1 Flash Bus Name
 - .2 Protective Device Name
 - .3 Bus Operating Voltage
 - .4 Bus Bolted Fault Current
 - .5 Protective Device Bolted Fault Current
 - .6 Protective Device Arcing Fault Current
 - .7 Trip/Delay Time (Sec)
 - .8 Breaker Opening Time (Sec)
 - .9 Ground
 - .10 Equipment Type
 - .11 Gap (mm)
 - .12 Arc Flash Boundary (in)
 - .13 Working Distance (in)
 - .14 Incident Energy (cal/cm²)
 - .15 Required Protective FR Clothing Category

3.3 FINAL WRITTEN REPORT

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CAN/CSA-C22.2 No.47-M90 (R2007), Air-Cooled Transformers (Dry Type).
 - .2 CSA C9-02 (R2007), Dry-Type Transformers.
 - .3 CAN/CSA-C802.2-06, Minimum Efficiency Values for Dry Type Transformers.
 - .4 CSA C22.1-12, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 Transformers shall meet NEMA TP-1 (table 4.2) standards for energy efficiency.

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 dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Dimensions showing enclosure, mounting devices, terminals, taps, internal and external component layout.
 - .2 Total weight of transformer and individual weights of transformer coil, coil frame, bus, accessories and enclosure.
 - .3 Transformer Nameplate Technical data:
 - .1 kVA rating.
 - .2 Primary and secondary voltages.
 - .3 Frequency.
 - .4 Windings – copper.
 - .5 Number and percentage of taps.
 - .6 Estimated impedance, engraved on nameplate.
 - .7 Cooling designation, natural and/or forced.
 - .8 Temperature Class.
 - .9 Temperature Rise.
 - .10 Three phase.
 - .11 Polarity or angular displacement.
 - .12 Full load efficiency.
 - .13 Regulation at unity pf.
 - .14 BIL for LV.

- .15 Insulation type.
- .16 Total weight of core, coils, and enclosure.
- .17 Sound rating.

- .4 Factory Test Submittals: submit standard factory test certificates of each transformer and type test of each transformer in accordance with CSA C9-02.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for medium, dry type transformers for incorporation into O&M manuals.
- .3 Operation and maintenance instructions to include:
 - .1 Tap changing.
 - .2 Recommended environmental conditions.
 - .3 Recommended periodic inspection and maintenance.
 - .4 Bushing replacement.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off the ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect transformers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Notify Departmental Representative two working days prior to expected arrival of equipment on site and/or in storage.
- .5 The transformers shall be inspected and tested for integrity prior to acceptance and operation. Acceptance tests shall be according to the latest edition of the NETA standards.
- .6 Perform, record and submit results for approval by the Departmental Representative. Inspection and tests shall include, but not be limited to:
 - .1 Evidence of moisture and corrosion
 - .2 Bolted mechanical connections, anchorage, alignment, bonding
 - .3 Evidence of damage to enclosure, fixtures, accessories, electrical apparatus including paint scrapes
 - .4 Evidence of loose or missing fixtures, bolts, attachments or spare parts
 - .5 Low-resistance measurements through bolted electrical connections
 - .6 Insulation tests winding to winding, and each winding to ground, for each primary winding tap setting

- .7 Core ground test
- .8 Power factor or dissipation factor test
- .9 Turns ratio test at each designated tap position and each primary winding tap setting
- .7 Any damages noted or tests failed prior to operation shall constitute sub-standard equipment. Equipment shall be refused by the Departmental Representative and contractor shall be responsible for all costs related to the repair and/or the replacement of defective equipment.

1.6 EXTRA MATERIALS

- .1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 MATERIALS

- .1 Dry-type transformers: to CSA C9.
- .2 Bushings: to CAN/CSA-C88.1-96.

2.2 DESIGN DESCRIPTION

- .1 Transformer provided for MDC-Gulf as per electrical drawings:
 - .1 ANN, NEMA/CSA Type 3R enclosure
 - .2 Rating: 30kVA, 3 phase, 60 Hz, 600:120/208V, Impedance 1.5 -3%, delta-wye grounded
 - .3 Voltage taps standard +/- 2½% and +/- 5%
 - .4 Insulation: Class H 220°C insulation
 - .5 Windings: copper
 - .6 Basic Impulse Level (BIL): standard
 - .7 Hi-pot: standard
 - .8 Average sound level: 50-55 dBA maximum
 - .9 Impedance at 170°C: standard
 - .10 Epoxy Potted
 - .11 Voltage Regulation to be 4% or better.
- .2 Transformer shall meet the energy efficiency per CAN/CSA-C802.2-12, Minimum Efficiency Values for Dry-Type Transformers.
- .3 Transformer shall be manufactured and tested (production tests) in accordance with CSA C9 (current issue) incorporating modifications as specified herein.
- .4 Dry type transformer shall be as manufactured by Schneider Group, Cutler Hammer, CGE, Rex, Hammond, Delta, Tracon or approved equal.

2.3 EQUIPMENT IDENTIFICATION

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

2.4 WARRANTY

- .1 Manufacturer shall warrant equipment free from defects in materials and workmanship for the lessor of one year from the date of installation or 18 months from the date of purchase.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for transformers installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Transformers 75kVA and smaller may be wall mounted. Seismic restraint and structural support information shall be provided to the Departmental Representative when requested. Provide vibration isolation hangers to prevent transmission to building structure. Transformer to be installed to ensure adequate air circulation is available on all four sides.
- .2 Mount dry type transformers above 75 kVA on floor.
- .3 Ensure adequate clearance around transformer for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 Adjust primary taps as necessary to produce rated secondary voltage at no-load.
- .9 Wire one set of contacts on winding temperature detector relay to sound alarm, wire second set of contacts to trip transformer circuit interrupter.
- .10 Wire alarm contacts on winding temperature indicator to sound alarm when excessive temperature reached.

- .11 Use torque wrench to adjust internal connections in accordance with manufacturers' recommended values.
- .12 Check transformer for dryness before putting it into service and if it has not been energized for some considerable time.
- .13 Energize transformers after installation is complete.
- .14 Make conduit entry into bottom 1/3 of transformer enclosure.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results- Electrical.
- .2 Energize transformers and apply incremental loads:
 - .1 0% for 4 hours.
 - .2 10% for next 1 hour.
 - .3 25% for next 2 hours.
 - .4 50% for next 3 hours.
 - .5 Full load.
 - .6 At each load change, check temperatures ambient, ventilating air and winding.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 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.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by dry type transformers installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No.29-11, Panelboards and Enclosed Panelboards.

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 panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.

Part 2 Products

2.1 RATING

- .1 MDC-Gulf: Outdoor (non-walk-in) 600/347V, 800A, 3 phase, 4wire, 60 Hz, minimum short circuit capacity 22kA (rms symmetrical).
- .2 Voltage rating shall be as indicated on the drawings. The entire assembly shall be suitable for 600 volts maximum ac service.
- .3 The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of 22,000 amperes symmetrical at rated voltage as shown on the drawings.

- .4 The bus system shall have a minimum ANSI short-circuit withstand rating of 22,000 amperes symmetrical tested in accordance with ANSI C37.20.1 and UL1558.
- .5 All circuit breakers shall have a minimum symmetrical interrupting capacity of 22,000 amperes. To ensure a fully selective system, all circuit breakers shall have 30 cycle short-time withstand ratings equal to their symmetrical interrupting ratings through 22,000 amperes, regardless of whether equipped with instantaneous trip protection or not.
- .6 All ratings shall be tested to the requirements of CSA C22.2 No.31. witnessed and approved.

2.2 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 Bus and breakers rated for 22 KA symmetrical, minimum, interrupting capacity or as indicated.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Minimum of 2 flush locks for each panel board.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper bus with neutral of double ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked enamel air dried enamel as per colour schedule.
- .11 Isolated ground bus.
- .12 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.

2.3 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 All breakers to be bolt on type, moulded case, non-adjustable and non-interchangeable trip, single, two and three pole, 120/208(240) V or 347/600V and with trip free position separate from "On" or "Off" positions.
- .4 Two and three pole breakers to have common simultaneous trip and able to be located in any circuit position within the panelboard. Minimum interrupting rating of breakers to be as follows:

- .1 347/600V panelboards - 22,000 Amps at 347 volts.
- .2 120/208V panelboards - 10,000 Amps at 240 volts.
- .5 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .6 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.
- .7 Provide circuit breakers with indicated trip ratings as per electrical drawings.
- .8 Lock-on devices for receptacles circuits.

2.4 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 5 (2 line) engraved as indicated and include panel designation and voltage/phase.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten card(s) located in slide-in plastic pocket(s) fixed to the back of the related door. Directory card to indicate the panel designation, mains size, voltage/phase and the location and load controlled of each circuit. Include a "letter sized" paper copy of each directory in the project maintenance manual.
- .5 Provide a plasticized typewritten information card fixed to the back of each panel door. Information card to indicate the panel designation and location, feeder type and size and locations of any controlling contactors and feeder pullboxes. Include a "letter sized" paper copy of each information card in the project maintenance manual.

2.5 STANDARD OF ACCEPTANCE

- .1 Siemens Canada.
- .2 Schneider Electric.
- .3 Eaton Cutler Hammer.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Where panels of different systems (i.e. Standard and Vital Power) supply a common patient care area, ground busses in panels to be interconnect with a minimum #6 AWG ground conductor.

3.3 CLEANING

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

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by panelboards installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Coordinate and install BC Hydro meter socket enclosure with BC Hydro and the Departmental Representative.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CAN/CSA C22.2 No.94.1-07, Enclosures for Electrical Equipment, Non Environment Considerations.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA 250-2008, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .3 The Munsell System of Colour Notation
- .4 BC Hydro ES-54 Underground-Civil-Manual-2016

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 dry location off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect electrical cabinets and enclosures from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MDC ENCLOSURES

- .1 Provide MDC enclosures complete with all components including transformers, as specified and indicated on electrical drawings.
- .2 Internal components include transformer, panel, breakers, receptacles, luminaires, all fittings and connections.
- .3 Main incoming section to contain:
 - .1 BC Hydro utility wireway and metering system as per BC Hydro ES-54 standards.
 - .2 Insulated case power circuit breaker Moulded case circuit breaker sized as indicated.
 - .3 Digital metering system to Section 26 09 23.01 - Metering and Switchboard Instruments.
 - .4 Provision for electrical power supply authority metering.
- .4 Distribution sections to contain:
 - .1 Air circuit breakers or Moulded case circuit breaker sized as indicated.
 - .2 Copper bus, from main section to distribution sections including vertical bussing.
- .5 Blanked off spaces with bus stabs and hardware for mounting future units.
- .6 Metal enclosed, free standing, floor mounted, dead front, outdoor, non-walk-in, CSA Type NEMA 3R Enclosure 1 cubicle unit.
- .7 Ventilating louvres: vermin, insect rain proof with easily replaceable fibre glass filters.
- .8 Access from rear to be bolted. Doors, c/w neoprene gaskets and three point latches.
- .9 Steel channel sills for base mounting in single length common to multi-cubicle switchboard.
- .10 Provision for future extension on both sides.
- .11 Space heaters: 120 V, 300 W, 60 Hz, single phase, complete with thermostat and breaker.
- .12 Receptacle: 120 V, single phase, 60 Hz, quadruple, U-ground, in each cubicle.
- .13 Lighting in each cubicle, as per Section 26 50 00 Lighting.

2.2 MATERIALS

- .1 MDC-Gulf enclosure constructed with 2.7 mm thick minimum steel, with weather and corrosion resistant finish to NEMA 3R CAN/CSA C22.2, Munsell Notation 7.5GY3.5/1.5, size as indicated.
- .2 Entire enclosure to be capable of withstanding maximum impact force of 86 MN/m² area without rupture of material.
- .3 Removable enclosure panels with formed edges, galvanized steel external fasteners removable only from inside enclosure.

- .4 Equip enclosure with hot dipped galvanized mounting rails 1.3 m adjustable horizontally and vertically to enable mounting of equipment at any location within housing.
 - .1 Rails: 14 mm holes and 50 x 14 mm slots on 100 mm centres for horizontal adjustment.
 - .2 Holes in side panel flanges in 60 mm increments for vertical adjustment.
- .5 Cover: tamperproof, bolt-on, domed to shed water.
- .6 Ventilation panel constructed to allow air circulation yet preventing entry of foreign objects, wild life, and vermin.
- .7 Enclosure construction such as to allow configuration of single or ganged enclosures.
- .8 CSA approved.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for electrical cabinet and enclosure installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Assemble enclosure in accordance with manufacturer's instructions and securely mount on building structure with channels, supports and fastenings.
- .2 Mount equipment in enclosure.
- .3 Label electrical cabinets and enclosure to Section 26 05 00 - Common Work Results for Electrical.

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

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1-00 (R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55-M1986 (R2008), Special Use Switches.
 - .4 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20).
- .2 BC Hydro ES-54 Underground-Civil-Manual-2016

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

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

- .1 20 A, 120 V, 347 V, single pole, double pole, three-way, four-way switches to: CSA C22.2 No.111, CSA C22.2 No.55.
 - .1 Switches shall be industrial weatherproof neoprene pres-switch.
 - .2 Switches of one manufacturer throughout project.
 - .3 Provide 3 way switches/dimmers/occupancy sensors as required and as shown.

.4 Manufactures: Pass & Seymour, Hubbell

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15R, 125 V, 15 A, U ground, white industrial grade.
- .2 T-Slot duplex receptacles, CSA type 5-20R, 125 V, 20 A, U ground, white industrial grade.
- .3 Use tamper resistant receptacles where required by Code and as indicated.
- .4 Receptacles of one manufacturer throughout project.
- .5 Standard of acceptance:
 - .1 LEVITON
 - .2 HUBBELL
 - .3 PASS & SEYMOR, or approved equal by the Departmental Representative.
- .6 Other receptacles with ampacity and voltage as indicated.
- .7 Receptacles of one manufacturer throughout project.

2.3 RECEPTACLES – PARTICULAR APPLICATION

- .1 Ground Fault Interrupter type to be 15 Amp, 125 volt duplex receptacles to be 2 pole, 3 wire, U ground, impact resistant nylon face, complete with breaker and reset button. white commercial grade.
- .2 Ground Fault Interrupter located outside shall come with wet location cover plates.
- .3 Use tamper resistant receptacles where required by Code and as indicated.
- .4 Receptacles of one manufacture throughout project.
- .5 Standard of Acceptance:
 - .1 Leviton 7899 series indoors
 - .2 Leviton W7899 series outdoors
- .6 Alternate Manufactures: Pass & Seymour, Hubbell
- .7 Surge Protective type to be T slot 5-20R, 125 volt duplex receptacles to be 2 pole, 3 wire hospital grade, blue face, parallel blade, U ground, impact resistant nylon face audible and LED indicator.
- .8 Standard of Acceptance:
 - .1 Leviton 7380-IGG (type 3)
- .9 Alternate Manufacture: Pass & Seymour, Hubbell.
- .10 All other single outlet and special purpose receptacles to be similar to the grade and series indicated above. Confirm ampacity, voltage and pin configuration prior to installation.

2.4 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.

- .2 Cover plates for devices shall be stainless steel.
- .3 Wall plates to be flush mounting with "positive bow" feature to ensure that all edges of plate are flush with wall or surface box when installed.
- .4 All plates to be bevelled type with smooth rolled outer edge and smooth face. Exposed sharp edges are not acceptable.
- .5 Cover plates for all wiring devices to be from one manufacturer throughout project.

2.5 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
- .2 Mount wiring devices to height specified in Section 26 05 00 or as indicated.
- .3 Upper edge of plates located on separate outlets immediately alongside one another to be at exactly the same height above finished floor.
- .4 All plates to be installed parallel or perpendicular to building lines.

3.2 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height as indicated in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height as indicated in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFI type receptacles as indicated.
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

- .3 Provide wet location cover plates which provide a seal whether or not a plug is inserted into the receptacle.

3.3 CLEANING

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

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International).
 - .1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.3 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 interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage with ampacity of 100A and over.
- .4 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 3 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
 - .1 Production certificate of origin must be submitted to Departmental Representative for approval.
 - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.
 - .4 Production certificate of origin must contain:
 - .1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
 - .2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.
 - .3 Contractor's name and address and person responsible for project.

- .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
- .5 Name and address of building where circuit breakers will be installed:
 - .1 Project title
 - .2 End user's reference number
 - .3 List of circuit breakers

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions 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 circuit breakers in dry location indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect circuit breakers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters to CSA C22.2 No. 5.
- .2 All breakers shall be for application in their intended enclosures for 100% of their continuous ampere rating.
- .3 Breakers shall be provided in drawout configuration. All breaker cell sizes shall have a common height and depth. Breaker frames of the same size shall be fully interchangeable.
- .4 Breakers shall be manually operated unless electrically operated is indicated on the drawings.
- .5 The power circuit breaker shall have three windows in the front cover to clearly indicate any electrical accessories that are mounted in the breaker. The accessory shall have a label that will indicate its function and voltage. The accessories shall be plug and lock type and UL listed for easy field installation. They shall be modular in design and shall be common to all frame sizes and ratings.
- .6 The breaker control interface shall have color-coded visual indicators to indicate contact open or closed positions, as well as mechanism charged and discharged positions. Manual control pushbuttons on the breaker face shall be provided for opening and closing the breaker. The power circuit breaker shall have a "Positive On" feature. The breaker flag will read "Closed" if the contacts are welded and the breaker is tripped or opened.
- .7 The current sensors shall have a back-cover window that will permit viewing the sensor rating on the back of the breaker. A rating plug will offer indication of the rating on the

front of the trip unit. The current sensor and rating plug shall be of the same current rating.

- .8 A position indicator shall be located on the faceplate of the breaker. This indicator shall provide color indication of the breaker position in the cell. These positions shall be Connect (Red), Test (Yellow), and Disconnect (Green). The levering door shall be interlocked so that when the breaker is in the closed position, the breaker levering-in door shall not open.
- .9 Each power circuit breaker cell shall offer sixty (60) front-mounted dedicated secondary wiring points. Each wiring point shall have finger safe contacts, which will accommodate #10 AWG maximum field connections with ring tongue, spade terminals or bare wire.
- .10 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient
- .11 Common-trip breakers: with single handle for multi-pole applications.
- .12 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .13 Circuit breakers with interchangeable trips as indicated.
- .14 Circuit breakers to have minimum **10kAIR** symmetrical RMS interrupting capacity rating at **208V** and **22kAIR** at **600 V**.

2.2 THERMAL MAGNETIC BREAKERS

- .1 MDC-Gulf shall have thermal magnetic breakers:
 - .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.
 - .2 All thermal magnetic breakers shall be reviewed and accepted by the Departmental Representative prior to purchase.

2.3 OPTIONAL FEATURES

- .1 Include:
 - .1 On-off locking device.
 - .2 Handle mechanism.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.

3.2 INSTALLATION

- .1 Install circuit breakers as indicated.

3.3 CLEANING

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

- .1 SPEC NOTE: Edit the following paragraphs for this specific project.
- .2 CAN/CSA C22.1-09, Canadian Electrical Code, Part I.
- .3 CAN/CSA C22.2 No.9.0, General Requirements for Luminaires.
- .4 IESNA Illuminating Engineering Society of North America - Lighting Handbook - 10th Edition
- .5 ASHRAE 90.1-10-2016 – American Society of Heating, Refrigerating and Air-Conditioning Engineers.
- .6 Underwriters' Laboratories of Canada (ULC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit complete photometric and heat dissipation data prepared by independent testing laboratory for proposed luminaires.

1.4 INTENT

- .1 Provide CSA labelled LED lighting fixtures and accessories for MDC-Gulf.
- .2 Lighting fixtures shall be structurally well designed and constructed, using new parts and materials of the highest commercial grade available.
- .3 Bond all lighting equipment to grounding system.
- .4 Verify all ceiling types and finishes before ordering fixtures and provide fixtures suitable for mounting in or on ceilings being installed in each area, as specified. Where fixture types specified are not suitable for ceiling being installed, obtain written instructions from the Departmental Representative before ordering fixtures.
- .5 Fixtures of the same or similar type shall be supplied by the same manufacturer.
- .6 Electrical contractor shall supply and install all luminaires complete with lamps, mounting brackets, lenses, ballasts (dimming or otherwise), drivers and all necessary accessories in accordance with enclosure manufacturer's recommendations and all codes and standards.

1.5 DELIVERY, STORAGE AND HANDLING

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

- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 LED DRIVERS

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

2.2 FINISHES

- .1 Light fixture finish and construction to meet all code and standard listings and CSA certifications related to intended installation.

2.3 LUMINAIRES

- .1 All fixtures shall comply with CSA Standard C22.2 No.9. Accessories and components shall comply with relevant CSA Standards applicable to accessory or components.
- .2 Provide minimum 3 LED vapour seal luminaires for MDC-Gulf as per electrical drawings. LED luminaires shall have appropriate occupancy sensors as per IESNA. Coordinate and obtain approval of all lighting system equipment with the Departmental Representative prior to purchase.
- .3 LED luminaires shall be as specified below:
 - .1 CSA labelled, rated for 120 Volts
 - .2 Vaporite LED:
 - .1 30W 4', 120V, 3500k, 4000 Nominal Lumens
 - .2 L90 at 60,000 hours.
 - .3 Tamper Resistant
 - .4 Polycarbonate lens sealed
 - .5 Operating temperature of -40°C to 35°C
 - .3 Grounding: green ground wire to grounding screw at fixtures.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Provide complete and proper support for all fixtures, fixture hangers, etc., including headers in ceiling space, where required, for proper support of outlet boxes and fixture hanger assemblies.

- .3 All hangers, supports, fastenings or accessory fittings shall be protected against corrosion. Care shall be taken during the installation to assure that insulation and corrosion protection is not damaged.
- .4 Wiring from outlet boxes to fixtures and wiring through fixture channels shall be rated for 90 degrees C.
- .5 All recessed fixtures to be installed so that they are removable from below to gain access to outlet box or prewired fixture box. Connect all recessed fixtures to boxes with flexible conduit and approved fixture wire. Volume of enclosure to comply with Electrical Code.
- .6 Install fixture lenses as late as possible to protect from dirt and dust. Remove and clean or replace lenses to the satisfaction of the Departmental Representative.
- .7 Provide and install all conduit, boxes, wire. Obtain all specialty backboxes, switches, controllers, etc. from contractor and coordinate installation as required.

3.2 WIRING

- .1 Connect luminaires to lighting circuits:
 - .1 Install rigid conduit for luminaires as indicated.

3.3 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 MEASUREMENT PROCEDURES

- .1 Excavated materials will be measured in cubic metres in their original location.
 - .1 Unclassified excavation quantities measured will be actual volume removed within following limits:
 - .1 Width for trench excavation as indicated.
 - .2 Width for excavation for structures as indicated.
 - .3 Depth from ground elevation surface of pavement immediately prior to excavation, to elevation as indicated by Departmental Representative.
 - .2 Rock quantities measured will be actual volume removed within following limits:
 - .1 Width for trench excavation as indicated.
 - .2 Width for excavation for structures to be bounded by vertical planes up to 500 mm outside of and parallel to neat lines of footings as indicated.
 - .3 Depth from rock surface elevations immediately prior to excavation, to elevation as indicated.
 - .4 Where design elevation is less than 300 mm below original rock surface, depth will be considered to be 300 mm below original rock surface.
 - .5 Volume of individual boulders and rock fragments will be determined by measuring three maximum mutually perpendicular dimensions.
- .2 Sheeting and bracing left in place on direction of Departmental Representative will be measured in square metres of surface area of plane surface of sheeting.
- .3 Shoring, bracing, cofferdams, underpinning and de-watering of excavation will not be measured separately for payment.
- .4 Backfilling to authorized excavation limits will be measured in cubic metres compacted in place for each type of material specified.
- .5 Placing and spreading of topsoil will be measured for payment in cubic metres calculated from cross sections taken in area of excavation from original location.
 - .1 If double handling of topsoil is directed by Departmental Representative (stockpiling and later placing), then quantities will be measured twice; on excavation from original location and on excavation from stockpile.

1.3 REFERENCE STANDARDS

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C117-04, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136-05, Standard Test Method for Sieve Analysis of Fine and

Coarse Aggregates.

- .3 ASTM D422-632002, Standard Test Method for Particle-Size Analysis of Soils.
- .4 ASTM D698-00ae1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN- m/m³).
- .5 ASTM D1557-02e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2,700 kN- m/m³).
- .6 ASTM D4318-05, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CANGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.
 - .2 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .4 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.4 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
 - .1 Rock: solid material in excess of 1.00 m; and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 to 1.15 m; bucket. Frozen material not classified as rock.
 - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- .3 Topsoil:
 - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimeters in any dimension.
- .4 Waste material: excavated material unsuitable for use in Work or surplus to requirements.

- .5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .6 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .7 Unsuitable materials:
 - .1 Weak, chemically unstable, and compressible materials.
 - .2 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422 and ASTM C136: Sieve sizes to CAN/CGSB-8.1 CAN/CGSB-8.2.
 - .2 Table:

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45 - 100
0.02 mm	10 - 80
0.005 mm	0 - 45
 - .3 Coarse grained soils containing more than 20 % by mass passing 0.075 mm sieve.
- .8 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality Control:
 - .1 Submit condition survey of existing conditions as described in EXISTING CONDITIONS article of this Section.
 - .2 Submit for review by Departmental Representative proposed dewatering heave prevention methods as described in PART 3 of this Section.
 - .3 Submit to Departmental Representative written notice at least 7 days prior to excavation work, to ensure cross sections are taken.
 - .4 Submit to Departmental Representative written notice when bottom of excavation is reached.
 - .5 Submit to Departmental Representative testing inspection results report as described in PART 3 of this Section.
- .3 Preconstruction Submittals:
 - .1 Submit construction equipment list for major equipment to be used in this section prior to start of Work.
 - .2 Submit records of underground utility locates, indicating: location plan of existing utilities as found in field.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

1.6 QUALITY ASSURANCE

- .1 Qualification Statement: submit proof of insurance coverage for professional liability.
- .2 Submit design and supporting data at least 2 weeks prior to beginning Work.
- .3 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of British Columbia, Canada.
- .4 Keep design and supporting data on site.
- .5 Engage services of qualified professional Engineer who is registered or licensed in Province British Columbia, Canada in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.
- .6 Do not use soil material until written report of soil test results are reviewed and approved by Departmental Representative.
- .7 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.7 WASTE MANAGEMENT AND DISPOSAL

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

1.8 EXISTING CONDITIONS

- .1 Buried services
 - .1 Before commencing work verify location of buried services on and adjacent to site.
 - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
 - .3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.
 - .4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .5 Prior to beginning excavation Work, notify applicable Departmental Representative establish location and state of use of buried utilities and structures. Clearly mark such locations to prevent disturbance during Work.
 - .6 Confirm locations of buried utilities by careful test excavations or soil hydrovac methods.
 - .7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
 - .8 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing or re-routing.
 - .9 Record location of maintained, re-routed and abandoned underground lines.

- .10 Confirm locations of recent excavations adjacent to area of excavation.
- .2 Existing buildings and surface features:
 - .1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
 - .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.
 - .3 Where required for excavation, cut roots or branches as directed by Departmental Representative.

Part 2 Products

2.1 MATERIALS

- .1 Type 1 and Type 2 fill: properties in accordance with the following requirements:

- .1 Crushed, pit run or screened stone, gravel or sand.
- .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1 CAN/CGSB-8.2.

- .3 Table:

Sieve Designation	% Passing	
	Type 1	Type 2
75 mm	-	100
50 mm	-	-
37.5 mm	-	-
25 mm	100	-
19 mm	75-100	-
12.5 mm	-	-
9.5 mm	50-100	-
4.75 mm	30-70	22-85
2.00 mm	20-45	-
0.425 mm	10-25	5-30
0.180 mm	-	-
0.075 mm	3-8	0-10

- .2 Type 3 fill: selected material from excavation or other sources, approved by Departmental Representative for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.
- .3 Unshrinkable fill: proportioned and mixed to provide:
 - .1 Maximum compressive strength of 0.4 MPa at 28 days.
 - .2 Maximum cement content of 25 kg/m; to CSA-A3001, Type GU.
 - .3 Minimum strength of 0.07MPa at 24 h.
 - .4 Concrete aggregates: to CSA-A23.1/A23.2.
 - .5 Cement: Type GU.

.6 Slump: 160 to 200 mm.

- .4 Shearmat: honeycomb type bio-degradable cardboard 100 mm thick, treated to provide sufficient structural support for poured concrete until concrete cured.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control drawings, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.3 PREPARATION/PROTECTION

- .1 Protect existing features in accordance with applicable local regulations.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .5 Protect buried services that are required to remain undisturbed.

3.4 STRIPPING OF TOPSOIL

- .1 Begin topsoil stripping of areas as indicated after area has been cleared of brush, weeds, grasses and removed from site.
- .2 Strip topsoil to depths as indicated.
- .1 Do not mix topsoil with subsoil.
- .3 Stockpile in locations as directed by Departmental Representative.
- .1 Stockpile height not to exceed 2 m and should be protected from erosion.
- .4 Dispose of unused topsoil as directed by Departmental Representative.

3.5 STOCKPILING

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

3.6 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Section 01 35 33 - Health and Safety Requirements and WorkSafe BC.
 - .1 Where conditions are unstable, Departmental Representative to verify and advise methods.
- .2 Obtain permit from authority having jurisdiction for temporary diversion of water course.
- .3 Construct temporary Works to depths, heights and locations as indicated by Departmental Representative.
- .4 During backfill operation:
 - .1 Unless otherwise indicated or directed by Departmental Representative, remove sheeting and shoring from excavations.
 - .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
 - .3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500 mm above toe of sheeting.
- .5 When sheeting is required to remain in place, cut off tops at elevations as indicated.
- .6 Upon completion of substructure construction:
 - .1 Remove cofferdams, shoring and bracing.
 - .2 Remove excess materials from site and restore watercourses as directed by Departmental Representative.

3.7 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
- .2 Provide for Departmental Representative review details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
- .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
 - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .4 Protect open excavations against flooding and damage due to surface run-off.
- .5 Dispose of water as directed by Departmental Representative to approved runoff areas and in manner not detrimental to public and private property, or portion of Work

completed or under construction.

- .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.
- .6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

3.8 EXCAVATION

- .1 Advise Departmental Representative at least 7 days in advance of excavation operations. Excavate to lines, grades, elevations and dimensions as indicated.
- .2 Remove concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation offsite.
- .3 Excavation must not interfere with bearing capacity of adjacent foundations.
- .4 Do not disturb soil within branch spread of trees or shrubs that are to remain.
 - .1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .5 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations. No more than 5 m of trench may be exposed at end of day's operation and must be securely covered. Road plates are to be used to cover exposed excavations in areas of vehicular travel.
- .6 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.
- .7 Restrict vehicle operations directly adjacent to open trenches.
- .8 Dispose of surplus and unsuitable excavated material in approved location on site.
- .9 Do not obstruct flow of surface drainage or natural watercourses.
- .10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .11 Notify Departmental Representative when bottom of excavation is reached.
- .12 Obtain Departmental Representative approval of completed excavation.
- .13 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.
- .14 Correct unauthorized over-excavation as follows:
 - .1 Fill under bearing surfaces and footings with concrete specified for footings Type 2 fill compacted to not less than 100% of corrected Standard Proctor maximum dry density.
 - .2 Fill under other areas with Type 2 fill compacted to not less than 95 % of corrected Standard Proctor maximum dry density.
- .15 Hand trim, make firm and remove loose material and debris from excavations.

- .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
- .2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.

3.9 FILL TYPES AND COMPACTION

- .1 Use types of fill as indicated or specified below. Compaction densities are percentages of maximum densities obtained from ASTM D698 ASTM D1557.
 - .1 Exterior side of perimeter walls: use Type 3 fill to subgrade level. Compact to 95% of corrected maximum dry density.
 - .2 Within building area: use Type 2 to underside of base course for floor slabs. Compact to 100 % of corrected maximum dry density.
 - .3 Under concrete slabs: provide 150 mm compacted thickness base course of Type 1 fill topped with shearmat filler as indicated to underside of slab. Compact base course to 10 %.
 - .4 Retaining walls: use Type 2 fill to subgrade level on high side for minimum 500 mm from wall and compact to 95 %. For remaining portion, use Type 3 fill compacted to 95 %.
 - .5 Place unshrinkable fill in areas as indicated.

3.10 BEDDING AND SURROUND OF UNDERGROUND SERVICES

- .1 Place and compact granular material for bedding and surround of underground services as indicated.
- .2 Place bedding and surround material in unfrozen condition.

3.11 BACKFILLING

- .1 Do not proceed with backfilling operations until completion of following:
 - .1 Departmental Representative has inspected and approved installations.
 - .2 Departmental Representative has inspected and approved of construction below finish grade.
 - .3 Inspection, testing, approval, and recording location of underground utilities.
 - .4 Removal of concrete formwork.
 - .5 Removal of shoring and bracing, backfilling of voids with satisfactory soil material.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Place backfill material in uniform layers not exceeding 300 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .5 Backfilling around installations:
 - .1 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.

- .2 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 0.150m.
- .3 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
 - .1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Departmental Representative.
- .6 Place unshrinkable fill in areas as indicated.
- .7 Consolidate and level unshrinkable fill with internal vibrators.
- .8 Install drainage system in backfill as indicated.

3.12 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris in accordance to Section 01 74 19 - Waste Management and Disposal, trim slopes, and correct defects as directed by Departmental Representative.
- .2 Replace topsoil as indicated.
- .3 Reinstate lawns to elevation which existed before excavation.
- .4 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .5 Clean and reinstate areas affected by Work as directed by Departmental Representative.
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 BC Hydro ES54-Underground-Civil-Manual-2016.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM A82/A82M-05a, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - .2 ASTM A185/A185M-05a, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .3 ASTM C139-05, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
 - .4 ASTM C 478/C478M-06, Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - .5 ASTM D1056-00, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- .2 CSA Group (CSA)
 - .1 CAN/CSA-A3000-03 (R2005), Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.
 - .2 CSA A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .3 CAN/CSA-G30.18-M92 (R2002), Billet-Steel Bars for Concrete Reinforcement.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies WHMIS SDS - Safety Data Sheets.
- .3 Shop Drawings:
 - .1 Submit shop drawings for precast manholes.

- .2 Test reports: submit certified test reports for specified materials from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 PVC DUCTS

- .1 PVC ducts, type EB1, encased in reinforced concrete.

2.2 PVC DUCT FITTINGS

- .1 Rigid PVC translucent pushfit type couplings, bell end fittings, plugs, caps, adaptors as required to make complete installation.
- .2 Expansion joints.
- .3 Rigid PVC 5 degree angle couplings.

2.3 MANHOLES

- .1 Provide type indicated.
- .2 Top, walls, and bottom: reinforced concrete.
- .3 Walls and bottom: monolithic concrete construction.
- .4 Locate duct entrances and windows near corners of structures to facilitate cable racking.
- .5 Covers: fit frames without play.
- .6 Form steel and iron to shape and size with sharp lines and angles.
- .7 Castings: warp and blow hole free.
- .8 Exposed metal: smooth finish without sharp lines and arises.
- .9 Provide lugs, rabbets, and brackets.
- .10 Set pulling-in irons and other built-in items in place before depositing concrete.
- .11 Install pulling-in iron in wall opposite each duct line entrance.
- .12 Cable racks, including rack arms and insulators: sized to accommodate cable.

2.4 PRECAST CONCRETE MANHOLES

- .1 Precast concrete manholes and auxiliary sections fabricated in steel forms.
- .2 Aggregates: to CSA A23.1/A23.2.
- .3 Cement: CAN/CSA-A3001, Type GU.
- .4 Steel welded wire fabric mesh reinforcing: to ASTM A82/A82M.
- .5 Neoprene gasket seals between manhole sections: to ASTM D1056.
- .6 Size: 762 mm clear diameter.
- .7 Precast Concrete Manholes: to ASTM C478/C478M.
 - .1 Manhole step and ladder rung spacing: 405.

2.5 CAST-IN-PLACE CONCRETE MANHOLES

- .1 Smooth trowel finish for floors and horizontal surfaces.
- .2 Construct walls on cast-in-place concrete footing except that precast concrete base sections are used for precast concrete manhole risers.

2.6 DRAINAGE

- .1 Floor drain fittings: consisting of floor drain, back water valve, trap and pipe connection to drainage system.
- .2 Storm sewer connection: cast iron service saddle consisting of oil resistant gasket, stainless steel clamp and oil resistant O ring.
- .3 Sump pit: 300 x 300 x 125 mm.

2.7 MANHOLE NECKS

- .1 Concrete brick and mortar.

2.8 MANHOLE FRAMES AND COVERS

- .1 Cast iron manhole frames and covers.
- .2 Bolted on covers to prevent unauthorized entry.
- .3 Size: 762 mm clear diameter.

2.9 CABLE RACKS

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

2.10 CABLE PULLING EQUIPMENT

- .1 Pulling iron: galvanized steel rods, size and shape as indicated.
- .2 Pull rope: 6 mm stranded polypropylene, tensile strength 5 kN, continuous throughout each duct run with 3 m spare rope at each end.

2.11 MARKERS

- .1 Concrete type cable markers: 600 x 600 x 100 mm, with words: "Cable", "Joint", "Conduit" impressed in top surface, with arrows to indicate change in direction of duct runs.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION GENERAL

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

- .2 Remove weights or wood braces before concrete has set and fill voids.
- .15 Clean ducts before laying:
 - .1 Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.
- .16 Duct cleaning:
 - .1 Pull 300 mm long x diameter 6 mm less than internal diameter of duct steel mandrel through each duct, immediately after placing of concrete.
 - .2 Then pull stiff bristle brush through duct; avoid disturbing or damaging ducts where concrete has not set completely.
 - .3 Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .17 Install four 3 m lengths of 10M reinforcing rods, one in each corner of duct bank when connecting duct to manholes or buildings.
 - .1 Wire rods to 10M dowels at manhole or building and support from duct spacers.
 - .2 Protect existing cables and equipment when breaking into existing manholes.
 - .3 Place concrete down sides of duct bank filling space under and around ducts.
 - .4 Rod concrete with flat bar between vertical rows filling voids.
- .18 Install pull rope continuous throughout each duct run with 3 m spare rope at each end.

3.3 MANHOLES

- .1 Build cast-in-place manholes.
- .2 Install precast manholes.
- .3 Concrete Placement:
 - .1 Place concrete in two lifts with slab and sump in first, walls, roof and neck in second lift.
 - .2 Provide key in walls to slab.
 - .3 Place 100 x 6 mm PVC water bar vertically in key.
 - .4 Install ground rod before placing slab and place reinforcing steel, inserts for cable rack, pulling irons, drain, duct outlets, duct run dowels before casting walls. Make manhole to duct connection as indicated.
- .4 Provide 115 mm deep window to facilitate cable bends in wall at each duct connection.
 - .1 Terminate ducts in bell-end fitting flush with window face.
 - .2 Provide four 10M steel dowels at each duct run connection to anchor duct run.
 - .3 On runs of 16 ducts and over, support concrete duct encasement on a 700 mm thick concrete pier poured against manhole wall between slab and bottom of duct run, provide dowels for anchoring.
- .5 Alternately connect large duct runs by leaving square opening in wall, later pouring duct run and wall opening in one pour, and install 10M x 3m reinforcing rods in duct run at manhole connection.
- .6 Build up concrete manhole neck to bring cover flush with finished grade in paved areas and 40 mm above grade in unpaved areas.

- .7 Install manhole frames and covers for each manhole:
 - .1 Set frames in concrete grout onto manhole neck.
- .8 Drain floor towards sump with 1 to 48 slope minimum and install drainage fittings as indicated.
- .9 Install cable racks, anchor bolts and pulling irons as indicated.
- .10 Grout frames of manholes:
 - .1 Cement grout to consist of two parts sand and one part cement and sufficient water to form a plastic slurry.
- .11 Ensure filling of voids in joint being sealed.
 - .1 Plaster with cement grout, walls, ceiling and neck.
- .12 Spray paint "X" on ceiling of manhole above floor drain or sump pit.

3.4 MARKERS

- .1 Mark location of duct runs under hard surfaced areas not terminating in manhole with railway spike driven flush in edge of pavement, directly over run.
 - .1 Place concrete duct marker at ends of such duct runs.
 - .2 Construct markers and install flush with grade.
- .2 Mark ducts every 150 m along straight runs and changes in direction.
- .3 Where markers are removed to permit installation of additional duct, reinstall existing markers.
- .4 Lay concrete markers flat and centered over duct with top 25 mm above earth surface.
- .5 Submit drawings showing locations of markers.

3.5 FIELD QUALITY CONTROL

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

3.6 CLEANING

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 PVC DUCTS AND FITTINGS

- .1 Rigid PVC duct: Type DB2/ES2, with moulded/fabricated fittings, for direct burial expanded flange ends, Trade size 6.
 - .1 Nominal length: 3 m plus or minus 12 mm.
- .2 Rigid PVC split ducts.
- .3 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make a complete installation.
- .4 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 5 kN.

2.4 MARKERS

- .1 Concrete type cable markers: as indicated, with words: "Cable", "Joint" or "Conduit" impressed in top surface, with arrows to indicate change in direction of duct runs.

- .2 Cedar post type markers: 89 x 89 mm square, 1.5 m long, pressure treated with coloured or copper naphthenate or 5% pentachlorophenol solution, water repellent preservative, with nameplate fastened near post top, on side facing duct.
 - .1 Nameplate: aluminum anodized 89 x 125 mm, 1.5 mm thick mounted on cedar post with mylar label 0.125 mm thick with words "Cable" "Joint" or "Conduit" with arrows to indicate change in direction.

2.5 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 steel 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 the Departmental Representative 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.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA A23.1-04 /A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Perform Work to comply with applicable Provincial regulations.
 - .2 Co-ordinate and meet requirements of power supply authority.
 - .1 Ensure availability of power when required.
- .2 Certificates: submit certificates signed by manufacturer certifying materials comply with specified performance characteristics and physical properties.

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 MATERIALS

- .1 Underground ducts: rigid type DB2, size as indicated.
- .2 Rigid steel galvanized conduit and fittings: size as indicated.
- .3 Conductors: copper, size and number of conductors as indicated.

- .4 Meter socket: weatherproof, and approval of supply authority.
- .5 Concrete: to CSA A23.1/A23.2.
- .6 Backfill: clean and free of debris.
- .7 Pulling Iron:
 - .1 22 mm diameter hot dipped galvanized steel bar with exposed triangular shaped opening.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Install cables in trenches and in ducts conduit in accordance with Section 26 05 43.01 - Installation of Cables in Trenches and in Ducts.
- .2 Allow adequate conductor length for connection to supply by power supply authority.
- .3 Install metre socket and conduit.
- .4 Allow adequate conductor length for connection to service equipment.
- .5 Make grounding connections in accordance with Section 26 05 28 - Grounding - Secondary.
- .6 Install concrete encased ducts for electrical systems as indicated and in accordance with CSA A23.1.
- .7 Install pulling irons as required.
- .8 Seal ducts and conduits at building entrance location after installation of cable.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Perform additional tests if required by authority having jurisdiction.
- .2 Submit written test results to Departmental Representative for approval.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION