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SPECIFICATION

Project No. R.094408.001
Generator Replacement
Canadian Border Services Agency
Boissevain, Manitoba

Solicitation No.

PROJECT NO.
R.094408.001
CBSA Boissevain POE
Generator Replacement

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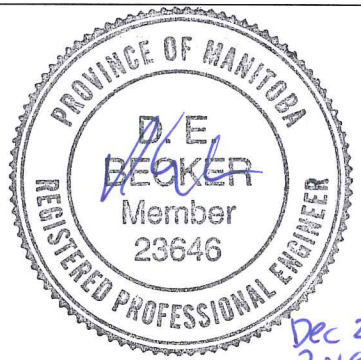
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DRAWINGS

Drawing Number	Rev.	Description
CBSA Boissevain POE Generator Replacement		
R.094408.001-ED01	00	Site Plan – Electrical Layout – Demolition
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R.094408.001-ED03	00	Basement Floor Plan – Electrical Layout – Demolition
R.094408.001-ED04	00	Main Floor Plan – Electrical Layout – Demolition
R.094408.001-ED05	00	Second Floor Plan – Electrical Layout – Demolition
R.094408.001-E01	00	Site Plan – Electrical Layout – New Work and Excavation
R.094408.001-E02	00	Electrical Single-Line – Diagram – New Work
R.094408.001-E03	00	Basement Floor Plan – Electrical Layout – New Work
R.094408.001-E04	00	Main Floor Plan – Electrical Layout – New Work
R.094408.001-E05	00	Second Floor Plan – Electrical Layout – New Work
R.094408.001-E06	00	Genset – Electrical Block – Diagram
R.094408.001-E07	00	Electrical Details
R.094408.001-S01	00	Site Plan – Generator Foundation – Bollard Detail – New Work
R.094408.001-S02	00	Site Plan – Junction Box Support Detail – Generator Room Repairs – New Work

APPENDICES:

(NOT APPLICABLE)

Discipline	Company Name, Address and Name of Professional	Professional Seal
Structural Engineer	SNC-Lavalin Inc. 148 Nature Park Way Winnipeg, Manitoba R3P 0X7 Engineer: Anthony Deger	
Electrical Engineer	SNC-Lavalin Inc. 148 Nature Park Way Winnipeg, Manitoba R3P 0X7 Engineer: David Becker	

END OF SECTION

Project: _____

Bidder: _____

SCHEDULE OF PRICES

<u>Item</u>	<u>Description</u>	<u>Price</u>
1.	Mobilization / Demobilization	\$ _____
2.	Demolition & Removals	\$ _____
3.	Structural / Civil Work	\$ _____
4.	Site Restoration	\$ _____
5.	Electrical Work	
5a.	CSTE & Service Conduit / Cabling	\$ _____
5b.	Genset & Conduit / Genset Cabling	\$ _____
5c.	Main Distribution / Main Breakers / Pullboxes	\$ _____
5d.	Panelboards	\$ _____
5f.	Transfer Switch	\$ _____
5g.	UPS	\$ _____
5h.	Load Bank Junction Box	\$ _____
5i.	Receptacles / Misc Wiring / Conduit	\$ _____
5j.	Commissioning	\$ _____
6.	Controls Work	
6a.	Controls Commissioning	\$ _____
7.	<u>As Builts and O & M manuals</u>	\$ _____
8.	<u>All Other Items</u>	\$ _____
9.	Total Materials and Labour (for complete project)	\$ _____
10.	Cost of Performance and Labour and Material Payment Bonds	\$ _____
11.	Total Bid (All Items)	\$ _____
12.	Goods and Services Tax (GST) (based on all items)	\$ _____

END OF SECTION

Part 1 General

1.1 OVERALL PROJECT REQUIREMENTS

- .1 The needs and goals of the project are outlined within the contract but are not limited to the goals and objectives indicated below. All items are the responsibility of the Contractor:
 - .1 The port of entry must remain operational during construction. Traffic flow shall remain un-impeded at all times during constructions. Position equipment and work crews in a manner to allow continued operations of the facility.
 - .2 The installation of a new standby diesel generator system.
 - .3 The installation of a new transfer switch.
 - .4 Customs building distribution equipment modifications will include the replacement of the existing main distribution panel.
 - .5 The installation of a new electrical service, complete with CSTE and with Manitoba Hydro approved metering provisions and metering cabinet.
 - .6 The addition of a new UPS to the Customs Building for powering of critical application network and computer loads.
 - .7 Removal of the existing Genset and associated equipment. Patching and filling of floors / chimney and walls. The Contractor shall turn over the genset, genset controls, and genset exhaust system to CBSA.
 - .8 Related outside, removal, restoration, lawn, sod, sidewalk, pavement, and foundations works.
 - .9 The objectives and expectations of the system functionality during facility occupancy and operations are as follows:
 - .1 Upon a Manitoba Hydro utility power outage, the genset will start and the transfer switch will open the utility power feed connection, and close in the connection to the genset to transfer power flow from the genset to the facility.
 - .2 Upon utility power restoration, the transfer switch will open the genset supply, and close in the Manitoba Hydro utility supply.
 - .3 The genset will enter a cool down mode and will shut down.
- .2 The observable, measurable, and quantifiable benchmark performance criteria will be the following:
 - .1 The ability of the genset to be tested under load without disruption to the existing facility power supply or operations.
 - .2 The ability of the genset to start upon power failure and transfer power to the main distribution panel (applicable when the genset is not being manually load tested).
 - .3 The ability of the transfer switch to supply power from either the genset or the normal Manitoba Hydro utility power supply.
- .3 The success criteria associated with the design, construction, delivery and close-out services, will be based on the following:
 - .1 Successful installation of the genset and transfer switch.
 - .2 Successful installation of a new electrical service.

- .3 Successful testing and operation of the genset and transfer switch.
- .4 Minimal disruptions to the existing facility, and strict adherence to the outage periods and schedule.
- .4 The Contractor shall ensure seamless integration of the new installation into the existing facility, with provision of equipment compatible with, and fully integrated with existing systems.
- .5 Other work, by other contractors will be ongoing. Coordinate and plan work in a manner to not impede on the work by other parties. Coordinate excavations and site work with other contractors.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- .1 The Work of this Contract includes, but is not limited to, the following:
 - .1 Contractor to obtain required security clearances for all personnel working on this project. Staff members who do not successfully obtain the required clearances may not perform any work or view documents pertaining to this project.
 - .2 Provide all materials, and perform all work indicated in the specifications and drawings.
 - .3 Complete and submit all approval forms in order to complete the work.
 - .4 Comply with the security and search requirements to enter the facility to perform work.
 - .5 Complete and pay for permit application to the Authority Having Jurisdiction (AHJ).
 - .6 Coordinate a new electrical service with MB Hydro. Ensure that any power outages are kept to the minimal possible duration.
 - .7 Abide by facility procedures and guidelines. Submit and complete facility permit application forms, including but not limited to:
 - .1 Tools list and permit.
 - .2 Camera permit (as required).
 - .3 Security clearance application forms.
 - .4 Application for services shutdown.
 - .8 Construction survey for location of all buried systems and equipment. Identify on site, and markup survey layout on as built drawings.
 - .9 Excavation near facilities and services shall be done via hand digging, or soft dig means to ensure that all existing systems remain operating, and un-damaged.

1.3 WORK BY OTHERS

- .1 Public Service Procurement Canada (PSPC) and Canada Border Services Agency (CBSA) will be responsible for the following:
 - .1 Providing access to the site.
 - .2 Providing security escort throughout the facility.
 - .3 Providing Contractor orientation.
 - .4 Instructing the Contractor on the correct permit forms to utilize.

1.4 WORK SEQUENCE

- .1 Construct Work in stages to accommodate the on-going use of the space by the Canada Border Services Agency (CBSA). The Contractor shall be responsible for all work, materials and methods, staged and planned, in general conformance with the following:
 - .1 Prepare a detailed scheduled of construction work and submit to the Departmental Representative for approval. The schedule must indicate facility outages, and these outages must be performed during off-hours (with minimal interruption to the site).
 - .2 Perform site survey and coordinate work with all applicable utilities.
 - .3 With assistance from MB Hydro identify and plan the location of the new CSTE / metering.
 - .4 Excavate construction areas in order to install electrical cabling and conduit.
 - .5 Construct concrete pad for equipment.
 - .6 Provide cable runs in trenches.
 - .7 Provide new equipment, such as main distribution panel, transfer switch, panelboards, breakers, UPS in Customs building basement.
 - .8 Provide exterior mounted genset on concrete pad.
 - .9 Provide exterior junction box near the genset, complete with lugs, and cable / conduit connections for connection to a load bank. The mobile load bank will be brought to site as required to perform testing. The Contractor shall include rental fee of the mobile load bank to perform all testing to CSA C282 standards.
 - .10 Provide bollards for protection of genset.
 - .11 Wire and connect genset systems.
 - .12 Provide grounding systems for genset and electrical service.
 - .13 Arrange for, test, commission the new electrical service.
 - .14 Test the genset, transfer switch, along with utility power.
 - .15 Wire and connect tertiary garage loads from the new distribution panel.
 - .16 Once the new electrical service, along with the genset is operating, route cabling and conduit to back-feed existing distribution equipment in the Customs Building basement.
 - .17 Disconnect and re-feed critical loads from the new UPS system. Intercept wiring and extend wiring and conduit to suit the new panelboard location.
 - .18 Remove the existing Honda genset in the Customs building basement, along with all auxiliary equipment. Turn over the genset, and associated controls and exhaust to CBSA.
 - .19 Patch and repair floor, and walls. Provide concrete floor repair to bring the existing floor to a consistent height and finish.
 - .20 Coordinate with Departmental Representative and take power outages to energize existing distribution equipment.
 - .21 Remove un-used existing electrical equipment in the Customs building basement. Coordinate with MB Hydro and remove the redundant metering equipment.
 - .22 The facility remains operational throughout the work. Ensure that all facility outages are kept to the bare minimum. All work outages must be approved in writing by the Departmental Representative.

1.5 SHUTDOWN COORDINATION

- .1 Coordinate any required power, communications or mechanical systems shutdowns with the Departmental Representative as per following:
 - .1 All power interruptions shall be performed during off-hours, at the discretion of the Departmental Representative.
 - .2 0 to 4 hours; 4 weeks in advance.
 - .3 Greater than 4 hours; Not Acceptable,
- .2 The Contractor shall arrange for and complete work in 2 or more (as approved by the Departmental Representative) separate power outages. Perform outage work, only after all new electrical distribution and genset work is complete, to ensure that outages are kept to a bare minimum in quantity and in length.
 - .1 Power interruption will be required to disconnect and reconnect the tertiary garage to the new main distribution panel.
 - .2 A power interruption will be required to disconnect the existing sub-distribution panel and re-connect it to the new main distribution panel.

1.6 REGULATORY AGENCIES

- .1 Make timely application for all permits and certificates necessary to carry out the work. Supply and submit all drawings, application forms and fees payable to the relevant authorities.
- .2 Promptly advise the Departmental Representative of any specified equipment, material, or installation of same which appears inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; of any necessary items of work omitted from the Contract Documents, or any discrepancies in the Specification.
- .3 On completion of the work, submit, certificate of acceptance from inspection authority to the Departmental Representative.
- .4 Make reasonable changes and alterations required by inspection authority without additional cost.

1.7 SUBMITTALS

- .1 Submit shop drawings and product data for review by the Departmental Representative. All drawings must be in English with dimensions in metric. Manufacturing of equipment must not begin until the shop drawings have been reviewed by the Departmental Representative, and returned to the Contractor.
- .2 Submit schedule of Prices section 00 32 00 to the Departmental Representative.
- .3 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .4 Where applicable, include wiring, single line and schematic diagrams.
- .5 Include wiring drawings or diagrams showing interconnection with work of other Sections.
- .6 Submit product samples of products or equipment where requested. Samples shall be forwarded to the Departmental Representative's office. Pay all transportation costs to ship samples to the Departmental Representative's office and return. Approved samples will be retained until after tender closing, then all samples will be returned except for the sample submitted by the manufacturer who has been listed by the successful Contractor

in the Tender Documents. This sample will be used for comparison with the actual production run of successful manufacturer.

1.8 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

1.9 EXISTING SERVICES / FACILITIES

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Notify Departmental Representative of intended interruption of the use of any of the facilities and obtain required permission to perform the intended work.
- .3 Where work involves breaking into or connecting to existing services, give Departmental Representative the notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to vehicular traffic and facility operations.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .5 Provide temporary services when directed by Departmental Representative to maintain critical building and tenant systems.
- .6 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and cooling system services. Adhere to approved schedule and provide notice to affected parties.
- .7 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .8 Provide directional boring for road-way crossings, in order to be assured the continued operations at the site.
- .9 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .10 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .11 Record locations of maintained, re-routed and abandoned service lines.
- .12 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.10 DRAWINGS AND SPECIFICATIONS

- .1 All materials, equipment, labor, work denoted on the drawing set is to be considered as new work, to be provided by the Contractor unless specifically noted otherwise. Some of the drawings show existing systems (with modifications to these systems). These drawings specifically indicated that there are existing systems shown. Where drawings do not specifically indicate that existing systems are depicted, the Contractor shall assume that the materials, equipment, labor, work indicated will form part of his scope, and the Contractor shall include all costs (including materials, labor, etc) to perform the work.

- .2 Prior to installing power and control cabling, the Contractor shall review the equipment shop drawings, and to ensure that cabling requirements are understood. There may be variations in wiring requirements from that shown, that may require alternate wiring requirements from that shown on the drawings. Include such wiring and connections in tender at no additional costs.
- .3 The electrical drawings in some cases indicate the size of cables, breakers, conduits, etc. These sizes are based on the supply of specific sizes of equipment. For cases where the Contractor supplies equipment that varies from these assumptions it is the responsibility of the Contractor to provide the correct size of breaker, cable, etc to suit the installation, at no additional cost to the Contract.
- .4 The intent of the Drawings and Specifications is to indicate labor, products, and services necessary for a complete, installed, tested, commissioned and functional installation.
- .5 Electrical drawings may indicate approximate route to be followed by conduits and cables and general location of electrical equipment. They do not show all structural, architectural and mechanical details. In some cases, conduit or wiring is only shown diagrammatically on the drawings. The details on exact cable or conduit routing, and exact equipment installation location is the responsibility of the Contractor.

Where circuit numbers are shown adjacent to equipment, the electrical contractor shall
- .6 provide all wiring, conduit, supports, and any other requirements to provide power to that piece of equipment from the circuit indicated. Provide all wiring, conduit, supports, and any other requirements to provide power to that piece of equipment.
- .7 To provide sufficient detail and maximum degree of clarity on the drawings, symbols used for various electrical devices, particularly wall mounted devices, may take up more or less space on the drawings than devices physically do. Locate devices with primary regard for convenience of operation, accessibility, maintenance of systems and space utilization, rather than locating devices to comply with the exact scaled locations of the electrical symbols.
- .8 These specifications along with the drawings and specifications of all other divisions shall be considered as an integral part of the drawing package. Any item or subject omitted from the specifications or the drawings but which is mentioned or reasonably specified in the drawings or specifications of other divisions, shall be considered as properly and sufficiently specified and shall be provided.
- .9 If discrepancies or omissions in the drawings or specifications are found, or if the intent or meaning is not clear, advise the Departmental Representative for clarification before submitting a bid.
- .10 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the work.
- .11 Various package unit types of equipment are included in the work. It is the responsibility of the Contractor to familiarize himself with the requirements of the equipment vendor, and to include all materials and labor for a complete and working installation. In some cases this means that motors, valves, actuators, etc need to be wired and connected in the field. The Contractor shall include all costs to perform such services as part of his tender submittal. Coordination between the equipment vendor and the Contractor shall be performed prior to tender bid closing date, and all costs shall be included in the tender. Request for extras due to lack of coordination between the Contractor and the equipment vendors will not be accepted.

- .12 In some cases the plan drawings indicate the symbol for 1 motor - for package units – when in reality, there are multiple motors, valves, dampers, solenoids, associated with the piece of equipment. It is the responsibility of the Contractor to understand the intricacies of the packaged equipment, and to perform all field connections for a complete and working system.
- .13 In some cases devices are shown only with one symbol on the drawings, when in fact multiple components are required in order to accommodate the system. In these cases it is the responsibility of the Contractor to wire and connect all required components to allow for correct operation of the system at no additional cost.
- .14 Cables schedules / lists where shown do not include all cables required to perform the complete facility installation. They shall be used as a general guide. Accurate cable lists, quantities, take-offs remain the responsibility of the Contractor. Cable schedules only show cabling where specific cable tags are available on the drawings. Refer to the cable schedule for specific systems which are not included on the schedule, and include materials, and installation for all remaining cabling.

1.11 REGULATORY AGENCIES

- .1 Make timely application for all permits and certificates necessary to carry out the work. Supply and submit all drawings, application forms and fees payable to the relevant authorities.
- .2 Promptly advise the Departmental Representative of any specified equipment, material, or installation of same which appears inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; of any necessary items of work omitted from the Contract Documents, or any discrepancies in the Specification.
- .3 On completion of the work, submit, certificate of acceptance from inspection authority to the Departmental Representative.
- .4 Make reasonable changes and alterations required by inspection authority without additional cost.

1.12 EXAMINATION OF SITE AND CONSTRUCTION DOCUMENTS

- .1 Prior to submitting bid, visit the site and thoroughly investigate the location, connection points, and details of all services and systems which, in any way, may affect or tie-in with the work covered in these specifications and accompanying drawings.
- .2 Attend pre-tender site meeting as scheduled and request further information or clarifications at that time.
- .3 Claims for extra payments, resulting from conditions which could reasonably be foreseen during an examination of the documents and site, will not be recognized.
- .4 Any claim for extra payment will require documentation indicating pricing from sub-contractors, and vendors. The Departmental Representative reserves the right to request firm quotations from suppliers for equipment costs in order to substantiate the equipment costs put forward in the request for additional payment.
- .5 Any claim for extra payment shall be approved in writing prior to the work being completed. Work already completed is not eligible for extra payment.
- .6 Any discrepancies, points of doubt, or contention shall be made known to the Departmental Representative in writing not later than seven (7) days prior to closing date of tender; otherwise, allow for the most expensive alternative.

1.13 DEFINITIONS

- .1 The following are definitions used in Division 26.
 - .1 Inspection Authority means agent of any authority having jurisdiction over construction and safety standards associated with any part of the site work.
 - .2 Supply Authority or Supply Utility means electrical power company (MB Hydro) or commission responsible for delivering electrical power to the project site.
 - .3 Electrical Code or Code means the Electrical Code in force at the project location.
 - .4 CEC means Canadian Electrical Code (latest edition being enforced by law).
 - .5 Contractor and Electrical Contractor means the entity retained to perform the work listed herein.
 - .6 Departmental Representative means the person with the authority to make decisions and administer the contract on behalf of the Public Services and Procurement Canada (PSPC), Canada Border Services Agency (CBSA) and Public Works Government Services Canada (PWGSC).
 - .7 Provide means to supply, install, wire, connect, test, commission and leave in complete and working order.
 - .8 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.

1.14 EXISTING SERVICES / FACILITIES

- .1 Notify the Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Notify the Departmental Representative of intended interruption of the use of any of the facilities and obtain required permission to perform the intended work.
- .3 Where Work involves breaking into or connecting to existing services, give the Departmental Representative the notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to vehicular traffic and facility operations.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify the Departmental Representative of findings.
- .5 Provide temporary services when directed by the Departmental Representative to maintain critical building and tenant systems.
- .6 Submit schedule to and obtain approval from the Departmental Representative for any shut-down or closure of active service or facility including power and cooling system services. Adhere to approved schedule and provide notice to affected parties.
- .7 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .8 Where unknown services are encountered, immediately advise the 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 authorities having jurisdiction.
- .10 Record locations of maintained, re-routed and abandoned service lines.

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

1.15 PROJECT RECORD DOCUMENTS

- .1 The Contractor shall maintain one set of white prints on site to record all changes to the Contract Drawings, which affect electrical layouts of equipment. Record drawings shall indicate all circuit wiring and all conduit runs, circuit numbers and devices. All relocations of equipment shall be shown. At project completion, the Contractor shall transfer the record information to a clean set of white prints, using recognized drafting standards, and stamp drawings As-Built, including the company name, date and signature of site Supervisor. If the Departmental Representative notices errors or omissions in the As-Built drawings, these will be returned to the Contractor, with the requirement that the Contractor go to site, and verify all the information on the As-Built drawings.

1.16 REVIEW OF CONTRACTORS' WORK

- .1 When the Contractor is satisfied that the work is completed, and after making his own inspection of work to verify completion, the Contractor shall submit a written request to the Departmental Representative requesting a review of work.
- .2 Any deficiencies noted by the Departmental Representative during the review of work, will be listed by the Departmental Representative, and issued to the Contractor.
- .3 Such deficiencies shall be corrected within three (3) weeks of the issuance of the deficiency list, or by a mutually agreed upon date. Once complete, the Contractor shall submit a written request to the Departmental Representative requesting a final deficiency review.
- .4 If subsequent site visits are required by the Departmental Representative because the deficiencies listed were not complete, all time and expense costs incurred by the Departmental Representative will be the responsibility of the Contractor.
- .5 During construction, the Contractor shall make any equipment or wiring accessible for review purposes, as requested by the Departmental Representative.

1.17 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 List of Requests for Information (RFI)
 - .7 Change Orders.
 - .8 Other Modifications to Contract.
 - .9 Field Test Report, System Components List C/W Commissioning Verification Forms and Check Sheets and Commissioning Issues/Resolution Log.
 - .10 Copy of Approved Work Schedule.
 - .11 Health and Safety Plan and Other Safety Related Documents.
 - .12 Other documents as specified.

Part 2 Products

2.1 ACCEPTED MATERIALS

- .1 Materials: approved by and bearing a CSA label. Where there is no alternative to supplying equipment or material that is not approved or certified as indicated, obtain and pay for special approvals from the Office of the Fire Commissioner, Inspection and Technical Services Manitoba.
- .2 Factory assemble control panels and component assemblies. Control panels to be CSA certified. Include current interrupting rating on the front panel. Shop drawings for custom built control panels shall be signed and sealed by an engineer, registered in the Province of Manitoba.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 CONSTRUCTION ORGANIZATION AND START-UP

- .1 Within 5 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 sub-contractors, field inspectors and supervisors will be in attendance. Others may be in attendance at the discretion of the Departmental Representative.
- .3 Establish time and location of meeting and notify parties concerned a minimum of 5 days before meeting.
- .4 Agenda to include:
 - .1 Appointment of official representative of participants in Work.
 - .2 Schedule of Work, progress scheduling in accordance with Section 01 32 17 - Construction Progress Schedule - Critical Path Method (CPM).
 - .3 Schedule of submission of shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
 - .4 Site security.
 - .5 Proposed changes, change orders, procedures, approvals required, mark-up percentages, time extensions, overtime and administrative requirements.
 - .6 Record drawings in accordance with Section 01 78 00 – Closeout Submittals.
 - .7 Maintenance in accordance with Section 01 78 00 – Closeout Submittals.
 - .8 Take-over procedures, acceptance and warranties in accordance with Section 01 78 00 – Closeout Submittals.
 - .9 Monthly progress claims, administrative procedures, photographs and holdbacks.
- .5 Comply with Departmental Representative's allocation of mobilization areas of site; for field offices and storage, for access, traffic and parking facilities.
- .6 During construction coordinate use of site and facilities through Departmental Representative's procedures for intra-project communications: submittals, reports and records, schedules, coordination of drawings, recommendations, and resolution of ambiguities and conflicts.
- .7 Comply with instructions of Departmental Representative for use of temporary utilities and construction facilities.
- .8 Coordinate field engineering and layout work with Departmental Representative.

1.2 CONSTRUCTION PROGRESS MEETINGS

- .1 The Departmental Representative in consultation with the Contractor will arrange for regular course of construction project meetings throughout the project, every four weeks or as determined by the Departmental Representative, and will assume responsibility for setting times and recording and distributing minutes.
- .2 Representatives of the Contractor, major Subcontractors, other Subcontractors, Canada Border Services Agency (CBSA), Departmental Representative, and others involved in the Work and as required and decided upon by the Departmental Representative or Contractor are to be in attendance. The Contractor is to coordinate and notify all Subcontractors.

- .3 Agenda to include:
 - .1 Review and approve minutes of previous meeting.
 - .2 Review of work progress subsequent to previous meeting.
 - .3 Contractor identification of field conditions, problems, conflicts.
 - .4 Contractor identification of problems which impede construction schedule.
 - .5 Contractor identification of off-site fabrication delivery schedules.
 - .6 Review progress, schedule, during succeeding work period.
 - .7 Review submittal schedules. Revise and expedite as required.
 - .8 Review pending changes and substitutions.
 - .9 Review proposed changes for effect on construction schedule and on completion date.
 - .10 Any impacts foreseen to operations at the facility.
 - .11 Other business.
- .4 The Departmental Representative will distribute written notice of each meeting five days in advance of meeting date to the Contractor, Subcontractors and CBSA.
- .5 The meetings will take place at the construction site within existing facilities or via teleconference at the discretion of the Departmental Representative.
- .6 Departmental Representative or delegate will preside over the meetings.
- .7 The Departmental Representative will record minutes, including significant proceedings and decisions, and will identify action by parties. The Contractor will review the meeting minutes and advise of any required change.
- .8 The meeting minutes will be distributed by the Consultant within two working days after each meeting and be transmitted to the Contractor.

1.3 SCHEDULES

- .1 Submit preliminary construction progress schedule in accordance with Section 01 32 17 - Construction Progress Schedule - Critical Path Method (cpm) to Departmental Representative coordinated with Departmental Representative's project schedule.
- .2 After review, revise and resubmit schedule to comply with revised project schedule.
- .3 During progress of Work, revise and resubmit as directed by Departmental Representative.

1.4 ADDITIONAL DRAWINGS

- .1 Departmental Representative may furnish additional drawings for clarification. These additional drawings have same meaning and intent as if they were included with plans referred to in Contract documents.
- .2 When additional drawings and instructions are required by the contractor, provide reasonable notice in writing to the Departmental Representative in advance of the date they are required.

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 Attend project meetings throughout the progress of the work.
- .2 Agendas for meetings will be prepared by the Departmental Representative, with edits and items included as by the Contractor.
- .3 The Contractor will attend meetings.
- .4 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 5 days after award of contract, attend a meeting to discuss and resolve administrative procedures and responsibilities.
- .2 Senior representatives of the Departmental Representative, Contractor, PSPC, and Canada Border Services Agency (CBSA) should be in attendance.
- .3 Incorporate mutually agreed variations to contract documents into agreement prior to signing.
- .4 Agenda to include:
 - .1 Appointment of official representative of participants in the work.
 - .2 Schedule of work.
 - .3 Schedule of submission of shop drawings and samples. Submit in accordance with Section 01 33 00 *Submittal Procedures*.
 - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, and fences in accordance with Section 01 52 00 *Construction Facilities*.
 - .5 Delivery schedule of specified equipment.
 - .6 Site security in accordance with Section 01 56 00 *Temporary Barriers and Enclosures*.
 - .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, and administrative requirements.
 - .8 Record drawings in accordance with Section 01 33 00 *Submittal Procedures*.
 - .9 Maintenance manuals in accordance with Section 01 78 00 *Closeout Submittals*.
 - .10 Take-over procedures, acceptance, and warranties in accordance with Section 01 78 00 *Closeout Submittals*.
 - .11 Monthly progress claims, administrative procedures, photographs, and holdbacks.
 - .12 Appointment of inspection and testing agencies or firms.
 - .13 Insurances and transcript of policies.

1.3 PROGRESS MEETINGS

- .1 During course of work and weeks prior to project completion, schedule progress meetings as required.
- .2 Contractor, major subcontractors involved in work, and Departmental Representative are to be in attendance.
- .3 The Consultant will provide meeting minutes, and submit these to the various parties 2 working days after the meeting.
- .4 Agenda to include the following:
 - .1 Review and approve minutes of previous meeting.
 - .2 Review of work progress subsequent to previous meeting.
 - .3 Contractor identification of field conditions, problems, conflicts.
 - .4 Contractor identification of problems which impede construction schedule.
 - .5 Contractor identification of off-site fabrication delivery schedules.
 - .6 Review progress, schedule, during succeeding work period.
 - .7 Review submittal schedules. Revise and expedite as required.
 - .8 Review pending changes and substitutions.
 - .9 Review proposed changes for effect on construction schedule and on completion date.
 - .10 Any impacts foreseen to operations at the facility.
 - .11 Other business.

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 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 Actual Finish Date (AF): point in time that Work actually ended on activity
- .3 Actual Start Date (AS): point in time that Work actually started on activity.
- .4 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.
- .5 Baseline: original approved plan (for Project, work package, or activity), plus or minus approved scope changes.
- .6 Completion Milestones: they are firstly Substantial Completion and secondly Final Certificate.
- .7 Constraint: applicable restriction that will affect performance of Project. Factors that affect activities can be scheduled.
- .8 Control: process of comparing actual performance with planned performance, analyzing variances, evaluating possible alternatives, and taking appropriate corrective action as needed.
- .9 Critical Activity: any activity on a critical path. Most commonly determined by using critical path method.
- .10 Critical Path: series of activities that determines duration of Project. In deterministic model, critical path is usually defined as those activities with float less than or equal to specified value, often zero. It is longest path through Project.
- .11 Critical Path Method (CPM): network analysis technique used to predict Project duration by analyzing which sequence of activities (which path) has least amount of scheduling flexibility (least amount of float).
- .12 Data Date (DD): date at which, or up to which, Project's reporting system has provided actual status and accomplishments.
- .13 Duration (DU): number of work periods (not including holidays or other non-working periods) required to complete activity or other Project element. Usually expressed as workdays or work weeks.
- .14 Early Finish Date (EF): in critical path method, earliest possible point in time on which uncompleted portions of activity (or Project) can finish, based on network logic and schedule constraints. Early finish dates can change as Project progresses and changes are made to Project plan.
- .15 Early Start Date (ES): in critical path method, earliest possible point in time on which uncompleted portions of activity (or Project) can start, based on network logic and schedule constraints. Early start dates can change as Project progresses and changes are made to Project Plan.

- .16 Finish Date: point in time associated with activity's completion. Usually qualified by one of following: actual, planned, estimated, scheduled, early, late, baseline, target, or current.
- .17 Float: amount of time that activity may be delayed from its early start without delaying Project finish date. Float is mathematical calculation, and can change as Project progresses and changes are made to Project plan. This resource is available to both PWGSC and Contractor.
- .18 Lag: modification of logical relationship that directs delay in successor task.
- .19 Late Finish Date (LF): in critical path method, latest possible point in time that activity may be completed without delaying specified milestone (usually Project finish date).
- .20 Late Start Date (LS): in critical path method, latest possible point in time that activity may begin without delaying specified milestone (usually Project finish date).
- .21 Lead: modification of logical relationship that allows acceleration of successor task.
- .22 Logic Diagram: see Project network diagram.
- .23 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .24 Milestone: significant event in Project, usually completion of major deliverable.
- .25 Monitoring: capture, analysis, and reporting of Project performance, usually as compared to plan.
- .26 Near-Critical Activity: activity that has low total float.
- .27 Non-Critical Activities: activities which when delayed, do not affect specified Contract duration.
- .28 Project Control System: fully computerized system utilizing commercially available software packages.
- .29 Project Network Diagram: schematic display of logical relationships of Project activities. Always drawn from left to right to reflect Project chronology.
- .30 Project Plan: formal, approved document used to guide both Project execution and Project control. Primary uses of Project plan are to document planning assumptions and decisions, facilitate communication among stakeholders, and document approved scope, cost, and schedule baselines. Project plan may be summary or detailed.
- .31 Project Planning: development and maintenance of Project Plan.
- .32 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of Project Work in relation to established milestones.
- .33 Project Schedule: planned dates for performing activities and 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.
- .34 Quantified days duration: working days based on 5 day work week, discounting statutory holidays.
- .35 Risk: uncertain event or condition that, if it occurs, has positive or negative effect on Project's objectives.

- .36 Scheduled Finish Date (SF): point in time that Work was scheduled to finish on activity. Scheduled finish date is normally within range of dates delimited by early finish date and late finish date.
- .37 Scheduled Start Date (SS): point in time that Work was scheduled to start on activity. Scheduled start date is normally within range of dates delimited by early start date and late start date.
- .38 Start Date: point in time associated with activity's start, usually qualified by one of following: actual, planned, estimated, scheduled, early, late, target, baseline, or current.
- .39 Work Breakdown Structure (WBS): deliverable-oriented grouping of project elements that organizes and defines total Work scope of Project. Each descending level represents increasingly detailed definition of Project Work.

1.2 SYSTEM DESCRIPTION

- .1 Construction Progress Schedule (Project Time Management): describes processes required to ensure timely completion of Project. These processes ensure that various elements of Project are properly co-ordinated. It consists of planning, time estimating, scheduling, progress monitoring and control.
- .2 Planning: this is most basic function of management, that of determining presentation of action and is essential.
 - .1 It involves focusing on objective consideration of future, and integrating forward thinking with analysis; therefore, in planning, implicit assumptions are made about future so that action can be taken today.
 - .2 Planning and scheduling facilitates accomplishment of objectives and should be considered continuous interactive process involving planning, review, scheduling, analysis, monitoring and reporting.
- .3 Ensure that planning process is iterative and results in generally top-down processing with more detail being developed as planning progresses, and decisions concerning options and alternatives are made. This implies progressively more reliability of scheduling data. Detail Project schedule is used for analysis and progress monitoring.
- .4 Ensure project schedule efficiencies through monitoring.
 - .1 When activities begin on time and are performed according to estimated durations without interruptions, original Critical Path will remain accurate. Changes and delays will however, create an essential need for continual monitoring of Project activities.
 - .2 Monitor progress of Project in detail to ensure integrity of Critical Path, by comparing actual completions of individual activities with their scheduled completions, and review progress of activities that has started but are not yet completed.
 - .3 Monitoring should be done sufficiently often so that causes of delays are immediately identified and removed if possible.
- .5 Project monitoring and reporting: as Project progresses, keep team aware of changes to schedule, and possible consequences. In addition to Bar Charts and CPM networks, use narrative reports to provide advice on seriousness of difficulties and measures to overcome them.

- .1 Narrative reporting begins with statement on general status of Project followed by summarization of delays, potential problems, corrective measures and Project status criticality.
- .6 Ensure Master Plan and Detail Schedule are practical and remain within specified Contract duration.
- .7 Master Plan and Detail Schedule deemed impractical by Departmental Representative are revised and resubmitted for approval.
- .8 Acceptance of Master Plan and Detail Schedule showing scheduled Contract duration shorter than specified Contract duration does not constitute change to Contract. Duration of Contract may only be changed through bilateral Agreement.
- .9 Consider Master Plan and Detail Schedule deemed practical by Departmental Representative, showing Work completed in less than specified Contract duration, to have float.
- .10 First Milestone on Master Plan and Detail Schedule will identify start Milestone with an "ES" constraint date equal to Award of Contract date.
- .11 Calculate dates for completion milestones from Plan and Schedule using specified time periods for Contract.
- .12 Substantial Completion with "LF" constraint equal to calculated date.
- .13 Calculations on updates to be such that if early finish of Interim Certificate falls later than specified Contract duration then float calculation to reflect negative float.
- .14 Delays to non-critical activities, those with float may not be basis for time extension.
- .15 Do not use float suppression techniques such as software constraints, preferential sequencing, special lead/lag logic restraints, extended activity times or imposed dates other than required by Contract.
- .16 Allow for and show Master Plan and Detail Schedule adverse weather conditions normally anticipated. Specified Contract duration has been predicated assuming normal amount of adverse weather conditions.
- .17 Provide necessary crews and manpower to meet schedule requirements for performing Work within specified Contract duration. Simultaneous use of multiple crews on multiple fronts on multiple critical paths may be required. Arrange participation on and off site of subcontractors and suppliers, as required by Departmental Representative, for purpose of network planning, scheduling, updating and progress monitoring. Approvals by Departmental Representative of original networks and revisions do not relieve Contractor from duties and responsibilities required by Contract.
- .18 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Departmental Representative Project Control System for planning, scheduling, monitoring and reporting of project progress.
- .3 Submit Project Control System to Departmental Representative for approval.

- .4 Include costs for execution, preparation and reproduction of schedule submittals in bid documents.
- .5 Submit letter ensuring that schedule has been prepared in co-ordination with major sub-contractors.
- .6 Refer to article "Progress monitoring and reporting" of this specification Section for frequency of Project control system submittals.
- .7 Submit Project planning, monitoring and control system as required by Departmental Representative in following form.
 - .1 CD files in original scheduling software containing schedule and cash flow information, labelled with data date, specific update, and person responsible for update.
 - .2 Master Plan Bar Chart.
 - .3 Construction Detail schedule Bar Chart.
 - .4 Listing of project activities including milestones and logical connectors, networks (sub-networks) from Project start to end. Sort activities by activity identification number and accompany with descriptions. List early and late start and finish dates together with durations, codes and float.
 - .5 Criticality report listing activities and milestones with up to 5 days total float used as first sort for ready identification of critical or near critical paths through entire project. List early and late starts and finishes dates, together with durations, codes and float for critical activities.
 - .6 Progress report in early start sequence, listing for each trade, activities due to start, underway, or finished within two months from monthly update date. List activity identification number, description and duration. Provide columns for entry of actual start and finish dates, duration remaining and remarks concerning action required.

1.4 QUALITY ASSURANCE

- .1 Use experienced personnel, fully qualified in planning and scheduling to provide services from start of construction to Final Certificate, including Commissioning.

1.5 PROJECT MEETING

- .1 Meet with Departmental Representative within 10 working days of Award of Contract date, to establish Work requirements and approach to project construction operations.

1.6 WORK BREAKDOWN STRUCTURE (WBS)

- .1 Prepare construction Work Breakdown Structure (WBS) within 15 working days of Award of Contract date. Develop WBS through at least five levels: Project, stage, element, sub-element and work package.

1.7 PROJECT MILESTONES

- .1 Mandatory and recommended project milestones form targets for both Master Plan and Detail Schedule of CPM construction network system.
 - .1 Mandatory: interim Certificate (substantial completion) by November 16, 2020.
 - .2 Mandatory: final Certificate completion by December 1, 2020.

1.8 MASTER PLAN

- .1 Structure and base CPM construction networks system on WBS coding in order to ensure consistency throughout Project.
- .2 Prepare comprehensive construction Master Plan (CPM logic diagram) and dependent Cash Flow Projection within 20 working days of finalizing Agreement to confirm validity or alternates of identified milestones.
 - .1 Master Plan will be used as baseline.
 - .1 Revise baseline as conditions dictate and as required by Departmental Representative.
 - .2 Departmental Representative will review and return revised baseline within 5 work days.
- .3 Reconcile revisions to Master Plan and Cash Flow Projections with previous baseline to provide continuous audit trail.
- .4 Initial and subsequent Master Plans will include:
 - .1 CD containing schedule and cash flow information, clearly labelled with data date, specific update, and person responsible for update.
 - .2 Bar chart identifying coding, activity durations, early/late and start/finish dates, total float, completion as percentile, current status and budget amounts.
 - .3 Network diagram showing coding, activity sequencing (logic), total float, early/late dates, current status and durations.
 - .4 Actual/projected monthly cash flow: expressed monthly and shown in both graphical and numerical form.

1.9 DETAIL SCHEDULE

- .1 Provide detailed project schedule (CPM logic diagram) within 20 working days of Award of Contract date showing activity sequencing, interdependencies and duration estimates. Include listed activities as follows:
 - .1 Shop drawings.
 - .2 Approvals.
 - .3 Procurement.
 - .4 Construction.
 - .5 Installation.
 - .6 Site works.
 - .7 Testing.
 - .8 Commissioning and acceptance.
- .2 Detail CPM schedule to cover in detail minimum period of 8 months beginning from Award of Contract date.
 - .1 Show remaining activities for CPM construction network system up to Final Certificate and develop complete detail as project progresses.
 - .2 Detail activities completely and comprehensively throughout duration of project.
- .3 Relate Detail Schedule activities to basic activities and milestones developed and approved in Master Plan.
- .4 Clearly show sequence and interdependence of construction activities and indicate:

- .1 Start and completion of all items of Work, their major components, and interim milestone completion dates.
- .2 Activities for procurement, delivery, installation and completion of each major piece of equipment, materials and other supplies, including:
 - .1 Time for submittals, resubmittals and review.
 - .2 Time for fabrication and delivery of manufactured products for Work.
 - .3 Interdependence of procurement and construction activities.
- .3 Include sufficient detail to assure adequate planning and execution of Work. Activities should generally range in duration from 3 to 15 workdays each.
- .5 Provide level of detail for project activities such that sequence and interdependency of Contract tasks are demonstrated and allow co-ordination and control of project activities. Show continuous flow from left to right.
- .6 Ensure activities with no float are calculated and clearly indicated on logical CPM construction network system as being, whenever possible, continuous series of activities throughout length of Project to form "Critical Path". Increased number of critical activities is seen as indication of increased risk.
- .7 Insert Change Orders in appropriate and logical location of Detail Schedule. After analysis, clearly state and report to Departmental Representative for review effects created by insertion of new Change Order.

1.10 REVIEW OF THE CONSTRUCTION DETAIL SCHEDULE

- .1 Allow 5 work days for review by Departmental Representative of proposed construction Detail Schedule.
- .2 Upon receipt of reviewed Detail Schedule make necessary revisions and resubmit to Departmental Representative for review within 5 work days.
- .3 Promptly provide additional information to validate practicability of Detail Schedule as required by Departmental Representative.
- .4 Submittal of Detail Schedule indicates that it meets Contract requirements and will be executed generally in sequence.

1.11 COMPLIANCE WITH DETAIL SCHEDULE

- .1 Comply with reviewed Detail Schedule.
- .2 Proceed with significant changes and deviations from scheduled sequence of activities that cause delay, only after written receipt of approval by Departmental Representative.
- .3 Identify activities that are behind schedule and causing delay. Provide measures to regain slippage.
 - .1 Corrective measures may include:
 - .1 Increase of personnel on site for effected activities or work package.
 - .2 Overtime work or additional work shifts.
- .4 Submit to Departmental Representative, justification, project schedule data and supporting evidence for approval of extension to Contract completion date or interim milestone date when required. Include as part of supporting evidence:

- .1 Written submission of proof of delay based on revised activity logic, duration and costs, showing time impact analysis illustrating influence of each change or delay relative to approved contract schedule.
- .2 Prepared schedule indicating how change will be incorporated into the overall logic diagram. Demonstrate perceived impact based on date of occurrence of change and include status of construction at that time.
- .3 Other supporting evidence requested by Departmental Representative.
- .4 Do not assume approval of Contract extension prior to receipt of written approval from Departmental Representative.
- .5 In event of Contract extension, display in Detail Schedule that scheduled float time available for work involved has been used in full without jeopardizing earned float.
 - .1 Departmental Representative will determine and advise Contractor number of allowable days for extension of Contract based on project schedule updates for period in question, and other factual information.
 - .2 Construction delays affecting project schedule will not constitute justification for extension of contract completion date.

1.12 PROGRESS MONITORING AND REPORTING

- .1 On ongoing basis, Detail Schedule on job site must show "Progress to Date". Arrange participation on and off site of subcontractors and suppliers, as, and when necessary, for purpose of network planning, scheduling, updating and progress monitoring. Inspect Work with Departmental Representative at least once monthly to establish progress on each current activity shown on applicable networks.
- .2 Update and reissue project Work Breakdown Structure and relevant coding structures as project develops and changes.
- .3 Perform Detail Schedule update monthly with status dated (Data Date) on last working day of month. Update to reflect activities completed to date, activities in progress, logic and duration changes.
- .4 Do not automatically update actual start and finish dates by using default mechanisms found in project management software.
- .5 Submit to Departmental Representative copies of updated Detail Schedule.
- .6 Requirements for monthly progress monitoring and reporting are basis for progress payment request.
- .7 Submit monthly written report based on Detail Schedule, showing Work to date performed, comparing Work progress to planned, and presenting current forecasts. Report must summarize progress, defining problem areas and anticipated delays with respect to Work schedule, and critical paths. Explain alternatives for possible schedule recovery to mitigate any potential delay. Include in report:
 - .1 Description of progress made.
 - .2 Pending items and status of: permits, shop drawings, Change Orders, possible time extensions.
 - .3 Status of Contract completion date and milestones.
 - .4 Current and anticipated problem areas, potential delays and corrective measures.
 - .5 Review of progress and status of Critical Path activities.

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 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and 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.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .10 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 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.
- .3 Allow 14 days for Departmental Representative's review of each submission.
- .4 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .5 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .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.
 - .11 Field wiring and field interconnections
 - .12 Controls methods, and procedures
 - .13 Operating instructions.
 - .14 Maintenance and troubleshooting recommendations.
- .8 After Departmental Representative's review, distribute copies.
- .9 Submit an electronic copy of shop drawings in PDF format for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .10 Submit electronic copies in PDF format 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.
- .11 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .12 Submit copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.

- .13 Delete information not applicable to project.
- .14 Supplement standard information to provide details applicable to project.
- .15 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.
- .16 Maintain a log for the shop drawing submittals indicating the description, date of issuance, date of response, and current status.
- .17 The review of shop drawings by the Departmental Representative (SNC-Lavalin Inc), is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that the Departmental Representative, SNC-Lavalin Inc 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.

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 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Province of Manitoba
 - .1 The Workers Compensation Act RSM 1987 - Updated 2006.
- .4 Safe Work Manitoba
 - .1 Guide For Asbestos Management.
 - .2 Manitoba Workplace Safety and Health 2014 or Latest Edition.

1.2 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site specific permit application forms as required by the Departmental Representative and Canada Revenue Agency.
- .3 Submit "MB 25 RP1 Project Specific Health & Safety Plan": Within 7 days after date of Notice to Proceed and prior to commencement of Work. "MB 25 RP1 Project Specific Health & Safety Plan" must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .4 Submit two copies of Contractor's authorized representative's work site health and safety inspection reports to the Departmental Representative and authority having jurisdiction, weekly.
- .5 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .6 Submit copies of incident and accident reports.
- .7 Submit WHMIS SDS - Safety Data Sheets.
- .8 The Departmental Representative will review Contractor's "MB 25 RP1 Project Specific Health & Safety Plan" and provide comments to Contractor within 7 days after receipt of plan. Revise plan as appropriate and resubmit the plan to the Departmental Representative within 5 days after receipt of comments from the Departmental Representative.
- .9 The Departmental Representative's review of Contractor's final "MB 25 RP1 Project Specific Health & Safety Plan" should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

- .10 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 the Departmental Representative.
- .11 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.3 SAFETY ASSESSMENT

- .1 Perform site specific “MB 25 RP1 Project Specific Health & Safety Plan” related to project.

1.4 MEETINGS

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

1.5 REGULATORY REQUIREMENTS

- .1 Do Work in accordance with Section 01 41 00 - Regulatory Requirements.

1.6 GENERAL REQUIREMENTS

- .1 Develop written site-specific “MB 25 RP1 Project Specific Health & Safety Plan” based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. “MB 25 RP1 Project Specific Health & Safety Plan” must address project specifications.
- .2 The Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.7 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.8 COMPLIANCE REQUIREMENTS

- .1 Comply with The Workers Compensation Act.
- .2 Comply with The Workplace Safety and Health Act C.C.S.M. c. W210.
- .3 Comply with Manitoba Workplace Safety and Health Regulation 2014 or Latest Edition.
- .4 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.9 UNFORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise the Departmental Representative verbally and in writing.

1.10 HEALTH AND SAFETY CO-ORDINATOR

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

1.11 POSTING OF DOCUMENTS

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

1.12 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by the Departmental Representative.
- .2 Provide the Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 The Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.13 BLASTING

- .1 Blasting or other use of explosives is not permitted without prior receipt of written instruction by the Departmental Representative.

1.14 POWDER ACTUATED DEVICES

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

1.15 WORK STOPPAGE

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

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 REFERENCES AND CODES

- .1 Perform Work in accordance with National Building Code of Canada (NBC) including Manitoba amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.2 HAZARDOUS MATERIAL DISCOVERY

- .1 Mould, asbestos, lead and PCBs: stop work immediately when hazardous material is encountered during demolition work. Notify Departmental Representative.

1.3 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions and municipal by-laws.

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 INSPECTION

- .1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 Departmental Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents.
- .5 The Departmental Representative may engage an independent material testing laboratory to conduct random Quality Assurance (QA) testing. If the testing indicates substandard workmanship or materials, the Contractor will be responsible for payment of testing and for correcting the deficiencies.

1.2 ACCESS TO WORK

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

1.3 PROCEDURES

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

1.4 REJECTED WORK

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

1.5 CONCRETE TESTING

- .1 All material testing required to meet specifications is Quality Control (QC) testing to be conducted by a certified material testing laboratory to be engaged and paid by the Contractor.
- .2 One concrete test shall consist of :
 - .1 Slump test.
 - .2 Air content test.
 - .3 One lab cure cylinder – 7 day break.
 - .4 Two lab cure cylinders – 28 day break.
- .3 The minimum testing frequency per day for each mix design shall be one test on the first truck, then one test every 30 m³ or part thereof.
- .4 If any air or slump test fails for any concrete load, continue to test slump and air content on subsequent trucks until consistency is established.
- .5 Additional testing shall be as directed by the Departmental Representative.
- .6 Copies of all test results shall be sent to the Departmental Representative prior to the supply and placement of the concrete.
- .7 Acceptance criteria for compressive strengths of lab cured cylinders shall conform to CSA A23.1

1.6 AGGREGATE MATERIALS TESTING

- .1 All material testing required to meet specifications is Quality Control (QC) testing to be conducted by a certified material testing laboratory to be engaged and paid by the Contractor.
- .2 The Contractor shall ensure that a minimum of one sample shall be tested for gradation and LA abrasion for each grade of granular fill materials prior to starting construction. The materials shall be sampled from stockpiles designated to be used for the contract and shall be tested in accordance with the specifications.
- .3 If one test fails to meet the requirements of the specifications, the material shall be re-tested. If the material fails a second test, the Departmental Representative shall designate a new source for supply of the material.
- .4 Testing in addition to the requirements of the specifications shall be as directed by the Departmental Representative.
- .5 Copies of all test results shall be sent to the Departmental Representative prior to the supply and placement of the materials.

1.7 DOCUMENTATION LOGS

- .1 Maintain an up-to-date log of Requests for Information (RFI) and Shop Drawings (SD).

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 REFERENCES

- .1 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
 - .2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
- .2 Canadian Standards Association (CSA International):
 - .1 CSA-A23.1/A23.2-04 (R2019), Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA O121-17, Douglas Fir Plywood.
 - .3 CSA S269.2-16, Access Scaffolding for Construction Purposes.
- .3 U.S. Environmental Protection Agency (EPA), Office of Water:
 - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.2 SUBMITTALS

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

1.3 INSTALLATION AND REMOVAL

- .1 Work throughout the site will include modifications and construction tasks in a number of areas, including, but not necessarily limited to:
 - .1 Customs Building
 - .2 Tertiary Garage
 - .3 Exterior areas around Customs Building and Tertiary Garage
- .2 Perform site survey and identify areas that are to be excavated, if any are required.
- .3 Coordinate with the Departmental Representative and indicate use of supplemental or other staging area.
- .4 Provide construction facilities to execute work expeditiously.
- .5 Remove from site all surplus materials after work is completed.
- .6 Provide all required safe storage systems in accordance with the project requirements, and CBSA requirements.

1.4 SCAFFOLDING

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms and temporary stairs.

1.5 HOISTING

- .1 Provide, operate, and maintain lifts required for moving workers, materials, and equipment. Make financial arrangements with subcontractors for their use of equipment.
- .2 Lifts to be operated by qualified operators.

1.6 SITE STORAGE AND LOADING

- .1 Confine work and operations of employees by contract documents. Do not unreasonably encumber premises with products.
- .2 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 be permitted on site provided it does not disrupt ongoing operations at the site.

1.8 SECURITY

- .1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays, if required.

1.9 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.

1.10 SANITARY FACILITIES

- .1 Contractor to provide sanitary facilities. No existing washrooms in the existing facilities may be used.

1.11 CONSTRUCTION SIGNAGE

- .1 Contractor may provide the contractor's own identification and directional sign on site at the contractor's own expense.

- .2 No other signs or advertisements other than warning signs are permitted on site.
- .3 Locate project identification sign as directed by Departmental Representative and construct as follows:
 - .1 Erect framework, and attach signboard to framing.
- .4 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 consultant.

1.12 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access as necessary to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period .
- .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 roads as necessary.
- .8 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .9 Dust control: adequate to ensure safe operation at all times.

1.13 CLEAN-UP

- .1 Remove construction debris, waste materials, and packaging material from work site weekly, or more frequently if required.
- .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 may be stored within the existing facility.

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 INSTALLATION AND REMOVAL

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

1.2 GUARD RAILS AND BARRICADES

- .1 Provide secure, rigid guard rails and barricades around excavations.
- .2 Provide guards and barricades to separate areas of the facility. Construct a barricade to prevent un-intended access into construction areas which may pose a hazard to other personnel.
- .3 Provide as required by governing authorities.

1.3 WEATHER ENCLOSURES

- .1 Seal off openings / penetrations to interior spaces.
- .2 Design enclosures to withstand wind pressure and snow loading.

1.4 ACCESS TO SITE

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

1.5 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.

1.6 FIRE ROUTES

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

1.7 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.

1.8 PROTECTION OF BUILDING FINISHES

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

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 REFERENCES

- .1 Within text of each specifications section, reference may be made to reference standards.
- .2 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .3 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .4 Cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 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 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.
- .7 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.

- .8 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.4 TRANSPORTATION

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

1.5 MANUFACTURER'S INSTRUCTIONS

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

1.6 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.

1.7 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.

1.8 REMEDIAL WORK

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

1.9 LOCATION OF EQUIPMENT

- .1 Consider location of equipment, mechanical and electrical items indicated on the drawings 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 made 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 Departmental Representative and local authorities as applicable, with minimum of disturbance to Work, building occupants.
- .2 Protect, relocate or maintain existing active services. When services are encountered, protect existing services to ensure that no damage occurs. Stake and record location of 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 QUALIFICATIONS OF SURVEYOR

- .1 Qualified registered land surveyor, licensed to practice in Place of Work, with appropriate security clearances, and acceptable to Departmental Representative.

1.2 SURVEY REFERENCE POINTS

- .1 Not Used.

1.3 SURVEY REQUIREMENTS

- .1 All construction survey for location, layout and as built is the responsibility of Contractor.
- .2 Perform site surveys in vicinity of expected excavation areas, in order to establish a precise location for routing of new buried cabling and conduit.
- .3 Survey and mark a buried conduit or cables.
- .4 Establish lines and levels for mechanical and electrical work.

1.4 EXISTING SERVICES

- .1 Before commencing excavation work, establish location and extent of existing services and buried systems in area of Work and notify Departmental Representative of findings.

1.5 LOCATION OF EQUIPMENT AND FIXTURES

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

1.6 RECORDS

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .2 Record locations of all new nearby buried systems.
- .3 Provide as-built drawings.

1.7 SUBMITTALS

- .1 Submit name and address of Surveyor to Departmental Representative.
- .2 On request of Departmental Representative, submit documentation to verify accuracy of field engineering work.

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. Do not utilize existing Canada Border Services Agency waste disposal services, the Contactor must provide their own.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide secure, locked, on-site containers for collection of waste materials and debris.
- .5 Provide and use marked separate bins for recycling.
- .6 Dispose of waste materials and debris off site.
- .7 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .8 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .9 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .10 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .11 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.2 FINAL CLEANING

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from electrical and mechanical fixtures, walls, and floors.

- .9 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .10 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .11 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .12 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .13 Remove dirt and other disfiguration from exterior surfaces.
- .14 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .15 Sweep and wash clean paved areas.
- .16 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .17 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .18 Remove snow and ice from access to building.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling.

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 DEFINITIONS

- .1 Materials Source Separation Program (MSSP): Consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .2 Recyclable: Ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse by others.
- .3 Recycle: Process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .4 Recycling: Process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .5 Reuse: Repeated use of product in same form but not necessarily for same purpose. Reuse includes:
 - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
 - .2 Returning reusable items including pallets or unused products to vendors.
- .6 Salvage: Removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .7 Separate Condition: Refers to waste sorted into individual types.
- .8 Source Separation: Acts of keeping different types of waste materials separate beginning from first time they became waste.
- .9 Waste Management Coordinator (WMC): Contractor representative responsible for supervising waste management activities.
- .10 Waste Reduction Workplan (WRW): Written report which addresses opportunities for reduction, reuse, or recycling of materials.

1.2 DOCUMENTS

- .1 Maintain at job site, one copy of following documents:
 - .1 Waste Reduction Workplan.
 - .2 Material Source Separation Plan.
 - .3 Tools and materials list brought into the secure areas

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare and submit following prior to project start-up:

- .1 Submit 2 copies of completed Waste Reduction Workplan (WRW)
- .2 Submit 2 copies of Materials Source Separation Program (MSSP) description.

1.4 WASTE REDUCTION WORKPLAN (WRW)

- .1 Prepare WRW prior to project start-up.
- .2 WRW should include but not limited to:
 - .1 Destination of materials listed.
 - .2 Deconstruction/disassembly techniques and sequencing.
 - .3 Schedule for deconstruction/disassembly.
 - .4 Location.
 - .5 Security.
 - .6 Protection.
 - .7 Clear labelling of storage areas.
 - .8 Details on materials handling and removal procedures.
- .3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.
- .4 Describe management of waste.
- .5 Identify opportunities for reduction, reuse, and recycling of materials.
- .6 Post WRW or summary where workers at site are able to review content.
- .7 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.

1.5 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)

- .1 Prepare MSSP and have ready for use prior to project start-up.
- .2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Departmental Representative.
- .3 Provide on-site facilities for collection, handling, and storage of reusable and recyclable materials.
- .4 Provide containers to deposit reusable and recyclable materials. All containers must be secure, and locked.
- .5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .6 Locate separated materials in areas which minimize material damage.
- .7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.
 - .1 Transport to approved and authorized recycling facility for recycling.

- .8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.
 - .1 Ship materials to site operating under Certificate of Approval.
 - .2 Materials must be immediately separated into required categories for reuse or recycling.

1.6 STORAGE, HANDLING AND PROTECTION

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.
- .2 Unless specified otherwise, materials for removal do not become Contractor's property.
- .3 Protect, stockpile, and store salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Protect structural components not removed for demolition from movement or damage.
- .6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Departmental Representative.
- .7 Protect surface drainage, mechanical and electrical from damage and blockage.
- .8 Separate and store materials produced during dismantling of structures in designated areas.
- .9 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
 - .1 On-site source separation is recommended.
 - .2 Remove co-mingled materials to off-site processing facility for separation.

1.7 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, paint thinner, into waterways, storm, or sanitary sewers.
- .3 Remove materials from deconstruction as deconstruction/disassembly Work progresses.

1.8 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises.
- .2 Provide temporary security measures approved by Departmental Representative.

1.9 SCHEDULING

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 APPLICATION

- .1 Do Work in compliance with WRW.
- .2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 CLEANING

- .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
- .2 Clean-up work area as work progresses.
- .3 Source separate materials to be reused/recycled into specified sort areas.

3.3 DIVERSION OF MATERIALS

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

3.4 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT

- .1 Government Chief Responsibility for the Environment:

Manitoba Environment (204) 945-7100
Building 2, 139 Tuxedo
Avenue, Winnipeg, MB
R3N 0H6

The Clean Environment (204) 326-2395 (204) 326-2472
Commission, 284
Reimer Avenue, Box
21420, Steinbach, MB
R0A 2T3

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, four final copies of operating and maintenance manuals and one electronic copy (on a USB key memory stick in PDF format) in English.
- .3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .4 Provide evidence, if requested, for type, source and quality of products supplied.

1.3 FORMAT

- .1 Organize data as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.
- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.

- .1 Bind in with text; fold larger drawings to size of text pages.
- .9 Three USB keys with content in Portable Document Format (PDF).
- 1.4 CONTENTS - PROJECT RECORD O & M MANUAL DOCUMENTS**
 - .1 Binder Cover, Binder Edge, and Title Page
 - .1 Include: project name, building Name, address, project number (R#), project completion date.
 - .2 Index and Tabs
 - .1 Dividers with permanently marked tabs separate each section and sub section.
 - .2 Tab labels typed, not hand written.
 - .3 All contents (other than as built) type written, not hand written.
 - .4 Main tab for each specification section.
 - .5 Table of Contents
 - .1 Project name.
 - .2 Building name.
 - .3 Address
 - .4 Project number (R#)
 - .5 Project completion date.
 - .6 Table of Contents for all tabs
 - .6 Tab A
 - .1 Contact information for General Contractor, including:
 - .1 Name, address, telephone number of manufacturer, installing contractor.
 - .2 24-hour number for emergency service for all equipment in this section identified by equipment.
 - .2 Contact information for all sub-contractors and suppliers, including:
 - .1 Name, address, telephone number of manufacturer, installing contractor.
 - .2 24-hour number for emergency service for all equipment in this section identified by equipment.
 - .7 Tab B
 - .1 Letter of Warranty, signed and dated letter of warranty to include:
 - .1 Project name, project number (R#), and location.
 - .2 Warranty start date (to be the date of Substantial date).
 - .3 All manufacturer and extended warranties.
 - .8 Tab C
 - .1 Shop Drawings
 - .1 Copy of all approved shop drawings signed by
 - .1 The Departmental Representative's review authority
 - .2 The Contractor.
 - .3 Any 3rd party commissioning agent.
 - .9 Tab D
 - .1 All reports and permits.

- .2 Pre-functional tests.
- .3 Functional performance testing procedures
- .4 Start-up reports.
- .5 Completed performance verification forms.
- .6 Permits, inspections certificates from Authorities Having Jurisdiction.
- .7 Cabling verification.
- .8 ESA certification.
- .10 Tab E
 - .1 Sequence of Operation-outline how the systems installed were designed to work.
 - .2 Provide designers and / or the manufactures operating instructions and sequence of operations.
- .11 Tab F
 - .1 Project specific service and maintenance manuals.
 - .2 Preventative and corrective maintenance, with service procedures and schedules.
 - .3 Schedule for preventive maintenance in a printed format and electronic format.
 - .4 Recommended frequency of performance for each preventive maintenance task, cleaning, inspection and scheduled overhauls or reconditioning.
 - .5 Cleaning: Instructions and schedules for all routine cleaning and inspection recommended, including recommended cleaners and lubricants.
 - .6 Inspection: Periodic inspection of equipment required for operation, cleaning or other reasons, with items to be inspected indicated and inspection criteria given for motors, controls, filters, and any other maintenance items.
 - .7 Instructions for minor repairs or adjustments required for preventive maintenance routines.
 - .8 Instruction for any require calibration.
 - .9 Listing of any special tools required to service or maintain the equipment.
- .12 Tab G
 - .1 As Built Drawings
 - .1 As built drawings marked up by contractor with changes in red, and reviewed by the Departmental Representative.
- .13 Tab H
 - .1 CMMS data sheets (template included in this section)
 - .1 All equipment which is to be deleted, removed, added, or replaced is to have a CMMS inventory sheet completed and included in the O&M Manual by the Contractor.
- .14 Tab I
 - .1 Site Inspection / Observation Reports
 - .1 Contractor to include the site observation and inspection reports.

- .1 Each deficient line item within the report shall be initialed and dated to acknowledge that the remediation / corrective work has been completed by the Contractor.
- .15 Tab J
 - .1 Final Commissioning Manual
 - .1 Narrative of commissioning activities and challenges that occurred during each phase of the project.
 - .2 Confirmation letter identifying that all performance verification tests have met the requirements of the specification document, basis of design (if applicable) and requirement of the project
- .16 Tab K
 - .1 Miscellaneous Items
 - .1 Health and Safety submittals including: site specific hazard assessment, safety manual TOC and company safety policy, MSDS sheets(if applicable) signed site orientations for worker, copy of first aid certificate, copy of emergency plan and muster location.
 - .2 Special requirements for equipment (if any).
- .17 Tab L
 - .1 Spare Tab
- .18 Tab M
 - .1 Spare Tab
- .19 Tab N
 - .1 Spare Tab

1.5 AS -BUILT DOCUMENTS AND SAMPLES

- .1 Maintain, at site for Departmental Representative one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Inspection certificates.
 - .7 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.
- .6 The Contractor must accurately record and include all pertinent installation information on the As-Built drawings, including but not limited to:
 - .1 Location of all installation components, cabinets, devices, junction boxes
 - .2 Equipment tags and description of all installed equipment.
 - .3 Location and routing of all conduit, junction boxes. Description of all wiring installation within conduit runs.
 - .4 Circuit numbers utilized
 - .5 Updated panel directories
 - .6 Equipment part numbers / components sizes
 - .7 Location of existing panelboards / devices, when connections are made to existing equipment.
- .7 Submit final as-built documents (hard copy of drawings & specs) to the Departmental Representative. The Departmental Representative will make changes to the electronic set of drawings (dwg files) and specifications.

1.6 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of black line opaque drawings, 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.
- .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 References 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 manufacturer's certifications, inspection certifications required by individual specifications sections.
- .7 Provide digital photos, if requested, for site records.

1.7 FINAL SURVEY

- .1 Submit final site survey certificate in accordance with Section 01 71 00 - Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.8 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, circuit descriptions, breaker sizes.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
 - .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include system operation, test and balancing reports as specified in Section 01 91 13 - General Commissioning (Cx) Requirement and Section 23 05 93 - System Balancing & Operation Reports.
- .15 Additional requirements: as specified in individual specification sections.

1.9 MATERIALS AND FINISHES

- .1 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

- .2 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Additional requirements: as specified in individual specifications sections.

1.10 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 site; 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 site; 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 site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.

1.11 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.

1.12 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 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.
 - .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.

1.13 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 TRAINEES

- .1 Trainees: personnel selected for operating and maintaining this facility. Includes Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.
- .2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

1.2 INSTRUCTORS

- .1 The Departmental Representative will provide:
 - .1 Instruction on design philosophy, design criteria, and design intent.
- .2 Contractor and certified factory-trained manufacturers' personnel to provide instruction on the following:
 - .1 Descriptions of systems.
 - .2 Start-Up, operation, shut-down of equipment, components and systems.
 - .3 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
 - .4 Instructions on servicing, maintenance and adjustment of systems, equipment and components.
- .3 Contractor and equipment manufacturer to provide instruction on:
 - .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.3 TRAINING OBJECTIVES

- .1 Training to be detailed and duration to ensure:
 - .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
 - .2 Effective on-going inspection, measurements of system performance.
 - .3 Operation of relay control panels, control devices and building automation interface.
 - .4 Operation, settings, and controls adjustments for the web based server.
 - .5 Proper preventive maintenance, diagnosis and trouble-shooting.
 - .6 Ability to update documentation.
 - .7 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.4 TRAINING MATERIALS

- .1 Instructors to be responsible for content and quality.
- .2 Training materials to include:
 - .1 "As-Built" Contract Documents.
 - .2 Operating Manual.

- .3 Maintenance Manual.
- .4 Management Manual.
- .5 TAB and PV Reports.
- .3 Project Manager, Commissioning Manager and Facility Manager will review training manuals.
- .4 Training materials to be in a format that permits future training procedures to same degree of detail.
- .5 Supplement training materials:
 - .1 Multimedia presentations.
 - .2 Manufacturer's training videos.
 - .3 Equipment models.

1.5 SCHEDULING

- .1 Include in Commissioning Schedule the dates and times for training.
- .2 Deliver training during regular working hours, training sessions to be 4 hours in length and held on 2 separate non-consecutive days.
 - .1 Provide 1 training session 5 days prior to substantial completion.
 - .2 Provide 1 training session 5 days prior to total project completion

1.6 RESPONSIBILITIES

- .1 Be responsible for:
 - .1 Implementation of training activities,
 - .2 Coordination among instructors,
 - .3 Quality of training, training materials,
- .2 The Departmental Representative will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, witnessed by the Departmental Representative.

1.7 TRAINING CONTENT

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
 - .1 Review of facility and occupancy profile.
 - .2 Functional requirements.
 - .3 System philosophy, limitations of systems and emergency procedures.
 - .4 Review of system layout, equipment, components and controls.
 - .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
 - .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of equipment, switches, adjustment of control settings and emergency procedures.
 - .7 Maintenance and servicing.
 - .8 Trouble-shooting diagnosis.

- .9 Inter-Action among systems during integrated operation.
- .10 Review of O&M documentation.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

1.8 VIDEO-BASED TRAINING

- .1 Manufacturer's videotapes to be used as training tool with the Departmental Representative's review and written approval 3 months prior to commencement of scheduled training.
- .2 On-Site training videos:
 - .1 Videotape training sessions for use during future training.
 - .2 To be performed after systems are fully commissioned.
 - .3 Organize into several short modules to permit incorporation of changes.
- .3 Production methods to be high quality.

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 ACRONYMS:

- .1 Cx - Commissioning.
- .2 BMM – Building Management Manual
- .3 EMCS - Energy Monitoring and Control Systems.
- .4 O & M - Operation and Maintenance.
- .5 PI - Product Information.
- .6 PV - Performance Verification.
- .7 TAB - Testing, Adjusting and Balancing.

1.2 QUALITY ASSURANCE

- .1 Provide testing organization services under provisions specified in Section 01 45 00 - Quality Control.
- .2 Comply with applicable procedures and standards of the certification sponsoring association.
- .3 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

1.3 CONTRACTOR RESPONSIBILITIES

- .1 Prepare each system for testing and commissioning.
- .2 Coordinate, pay for and make available during testing, the equipment manufacturer certified technicians for operating the booster fire pumps and dual fire pump controller with transfer switch.
- .3 Cooperate with testing organization and provide access to equipment and systems.
- .4 Provide personnel and operate systems at designated times, and under conditions required for proper testing, and adjusting.
- .5 Notify testing organization 14 days prior to time project will be ready for testing and adjusting.

1.4 PREPARATION

- .1 Provide instruments required for testing, adjusting operations.
- .2 Make instruments available to the Departmental Representative to facilitate spot checks during testing.
- .3 Retain possession of instruments and remove at completion of services.
- .4 Verify systems installation is complete and in continuous operation.
- .5 Verify the system notification, supervision and alarm

1.5 REFERENCES

- .1 Perform installation, testing, commissioning and certification in accordance with the latest edition of all codes and standards in effect, including but not limited to:
 - .1 CSA C282

- .2 National Building Code
- .3 Canadian Electrical Code CSA C22.1
- .4 CSA Z320

1.6 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
 - .2 Ensure appropriate documentation is compiled into the O & M manual.
 - .3 Effectively train O&M staff.
- .2 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.
- .3 Design Criteria: as per client's requirements or determined by designer. To meet the project functional and operational requirements.

1.7 COMMISSIONING OVERVIEW

- .1 Section 01 91 13 13 - Commissioning (Cx) Plan.
- .2 For Cx responsibilities refer to Section 01 91 13 13 - Commissioning (Cx) Plan.
- .3 Cx to be a line item of Contractor's cost breakdown.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 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 systems are constructed and proven to operate satisfactorily under all conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .6 The Departmental Representative will issue Interim Acceptance Certificate when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by the Departmental Representative.
 - .2 Successful completion of life safety support systems tests and after meeting all requirements of the Authority Having Jurisdiction.
 - .3 Equipment, components, systems and integrated systems have been fully commissioned and functional as per design intent.
 - .4 Final O&M and training manuals have been received, reviewed and approved by the Departmental Representative for suitability.
 - .5 Completion of training session to all operations and maintenance staff.

1.8 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

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

1.9 PRE-Cx REVIEW

- .1 Before Construction:
 - .1 Review contract documents, confirm by writing to the Departmental Representative.
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
 - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
 - .1 Contractor shall prepare and completed and up-to-date Cx Plan.
 - .2 Ensure installation of related components, equipment, sub-systems, and systems are complete.
 - .3 Fully understand Cx requirements and procedures.
 - .4 Have Cx documentation shelf-ready.
 - .5 Understand completely design criteria and intent and special features.
 - .6 Submit complete start-up documentation to the Departmental Representative.
 - .7 Have Cx schedules up-to-date.
 - .8 Ensure systems have been cleaned thoroughly.
 - .9 Complete TAB procedures on systems, submit TAB reports to the Departmental Representative for review and approval.
 - .10 Ensure "As-Built" system schematics are available.
- .4 Inform the Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.10 CONFLICTS

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

1.11 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit documentation to confirm organization compliance with quality assurance provision.

- .3 Submit no later than 4 weeks after award of Contract:
 - .1 Name of Contractor's Cx agent.
 - .2 Draft Cx documentation.
 - .3 Preliminary Cx schedule.
- .4 Submit 3 preliminary specimen copies of each of report forms proposed for use.
- .5 Request in writing to the Departmental Representative for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
- .6 Submit proposed Cx procedures to the Departmental Representative where not specified and obtain written approval at least 8 weeks prior to start of Cx.
- .7 Fifteen days prior to Substantial Performance, submit 3 copies of final reports on applicable forms.
- .8 Provide additional documentation relating to Cx process required by the Departmental Representative.

1.12 COMMISSIONING DOCUMENTATION

- .1 Refer to 01 91 13 16, installation check lists, Product Information (PI), Performance Verification forms.
- .2 The Departmental Representative to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to the Departmental Representative.

1.13 COMMISSIONING SCHEDULE

- .1 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.

1.14 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings: as specified herein.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At the project shop-drawing stage, the Departmental Representative will call a separate Cx scope meeting to initiate project Cx, discuss schedule of equipment delivery, discuss Cx documentation. The Contractor will have the lighting equipment representative and building management system contractor available on site during the meeting. Issues at meeting to include:
 - .1 Discussion of equipment delivery times.
 - .2 Discussions on impacts to the operating facility, and on keeping the facility operating during construction, and Cx activities.
 - .3 Discussions on test forms.
 - .4 Discussions on genset programming / settings requirements.

- .5 At the 90% construction completion stage. The 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.
- .6 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .7 Meeting will be chaired by the Departmental Representative. The Consultant will record and distribute meeting minutes.
- .8 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.15 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.

1.16 WITNESSING OF STARTING AND TESTING

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

1.17 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing: manufacturer to:
 - .1 Coordinate time and location of testing.
 - .2 Provide testing documentation for approval by the Departmental Representative.
 - .3 Arrange for the Departmental Representative to witness tests.
 - .4 Obtain written approval of test results and documentation from the 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 the 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.

1.18 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 the 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 the 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 approved by the Departmental Representative.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by the Departmental Representative.
 - .3 If evaluation report concludes that major damage has occurred, the Departmental Representative shall reject equipment.
 - .1 Rejected equipment to be removed from site and replaced with new.
 - .2 Subject new equipment/systems to specified start-up procedures.

1.19 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to the 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 the Departmental Representative to repeat start-up at any time.

1.20 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit to the 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.

1.21 TEST RESULTS

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

1.22 START OF COMMISSIONING

- .1 Notify the 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.

1.23 INSTRUMENTS / EQUIPMENT

- .1 Submit to the 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 Equipment as required to complete work.

1.24 COMMISSIONING PERFORMANCE VERIFICATION

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

1.25 WITNESSING COMMISSIONING

- .1 The Departmental Representative to witness activities and verify results.

1.26 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 the Departmental Representative within 5 days of test and with Cx report.

1.27 EXTRAPOLATION OF RESULTS

- .1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by the Departmental Representative in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.28 EXTENT OF VERIFICATION

- .1 Provide manpower and instrumentation to verify up to 100 % of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of the Departmental Representative.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .5 Perform additional commissioning until results are acceptable to the Departmental Representative.
- .6 The Departmental Representative will chair commissioning meetings, and witness all commissioning, testing and inspections with the Contractor, and all applicable sub-trades in attendance.

1.29 REPEAT VERIFICATIONS

- .1 Assume costs incurred by the Departmental Representative for third and subsequent verifications where:
 - .1 Verification of reported results fail to receive the Departmental Representative's approval.
 - .2 Repetition of second verification again fails to receive approval.
 - .3 The Departmental Representative deem the Contractor's request for second verification was premature.

1.30 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.

1.31 DEFICIENCIES, FAULTS, DEFECTS

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

1.32 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 the Departmental Representative.

1.33 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.

1.34 TRAINING

- .1 The Contractor shall perform training in accordance with the project requirements, including Section 01 79 00 13 - Demonstration and Training for Building Cx.
- .2 The Departmental Representative will participate in the training sessions put on by the Contractor.

1.35 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.36 OCCUPANCY

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

1.37 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 the Departmental Representative.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.38 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.

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 REFERENCES

- .1 Canadian Standards Association
 - .1 CSA Z320 (2011) – Building Commissioning.
 - .2 CSA C282 (2015) – Emergency Electrical Power Supply for Buildings
- .2 Other codes and standards referenced within the specifications.

1.2 GENERAL

- .1 Provide a fully functional facility:
 - .1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
 - .2 CBSA personnel have been fully trained in aspects of installed systems.
 - .3 Optimized life cycle costs.
 - .4 Complete documentation relating to installed equipment and systems.
 - .5 Provide an installation, testing and commissioning in accordance with the above referenced standards, and with the requirements of the specifications, checklists, and all contract documents.
- .2 Term "Cx" in this section means "Commissioning".
- .3 Use this Cx Plan as master planning document for Cx:
 - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
 - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
 - .3 Sets out deliverables relating to O&M, process and administration of Cx.
 - .4 Describes process of verification of how built works meet the design requirements.
 - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
 - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
 - .1 Overview of Cx.
 - .2 General description of elements that make up Cx Plan.
 - .3 Process and methodology for successful Cx.
- .4 Acronyms:
 - .1 Cx - Commissioning.
 - .2 O & M – Operations & Maintenance Manual.
 - .3 EMCS - Energy Monitoring and Control Systems.
 - .4 MSDS - Material Safety Data Sheets.
 - .5 PI - Product Information.

- .6 PV - Performance Verification.
- .7 TAB - Testing, Adjusting and Balancing.
- .8 WHMIS - Workplace Hazardous Materials Information System.
- .5 Commissioning terms used in this Section:
 - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
 - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

1.3 DEVELOPMENT OF 100% CX PLAN

- .1 Cx Plan to be 100% completed within 8 weeks of award of contract, by the Contractor to take into account:
 - .1 Approved shop drawings and product data.
 - .2 Approved changes to contract.
 - .3 Contractor's project schedule.
 - .4 Cx schedule.
 - .5 Equipment manufacturer's recommended testing / commissioning procedures.
 - .6 Contractor's, sub-contractor's, suppliers' requirements.
 - .7 Project construction team's and Cx team's requirements.
 - .8 The facility restrictions, and requirements for the facility to maintain operations throughout the construction period.
- .2 Submit completed Cx Plan to the Departmental Representative and obtain written approval.

1.4 REFINEMENT OF CX PLAN

- .1 During construction phase, revise, refine and update Cx Plan to include:
 - .1 Changes resulting from the Departmental Representative or CBSA program modifications.
 - .2 Approved design and construction changes.
 - .3 Adjustments to work schedules and completion milestones
- .2 Revise, refine and update every month during construction phase. At each revision, indicate revision number and date.
- .3 Submit each revised Cx Plan to the Departmental Representative for review and obtain written approval.
- .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

1.5 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

- .1 The Contractor shall maintain overall responsibility for project and is sole point of contact between members of commissioning team.
- .2 The overall commissioning team consisting of following members:

- .1 Departmental Design Quality Review Team: during construction, the Departmental Representative or designate, will conduct periodic site reviews to observe general progress.
- .2 Departmental Quality Assurance Commissioning Manager: the Departmental Representative or his designate will ensure Cx activities are carried out to ensure delivery of a fully operational project including:
 - .1 Review of Cx documentation from operational perspective.
 - .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
 - .3 Monitoring of Cx activities, monitoring of training, monitoring of development of Cx documentation.
 - .4 Work closely with other members of the Contractor's Cx Team.
- .3 The Departmental Representative or his designate is responsible for:
 - .1 Approving Cx schedule and program.
 - .2 Monitoring the Contractor's Cx activities.
 - .3 Witnessing of the Contractor's reported results.
 - .4 Witnessing of Contractor's tests.
 - .5 Ensuring the Contractor is implementing the final Cx Plan in accordance with the specifications and drawing requirements.
 - .6 Witnessing of the Contractor's verification of performance of the installed systems and equipment.
 - .7 Witnessing the Contractor's training plan.
- .4 Construction Team: The Contractor, along with his sub-contractors (as needed) are responsible for the construction/installation in accordance with contract documents, including but not limited to:
 - .1 Ensuring the systems are operational and certified as needed to allow for continuous building occupancy – without interruption to the tenant group.
 - .2 System Testing.
 - .3 Planning of Cx activities.
 - .4 Performance of Cx activities.
 - .5 Creation and completion of Pre-Functional and Functional documentation and forms.
 - .6 Creation and completion of Pre-functional and Functional checklist tasks.
 - .7 Delivery of training on the functionality, operations and maintenance of the installed systems to the Departmental Representative, Facility Manager, and Facility Maintenance staff.
 - .8 Completion of all Cx documentation.
 - .9 Creating O & M manuals, including all Cx documentation
 - .10 Assigning one person as point of contact with the Departmental Representative.
- .5 Contractor's Cx agent implements specified Cx activities including:
 - .1 Demonstrations.
 - .2 Training.

- .3 Testing.
- .4 Preparation, submission of test reports.
- .5 Documentation as part of the O & Ms
- .6 Property Manager: represents lead role in Operation Phase and onwards and is responsible for:
 - .1 Coordinating access to the facility.
 - .2 Day-To-Day operation and maintenance of facility.

1.6 CX PARTICIPANTS

- .1 The Contractor shall employ the following Cx participants to verify performance of equipment and systems:
 - .1 Installation contractor/subcontractor:
 - .1 Employ the services of the genset manufacturer's representative for performance certification of the genset, and for complete, final (and deficiency free) system.
 - .2 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.
 - .3 Ensure that Cx participant:
 - .1 Will complete work within scheduled time frame.
 - .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O&M personnel, including:
 - .1 Transfer switch.
 - .2 Genset.
 - .4 Provide names of participants to the Departmental Representative and details of instruments and procedures to be followed for Cx prior to starting date of Cx for review and approval.

1.7 RISK ASSESSMENT

- .1 Perform a risk assessment, and identify any risks associated with the work to the project team.

1.8 EXTENT OF CX

- .1 The Contractor shall commission systems and associated equipment:
 - .1 Electrical service:
 - .1 Voltage Level Check / Tap Adjustment
 - .2 Current
 - .2 Standby power:
 - .1 Genset
 - .2 Transfer switch.
 - .3 Load bank junction box, under varying load conditions, up to 100% load.
 - .3 Power and receptacles including but not limited to:
 - .1 Duplex receptacles.
 - .2 UPS

- .3 Panelboards
- .4 Grounding Systems:
 - .1 Grounding electrodes

1.9 DELIVERABLES RELATING TO O&M PERSPECTIVES

- .1 General requirements:
 - .1 All documentation shall be in the English language.
 - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
 - .1 Warranties.
 - .2 Project record documentation.
 - .3 Inventory of spare parts, special tools and maintenance materials.
 - .4 Maintenance Management System (MMS) identification system used.
 - .5 WHMIS information.
 - .6 MSDS data sheets.
 - .7 Electrical panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.
 - .8 Preventative maintenance program.
 - .9 Standard Operating Procedures (SOP).
 - .10 Contractor and sub-contractors' as-built drawings.

1.10 DELIVERABLES RELATING TO THE CX PROCESS

- .1 General:
 - .1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.
- .2 Definitions:
 - .1 Cx as used in this section:
 - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
 - .2 Factory inspections and performance verification tests.
- .3 Deliverables, provide:
 - .1 Cx Specifications.
 - .2 Startup, pre-Cx activities and documentation for systems, and equipment.
 - .3 Completed installation checklists (ICL).
 - .4 Completed product information (PI) report forms.
 - .5 Completed pre-functional performance forms.
 - .6 Completed functional performance verification forms.
 - .7 Results of performance verification tests and inspections.
 - .8 Full genset testing to CSA C282 (latest) standards, along with documentation.
 - .9 Description of Cx activities and documentation.

- .10 Description of Cx of integrated systems and documentation.
- .11 Training Plans.
- .12 Cx Reports.
- .13 Prescribed activities during warranty period.
- .4 The Departmental Representative or his designate shall witness and test results at their discretion.

1.11 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Items listed in this Cx Plan include the following:
 - .1 Pre-Start-Up inspections: by the Departmental Representative prior to permission to start up.
 - .2 The Contractor shall conduct pre-start-up tests and verification. Complete the pre-functional checklist work items, and complete pre-functional checklist paperwork. Rectify any deficiencies found.
 - .3 Include completed documentation in Cx report.
 - .4 Transfer switch and genset system.

1.12 START-UP

- .1 Start up components, equipment and systems.
- .2 The Departmental Representative to monitor some of these start-up activities.
 - .1 Rectify start-up deficiencies to satisfaction of the Departmental Representative.
- .3 Performance Verification (PV):
 - .1 The Contractor's approved Cx agent to perform.
 - .1 Repeat when necessary until results are acceptable to the Departmental Representative .
 - .2 Use procedures modified generic procedures to suit project requirements.
 - .3 The Departmental Representative to witness and certify reported results using approved PI and PV forms.
 - .4 The Departmental Representative to approve completed PV reports and provide by the Contractor.
 - .5 The Departmental Representative reserves right to have the Contractor to test / verify all equipment while witnessed by the Departmental Representative at no additional cost.
 - .6 Failure of items shall result in rejection of PV report or report of system startup and testing.

1.13 CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Perform Cx by specified Cx agency in accordance with the requirements of the specifications, using procedures developed by the Contractor and approved by the Departmental Representative .
- .2 The Departmental Representative to monitor Cx activities.
- .3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.

- .4 The Departmental Representative reserves right to have 100% of reported results re-verified by the Contractor at no additional cost to the contract.

1.14 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

- .1 Cx to be performed by the Contractor's Cx specialist, using procedures developed by the Contractor in accordance with the specification requirements, and approved by the Departmental Representative .
- .2 Tests to be witnessed by the Departmental Representative and his designate, and documented on approved report forms.
- .3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by the Contractor and submitted to the Departmental Representative for review.
- .4 Integrated systems to include:
 - .1 Genset, transfer switch and associated mobile load bank testing.
 - .2 Electrical service.
 - .3 UPS system.
- .5 Identification:
 - .1 In later stages of Cx, before hand-over and acceptance, the Contractor shall complete inventory data sheets and provide assistance to CBSA in full implementation of MMS identification system of components, equipment, sub-systems.

1.15 INSTALLATION CHECK LISTS (ICL)

- .1 Refer to Section 01 91 33 16 - Commissioning (Cx) Forms: Pre-functional Check List and Functional Performance Verification (PV) Forms.

1.16 PRODUCT INFORMATION (PI) REPORT FORMS

- .1 Refer to Section 01 91 13 16 - Commissioning (Cx) Forms: Product Information (PI).

1.17 PERFORMANCE VERIFICATION (PV) REPORT

- .1 Refer to Section 01 91 13 16 - Commissioning (Cx) Forms: Functional Performance Verification (PV) Forms.

1.18 DELIVERABLES RELATING TO ADMINISTRATION OF CX

- .1 General:
 - .1 Because of risk assessment, complete Cx of occupancy, weather and seasonal-sensitive equipment and systems in these areas before building is occupied.

1.19 CX SCHEDULES

- .1 Prepare detailed Cx Schedule and submit to the Departmental Representative for review and approval same time as project Construction Schedule. Include:
 - .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
 - .1 Design criteria, design intents.
 - .2 Cx agents' credentials: 30 days before start of Cx.

- .3 Cx procedures: 30 days after award of contract.
- .4 Cx Report format: 30 days after contract award.
- .5 Notification of intention to start TAB testing: 21 days before start.
- .6 Notification of intention to start Cx: 10 days before start of Cx.
- .7 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.
- .8 Identification of deferred Cx.
- .9 Implementation of training plans.
- .10 Cx reports: 5 days upon successful completion of Cx.
- .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to the Departmental Representative .
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 The Departmental Representative will monitor progress of Cx against this schedule.

1.20 CX REPORTS

- .1 Submit reports of tests, witnessed and certified to the Departmental Representative .
- .2 Include completed and certified PV reports in properly formatted Cx Reports.
- .3 Before reports are accepted, reported results to be subject to verification by the Departmental Representative and his designate.

1.21 PRELIMINARY AND FINAL CX

- .1 Submit preliminary Cx documentation for review to the Departmental Representative . Correct any and all deficiencies noted.
- .2 Submit final Cx documentation in PDF format held on 4 USB memory stick drives, along with 4 hardcopies compiled within 4 or more 3-ring binders.

1.22 TESTS TO BE PERFORMED BY THE DEPARTMENTAL REPRESENTATIVE

- .1 None is anticipated on this project. All testing will be performed by the Contractor.

1.23 TRAINING PLANS

- .1 Refer to Section 01 79 00 13 - Commissioning (Cx) - Training.

1.24 FINAL SETTINGS

- .1 Upon completion of Cx to satisfaction of the Departmental Representative, lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

Part 2 Products

2.1 GENERAL

- .1 Provide all equipment and labor as necessary to perform Cx.

Part 3 Execution

3.1 GENERAL

- .1 Employ qualified personnel and complete commissioning of all systems.
- .2 The Contractor shall perform all services as required, and provide the personnel as needed in order to minimize interruptions at the facility. The facility is expected to be continuously operational during all the work. Provide personnel, and adjust work schedule as needed to maintain continuous operations at the facility.

END OF SECTION

Part 1 General

1.1 TESTING

- .1 Perform testing and commissioning of all installed systems, including but not limited to:
 - .1 Genset
 - .2 Transfer switch
 - .3 UPS
 - .4 Distribution panel, and panelboards
 - .5 Power and receptacles

1.2 CHECK LISTS

- .1 Include the following data:
 - .1 Product manufacturer's installation instructions and recommended checks.
 - .2 Special procedures as specified in relevant technical sections.
 - .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2 Equipment manufacturer's installation/start-up check lists are acceptable for use to supplement the check lists provided.
- .3 Use check lists for equipment installation. Document check list verifying checks have been made; indicate deficiencies and corrective action taken.
- .4 Contractor to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Departmental Representative. Check lists will be required during Commissioning and will be included in O & M Manuals at completion of project.
- .5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

1.3 PRODUCT INFORMATION (PI) REPORT FORMS

- .1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation shall be included in the O & Ms and commissioning manual at completion of work.
- .2 Prior to Performance Verification (PV) of systems complete items on the product information (PI) as well as the pre-functional checklist forms related to systems and obtain Departmental Representative's approval.

1.4 PERFORMANCE VERIFICATION (PV) FORMS

- .1 PV (performance verification functional checklist) forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.

- .2 PV report forms include those developed by the Contractor to record measured data and readings taken during functional testing and Performance Verification procedures.

1.5 SAMPLES OF COMMISSIONING FORMS

- .1 Revise items on Commissioning forms where required, and where agreed to by the Departmental Representative, to suit project specific requirements.
- .2 Complete all commissioning forms. These commissioning forms are attached to this section.

1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

- .1 When additional forms are required, but are not available, develop appropriate verification forms and submit to the Departmental Representative for approval prior to use.
 - .1 Additional commissioning forms to be verified and accepted by the Departmental Representative.

1.7 COMMISSIONING FORMS

- .1 Use commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
 - .1 The Contractor shall provide project-specific Commissioning forms. The forms will be based on and included at a minimum all requirements of the pre-functional and functional check list forms included herein. The Contractor shall add manufacturer specific requirements as necessary. The Contractor shall update the forms with project specific information.
 - .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
 - .3 Confirm operation, and sequence of operation of the systems, as per design criteria and intent.
 - .4 Identify variances between design and operation and reasons for variances.
 - .5 Record analytical and substantiating data.
 - .6 Verify reported results.
 - .7 Form to bear signatures of recording technician.
 - .8 Submit within 5 days, after tests are performed.
 - .9 The Contractor shall provide the Departmental Representative with 4 copies of the completed forms on 4 separate USB memory drives.
 - .10 Maintain a copy of the forms on site during start-up, testing and commissioning period.

1.8 LANGUAGE

- .1 English.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 GENERAL

- .1 Make a copies of the attached product information form, and fill out each form for each different equipment part number utilized on this project.
- .2 Include the product information forms as part of the overall O & M manuals.

Product Information Form

Project _____

Equipment Description _____

1. Vendor Information

Contact Name	
Address	
Phone number	

2. Product Information

Manufacturer	
Model #	
Serial #	
Size	
Capacity	
Warranty	
O&M Manuals Supplied	

END OF SECTION

Pre-functional Checklist

Project R.094408.001 / SLI 663574

Genset

Location _____ **TAG#** _____

1. General

Check if Okay. Enter comment or note number if deficient.

Check	Y / N	Contr.
CSA / ULC labels are affixed to all equipment / devices.		
Confirm that the equipment nameplate matches the shop-drawings and project requirements.		
All manufacturer recommended pre-functional checks are complete. Provide completed manufacturer approved Static Verification Check form in addition to the documentation herein.		
The system is installed in accordance with CSA C282.		
All field wiring (where applicable) has been terminated at the correct locations.		
Document and verify nameplate information. Ensure that nameplate is in accordance with the Shop drawing requirements.		

2. Physical Installation Checks

Check	Y / N	Contr.	Note
Units / components are free from physical damage.			
All components present.			
Installation and start-up manual provided and reviewed by Contractor.			
Device tags affixed.			
Transfer switch is installed and connected to the genset.			
Genset auxiliary power systems are installed and powered and tested.			
Verify fuel tank is full			
Verify lubrication / oil level and system			
Verify coolant level and system			
Verify ventilation system			
Verify cranking and DC system			
Verify isolation			
Verify grounding			
Verify exhaust system			

Genset (Continued)

3. Installation of Components and Systems

Check	Y / N	Contr.	Note
Units / components are secured as required by the manufacturer and specifications.			
All components are accessible for maintenance.			

4. Power and Wiring

Check	Y / N	Contr.	Note
All wiring has been installed (and correctly terminated) as required.			
All wiring connections are correctly torqued to the manufacturer's recommendations.			
Wiring is arranged for ease of unit removal.			
Conduit supports are as required by CEC and specifications.			
Wiring is neatly grouped and supported, without undue strain.			
Wires are correctly color coded in accordance with the Specifications.			
Conduits are correctly color coded in accordance with the Specifications.			
Wire tags are affixed to each wire termination end and are consistent with the wiring diagrams.			
All wiring used is CSA approved, and correctly sized.			

Contractor Name (Printed) _____

Contractor Phone Number (Printed) _____

Contractor Signature _____

Consultant Name / Signature _____ / _____

CBSA Name / Signature _____ / _____

NOTES:

- The Contractor shall make the appropriate number of copies of this document. One check list per device in every room.
- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

- This document does not take the place of a full and complete fire alarm V.I report. The Contractor is responsible for all the fire alarm V.I requirements in addition to the other requirements herein.
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- “Contr.” column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. CC = controls contractor, EC = electrical contractor, MC = mechanical contractor.

-- END OF GENSET PRE-FUNCTIONAL CHECKLIST—

Pre-functional Checklist

Project R.094408.001 / SLI 663574

Transfer Switch

FLOOR # _____ / ROOM # _____ / TAG# / CCT# _____

1. General

Check if Okay. Enter comment or note number if deficient.

Check	Y / N	Contr.
CSA / ULC labels are affixed to all equipment / devices.		
All manufacturer recommended pre-functional checks are complete.		
The system is installed in accordance with CSA C282		
All field wiring (where applicable) has been terminated at the correct locations.		

2. Physical Installation Checks

Check	Y / N	Contr.	Note
Units / components are free from physical damage.			
All components present.			
Installation and start-up manual provided and reviewed by Contractor.			
Device tags affixed.			
Transfer switch is installed, and connected to the genset.			
Control and power systems are installed.			

3. Installation of Components

Check	Y / N	Contr.	Note
Units / components are secured as required by the manufacturer and specifications.			
All components are accessible for maintenance.			

Transfer Switch (Continued)

4. Power and Wiring

Check	Y / N	Contr.	Note
All wiring has been installed (and correctly terminated) as required.			
All wiring connections are correctly torqued to the manufacturer's recommendations.			
Wiring is arranged for ease of unit removal.			
Conduit supports are as required by CEC and specifications.			
Wiring is neatly grouped and supported, without undue strain.			
Wires are correctly color coded in accordance with the Specifications.			
Conduits are correctly color coded in accordance with the Specifications.			
Wire tags are affixed to each wire termination end and are consistent with the wiring diagrams.			
All wiring used is CSA approved, and correctly sized.			

Contractor Name (Printed) _____

Contractor Phone Number (Printed) _____

Contractor Signature _____

Consultant Name / Signature _____ / _____

CBSA Name / Signature _____ / _____

NOTES:

- The Contractor shall make the appropriate number of copies of this document. One check list per device in every room.
- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- This document does not take the place of a full and complete fire alarm V.I report. The Contractor is responsible for all the fire alarm V.I requirements in addition to the other requirements herein.
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. CC = controls contractor, EC = electrical contractor, MC = mechanical contractor.

-- END OF TRANSFER SWITCH PRE-FUNCTIONAL CHECKLIST--

Pre-functional Checklist

Project R.094408.001 / SLI 663574

UPS

FLOOR # _____ / ROOM # _____ / TAG# / CCT# _____

1. General

Check if Okay. Enter comment or note number if deficient.

Check	Y / N	Contr.
CSA / ULC labels are affixed to all equipment / devices.		
All manufacturer recommended pre-functional checks are complete.		
The system is installed in accordance with CSA C282		
All field wiring (where applicable) has been terminated at the correct locations.		

2. Physical Installation Checks

Check	Y / N	Contr.	Note
Units / components are free from physical damage.			
All components present.			
Installation and start-up manual provided and reviewed by Contractor.			
Device tags affixed.			
UPS batteries are installed and connected.			
Control and power systems are installed.			

3. Installation of Components

Check	Y / N	Contr.	Note
Units / components are secured as required by the manufacturer and specifications.			
All components are accessible for maintenance.			

UPS (Continued)

4. Power and Wiring

Check	Y / N	Contr.	Note
All wiring has been installed (and correctly terminated) as required.			
All wiring connections are correctly torqued to the manufacturer's recommendations.			
Wiring is arranged for ease of unit removal.			
Conduit supports are as required by CEC and specifications.			
Wiring is neatly grouped and supported, without undue strain.			
Wires are correctly color coded in accordance with the Specifications.			
Conduits are correctly color coded in accordance with the Specifications.			
Wire tags are affixed to each wire termination end and are consistent with the wiring diagrams.			
All wiring used is CSA approved, and correctly sized.			

Contractor Name (Printed) _____

Contractor Phone Number (Printed) _____

Contractor Signature _____

Consultant Name / Signature _____ / _____

CBSA Name / Signature _____ / _____

NOTES:

- The Contractor shall make the appropriate number of copies of this document. One check list per device in every room.
- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- This document does not take the place of a full and complete fire alarm V.I report. The Contractor is responsible for all the fire alarm V.I requirements in addition to the other requirements herein.
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. CC = controls contractor, EC = electrical contractor, MC = mechanical contractor.

-- END OF UPS PRE-FUNCTIONAL CHECKLIST--

Pre-functional Checklist

Project GOC453027 & GOC1901409 / SLI 660213

Receptacles

FLOOR # _____ / ROOM # _____ / TAG# / CCT# _____

General

Check if Okay. Enter comment or note number if deficient.

Check	Y / N	Contr.
Check to ensure that painting and taping and other work did not impact receptacle. Clean, and remove tape		
CSA / ULC labels are affixed to all equipment / devices.		
Verify integrity of cover plate and screws.		
Correct coverplate with the correct circuit number is allocated for each receptacle.		

2. Physical Installation Checks

Check	Y / N	Contr.	Note
Units / components are free from physical damage.			
All components present.			

3. Installation of Components

Check	Y / N	Contr.	Note
Units / components are secured as required by the manufacturer and specifications.			
Equipment tagged, labeled and easy to see.			

4. Wiring and Connections

Check	Y / N	Contr.	Note
All wiring has been installed (and correctly terminated) as required.			
Verify that wiring connections have not been impacted and that connections are tight / properly torque.			

Receptacles (cont)

Contractor Name (Printed) _____

Contractor Phone Number (Printed) _____

Contractor Signature _____

Consultant Name / Signature _____ / _____

CBSA Name / Signature _____ / _____

NOTES:

- The Contractor shall make the appropriate number of copies of this document. One check list per room where the devices are installed.
- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. FA = fire alarm commissioning agent, CC = controls contractor, EC = electrical contractor, MC = mechanical contractor.

-- END OF RECEPTACLES PRE-FUNCTIONAL CHECKLIST--

Performance Verification Functional Performance Testing Procedures

Project R.094408.001 / SLI 663574

Genset

Location _____ **TAG#** _____

1. Test Prerequisites

Check	Y/N	Contr.
Pre-functional checks complete.		
Testing is to be scheduled with the Departmental Representative, CBSA, and PSPC. All parties, including sub-trades shall be on site to witness the testing.		
Maintenance personnel are present and access to the entire facility is available.		
Genset and transfer switch manufacturer representative are on site, and have reviewed the installation.		
Provide diesel fuel for the genset to perform the system tests.		
A mobile load bank is on site and available.		

2. Testing Procedures and Record

The Contractor shall supply appropriate personnel for a complete review of the system.

Test Procedure	Pass Y / N	Contr.	Note
Lock-out the genset circuit breaker feeding the Customs Building.			
With the genset de-energized, and the breaker at the genset which feeds the load bank locked-out. Connect the mobile load bank to the genset.			
Perform testing and commissioning of genset, in accordance with all the requirements of CSA C282. Provide documentation indicating successful test results including verification forms and check sheets for all mode of operations.			
With the genset running at 50% load and at full load, verify that system vibrations are in accordance with the manufacturer's tolerances.			
With the genset running at 50% load and at full load, verify that system noise output is in accordance with the manufacturer's tolerances.			
Perform 1-hour operational test:			
Observe and record time delay on start;			
Observe and record cranking time until the engine starts and runs;			
Observe and record the time required to come up to operating speed;			

Test Procedure	Pass Y / N	Contr.	Note
Observe and record the time required for each life safety equipment transfer switch to be transferred to the emergency position;			
Observe and record the time required to achieve a steady-state condition, with all switches transferred to the emergency position;			
Observe and record the time required for each life safety equipment transfer switch to be transferred to the emergency position;			
Observe and record the voltage, frequency, and amperes at start-up, at any observed change in load, and at maximum site design load;			
Observe and record the engine oil pressure, water temperature (or other representative engine operating temperature, where applicable, e.g., with air-cooled engines), and the battery charge rate 1 min after start, at 5 min intervals for the first 15 min, and at 15 min intervals thereafter;			
Observe and record the time delay on retransfer for each transfer switch; and			
Observe and record the time delay on engine cool-down and shutdown.			
Perform 4-hour full load test, Observe and record all parameters every 15 minutes:			
The voltage, frequency, and amperes			
The engine oil pressure, engine / water temperature			
Test and perform safety shutdown for:			
Low engine temp			
Pre hi temp			
Pre low oil pressure			
Over crank			
Over speed			
Low fuel			
Not in Auto			
Low battery voltage			

Genset (cont)

Contractor Name (Printed) _____

Contractor Phone Number (Printed) _____

Contractor Signature _____

Consultant Name / Signature _____ / _____

CBSA Name / Signature _____ / _____

NOTES:

- The Contractor shall make the appropriate number of copies of this document. One check list per device in every room.
- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- This document does not take the place of a full and complete fire alarm V.I report. The Contractor is responsible for all the fire alarm V.I requirements in addition to the other requirements herein.
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. CC = controls contractor, EC = electrical contractor, MC = mechanical contractor.

-- GENSET – FUNCTIONAL PERFORMANCE PROCEDURES --

Performance Verification Functional Performance Testing Procedures

Project R.094408.001 / SLI 663574

Transfer Switch

FLOOR # _____ / ROOM # _____ / TAG# _____

1. Test Prerequisites

Check	Y/N	Contr.
Pre-functional checks complete.		
Testing is to be scheduled with the Departmental Representative, CBSA, and PSPC. All parties, including sub-trades shall be on site to witness the testing.		
Equipment manufacturer representatives are present and access to the entire facility is available.		

2. Testing Procedures and Record

The Contractor shall supply appropriate personnel for a visual review of each strobe in every area on every floor to ensure that the new system operates as required.

Test Procedure	Pass Y / N	Contr.	Note
Simulate a power outage by opening the utility breaker power supply. Ensure that the transfer switch operates as intended on loss of power and in normal power to the facility.			

Contractor Name (Printed) _____

Contractor Phone Number (Printed) _____

Contractor Signature _____

Consultant Name / Signature _____ / _____

CBSA Name / Signature _____ / _____

Transfer Switch (cont)

NOTES:

- The Contractor shall make the appropriate number of copies of this document. One check list per device in every room.
- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- This document does not take the place of a full and complete fire alarm V.I report. The Contractor is responsible for all the fire alarm V.I requirements in addition to the other requirements herein.
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. CC = controls contractor, EC = electrical contractor, MC = mechanical contractor.

-- TRANSFER SWITCH – FUNCTIONAL PERFORMANCE PROCEDURES --

Performance Verification Functional Performance Testing Procedures

Project R.094408.001 / SLI 663574

UPS

FLOOR # _____ / **ROOM #** _____ / **TAG#** _____

1. Test Prerequisites

Check	Y/N	Contr.
Pre-functional checks complete.		
Testing is to be scheduled with the Departmental Representative, CBSA, and PSPC. All parties, including sub-trades shall be on site to witness the testing.		

2. Testing Procedures and Record

The Contractor shall supply appropriate personnel for a visual review of each strobe in every area on every floor to ensure that the new system operates as required.

Test Procedure	Pass Y / N	Contr.	Note
Simulate a power outage by opening the normal utility power breaker to the UPS, and ensure that UPS maintains continuous power supply at the output / loads.			

Contractor Name (Printed) _____

Contractor Phone Number (Printed) _____

Contractor Signature _____

Consultant Name / Signature _____ / _____

CBSA Name / Signature _____ / _____

UPS (cont)

NOTES:

- The Contractor shall make the appropriate number of copies of this document. One check list per device in every room.
- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- This document does not take the place of a full and complete fire alarm V.I report. The Contractor is responsible for all the fire alarm V.I requirements in addition to the other requirements herein.
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. CC = controls contractor, EC = electrical contractor, MC = mechanical contractor.

- UPS – FUNCTIONAL PERFORMANCE PROCEDURES --

Functional Performance Testing Procedures

Project R.094408.001 / SLI 663574

Receptacles

FLOOR # _____ / ROOM # _____ / TAG# _____

Test Prerequisites

Check	Y/N	Contr.
Pre-functional checks complete.		
Testing is to be scheduled with the Departmental Representative. All parties, including sub-trades shall be on site to witness the testing.		
Maintenance personnel are present and access to the entire facility is available.		

2. Testing Procedures and Record

The Contractor shall supply communications means, measuring devices and appropriate personnel for an audibility test of every room and every area on every floor to ensure that the new amplifier system operates as required.

Test Procedure	Pass Y / N	Contr.	Note
Utilizing a receptacle test devices, which confirms receptacle polarity, proper grounding, and receptacle fault, plug in tester at each receptacle, and confirm proper operation.			

Contractor Name (Printed) _____

Contractor Phone Number (Printed) _____

Contractor Signature _____

Consultant Name / Signature _____ / _____

CBSA Name / Signature _____ / _____

Receptacles (continued)

NOTES:

- The Contractor shall make the appropriate number of copies of this document. One check list is required per control device in each and every room.
- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. CC = controls contractor, EC = electrical contractor, etc

-END OF RECEPTACLES – FUNCTIONAL PERFORMANCE PROCEDURES --

-- END OF CHECKLIST --

Items Number	Date of Commissioning	Commissioning Issues	Expected Date of Rectification	Item Rectified	Technician Name / Phone Number	Technician Initials

Part 1 General

1.1 ACRONYMS

- .1 O & M – Operations and Maintenance.
- .2 Cx - Commissioning.
- .3 PI - Product Information.
- .4 PV - Performance Verification.
- .5 WHMIS - Workplace Hazardous Materials Information System.

1.2 GENERAL REQUIREMENTS FOR O & M MANUALS

- .1 Standard letter size paper.
- .2 Methodology used to facilitate updating.
- .3 Drawings, diagrams and schematics to be professionally developed using AutoCAD software, Microsoft Excel, or other approved professional software programs.
- .4 Contractor shall provide 3 hard copies within multiple, separate 50mm (or larger), 3-ring binders, and 3 USB memory drives with the required content to the Departmental Representative.
- .5 Electronic copy of data to be in a format accepted and approved by the Departmental Representative. All PDF format documents shall be searchable. In general accepted formats are:
 - .1 Microsoft Word format.
 - .2 PDF format.
 - .3 AutoCAD format.

1.3 APPROVALS

- .1 Prior to submittal of the hard copies of O & M manuals, provide an electronic copy (PDF format) to the Departmental Representative.
- .2 Prior to commencement, co-ordinate requirements for preparation, submission and approval with the Departmental Representative.

1.4 GENERAL INFORMATION

- .1 Provide the following for insertion into appropriate Part and Section of O & M manual:
 - .1 Complete list of names, addresses, telephone and fax numbers of contractors
 - .2 Summary of electrical systems installed and commissioned.
 - .3 System, equipment and components Maintenance Management System
 - .4 As Built drawings done in AutoCAD format
 - .5 All commissioning forms and commissioning reports.

1.5 CONTENTS OF OPERATING AND MAINTENANCE MANUALS

- .1 The Operations and Maintenance (O & M) Manual shall be neatly organized with appropriate labels and divider tabs. On the front cover of each binder, and on the binder edge, include: project name, building name and address, project number, project completion date (ex. June 2020).

- .2 The O & M manual content shall be ordered sequentially and shall include content in accordance with 01 78 00.
- .3 Include original manufactures brochures and written information on products and equipment installed on this project.
- .4 Organize the electronic files under specific folders, which correspond to the Tabs indicated.
- .5 Record and organize for easy access and retrieval of information contained in O & M.
- .6 Approved project shop-drawings, product and maintenance data.
- .7 Manufacturer's data and recommendations relating: manufacturing process, installation, commissioning, start-up, O&M, shutdown and training materials.
- .8 Warranty information – the warranty shall be signed, and dated, and shall be valid for 12 months from the period of substantial completion.

1.6 SUPPORTING DOCUMENTATION FOR INSERTION INTO SUPPORTING APPENDICES

- .1 Not applicable

1.7 LANGUAGE

- .1 English.

1.8 IDENTIFICATION OF FACILITY

- .1 When submitting information to the Departmental Representative for incorporation into O & M manual, use following system for identification of documentation:
 - .1 R.094408.001 – Genset Replacement - CBSA Highway 10 – Boissevain, MB.

1.9 USE OF CURRENT TECHNOLOGY

- .1 Not Applicable

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 SCHEDULE

- .1 The O & M manuals shall be submitted prior to substantial completion.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

Codes, Standards and Regulations

Perform the work in accordance with the relevant codes and standards from the regulatory agencies and institutes listed below.

The latest issue of an individual code, standard or regulation at the time of contract signing shall govern.

Work shall conform to the current edition of codes specified:

- .1 ANSI A10.8 2019, Safety Requirements for Scaffolding
- .2 ASTM C 475/C 475M 2017, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
- .3 NFPA 241 2019, Standard for Safeguarding Construction, Alteration, and Demolition Operations
- .4 In the event of conflict between the reference codes and standards, drawings, specifications, and/or the Purchase Order, obtain written clarification from the Departmental Representative before proceeding with the work.

1.2 DEFINITIONS

- .1 Demolish: Detach items from existing construction and legally dispose of them off site, unless indicated to be removed and salvaged or removed and reinstalled.
- .2 Remove and Salvage: Detach items from existing construction and deliver them to the Departmental Representative ready for reuse.
- .3 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .4 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed, removed and salvaged, or removed and reinstalled.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate with the Departmental Representative for the material ownership as follows:
 - .1 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain CBSA's property; demolished materials shall become the Contractor's property and shall be removed from Project site.
- .2 Sequencing
 - .1 Sequence activities to demolish the Work in the following order:
 - .1 Existing electrical equipment after new systems are installed.
 - .2 The existing genset, after the new genset is installed.
- .3 Scheduling: Schedule work to requirements of Section 01 31 00.

- .1 Schedule Work to precede new construction.
- .2 The demolition and construction are to be phased and demolition of one area must be coordinated with new construction of the phase. Complete all demolition of the phase prior to commencement of new construction.
- .3 Describe demolition removal procedures and schedule.
- .4 Perform dusty, noisy, and malodorous work:
 - .1 In coordinate work with the Departmental Representative.
- .5 Pre-Demolition Meeting: Convene pre-installation meeting 1 week prior to beginning work of this Section and on-site installation, with Contractor, the Departmental Representative to:
 - .1 Confirm extent of salvaged and demolished materials
 - .2 Review Contractor's demolition plan
 - .1 Verify existing site conditions adjacent to demolition work
 - .2 Coordination with other construction sub trades
- .6 Hazardous materials
 - .1 Provide asbestos abatement plan prior to demolition work.

1.4 ACTION AND INFORMATION SUBMITTALS

- .1 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Schedule of Selective Demolition Activities, which indicate the following:
 - .1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
 - .2 Coordinate with the Departmental Representative ongoing site operations and limit the number of interruptions during regular business hours.
 - .3 Interruption of services.
 - .4 Coordination for shutoff, capping, and continuation of utility services.
 - .5 Use of stairs.
 - .6 Locations of temporary partitions and means of egress, including for others affected by selective demolition operations.
 - .7 Coordination with the Departmental Representative continuing occupancy of the facility.
 - .2 Demolition Plan: Submit a plan of demolition area indicating extent of temporary facilities and supports, methods of removal and demolition prepared by a professional engineer in accordance with requirements of Authority Having Jurisdiction, and as follows:
 - .1 Proposed Dust Control and Noise Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. The Departmental Representative reserves the right to make modifications where proposed methods interfere with the Tenants ongoing operation

- .2 Inventory: Submit a list of items that have been removed and salvaged after selective demolition is complete.
- .3 Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work as follows; use most restrictive requirements where differences occur between the municipal, provincial and federal jurisdictions:
 - .1 Provincial and Federal Requirements: Perform work in accordance with governing environmental notification requirements and regulations of the Authority Having Jurisdiction.
 - .2 Municipal Requirements: Perform hauling and disposal operations in accordance with regulations of Authority Having Jurisdiction.
- .2 Qualifications: Provide proof of qualifications when requested by the Departmental Representative:
 - .1 Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project:
 - .1 Conform to the provincial Occupational Health and Safety Act and Regulation.
 - .2 Conform to Workers' Compensation Board Regulations.
 - .3 Conform to City of local municipal bylaws and regulations governing this type of work.

1.6 SITE CONDITIONS

- .1 CBSA will continue to occupy all buildings at the site:
 - .1 Conduct selective demolition so that building operations will not be disrupted.
 - .2 Provide not less than 10 days notice to the Departmental Representative of activities that will affect building operations.
- .2 Maintain access to existing means of egress, walkways, corridors, exits, and other adjacent occupied or used facilities:
 - .1 Do not close or obstruct means of egress, walkways, corridors, exits, or other occupied or used facilities without written acceptance from authorities having jurisdiction.
- .3 CBSA assumes no responsibility for systems to be selectively demolished:
 - .1 Conditions existing at time of Pre-Bid Site Review will be maintained by CBSA as far as practical.
- .4 Discovery of Hazardous Substances: Hazardous Substances are present at the worksite and have been identified in the attached Hazardous Material Assessment Report.
 - .1 Examine report to become aware of locations where hazardous materials are present.
 - .2 Perform remediation of hazardous materials in a safe and effective manner.

- .5 If materials other than those identified in the Hazardous Material Assessment Report are suspected of containing hazardous materials, do not disturb; immediately notify the Departmental Representative.

Part 2 PRODUCTS

2.1 DESCRIPTION

- .1 This section of the Work includes, but is not necessarily limited to, the following:
 - .1 Demolition, removal completely from site, and disposal of all identified components, materials, equipment and debris.
 - .2 Selective demolition to allow installation of new suspended ceiling, lighting and carpet installation.
 - .3 All material from demolition shall be removed from site immediately with no salvage, selling, sorting or burning permitted on site.
 - .4 Retain items indicated on drawings for re use in new construction

2.2 DEBRIS

- .1 Make all arrangements for transport and disposal of all demolished materials from the site.

2.3 EQUIPMENT

- .1 Provide all equipment required for safe and proper demolition of the building interiors indicated.

2.4 REPAIR MATERIALS

- .1 Use repair materials identical to existing materials:
 - .1 If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - .2 Use a material whose installed performance equals or surpasses that of existing material.
 - .3 Comply with material and installation requirements specified in individual Specification Sections.
- .2 Floor Patching and Levelling Compounds: Cement based, trowelable, self levelling compounds compatible with specified floor finishes; gypsum-based products are not acceptable for work of this Section.
- .3 Gypsum Board Patching Compounds: Joint compound to ASTM C 475/C 475M, bedding and finishing types thinned to provide skim coat consistency to patch and prepare existing gypsum board walls ready for new finishes in accordance with Section 09 21 16 - Gypsum Board Systems.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verify that utilities have been disconnected for all areas impacted by selective demolition.
- .2 Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- .3 Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- .4 Notify the Departmental Representative where existing mechanical, electrical, or structural elements conflict with intended function or design:
 - .1 Investigate and measure the nature and extent of conflict and submit a written report.
 - .2 Departmental Representative will issue additional instructions or revise drawings as required to correct conflict.
- .5 Perform surveys as the work progresses to detect hazards resulting from selective demolition activities.

3.2 PREPARATION

- .1 Identify and mark all equipment and materials identified to be retained or to be re used in subsequent construction. Separate and store items to be retained in an area away from area of demolition and protect from accidental disposal.
- .2 Post warning signs on electrical lines and equipment that must remain energized to serve other areas during period of demolition.
- .3 Confirm that all electrical power, data and telephone service lines impacted are surveyed, and marked.
- .4 Do not disable or disrupt building fire or life safety systems without 10 days prior written notice to the Departmental Representative.
- .5 Conform to applicable regulatory procedures when discovering hazardous or contaminated materials.
- .6 The presence of asbestos containing materials in the building is known. All material impacted by the demolition and construction must be handled in conformance with all applicable regulatory procedures. Refer to "Hazardous Material Assessment Report" for known locations of hazardous materials.
- .7 Provide and maintain barricades, warning signs, protection for workmen and the public during the full extent of the Work. Read drawings carefully to ascertain extent of protection required.
- .8 Mark all materials required to be re used, store in a safe place until ready for re installation.
- .9 Remove permanent marker lines used or found on exposed surfaces and at surfaces indicated for subsequent finish materials. Mechanically remove permanent marker lines

and associated substrates where permanent marker lines occur and patch surface. Sealing or priming over permanent marker lines is not acceptable.

3.3 SELECTIVE DEMOLITION

- .1 Demolish and dismantle work in a neat and orderly manner and in strict accordance with all regulations.
- .2 Saw cut straight lines for any removal of Asphalt and PCC.
- .3 At end of each day's work, leave Work in safe condition so that no part is in danger of toppling or falling.
- .4 Demolish in a manner to minimize dusting and to prevent migration of dust.
- .5 Selling or burning of materials on the site is not permitted.
- .6 Patch and repair all walls, floor and ceilings damaged during demolition with material matching adjacent walls, prepare ready for new finishes.
- .7 Perform demolition of asbestos containing materials.

3.4 PATCHING AND REPAIRING

- .1 Floors and Walls:
 - .1 Where walls or partitions that are demolished extend from one finished area into another, patch and repair floor and wall surfaces in the new space.
 - .2 Provide a level and smooth surface having uniform finish colour, texture, and appearance.
 - .3 Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform colour and appearance.
 - .4 Patch with durable seams that are as invisible as possible.
 - .5 Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - .6 Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
 - .7 Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- .2 Ceilings: patch, repair, or re hang existing ceilings as necessary to provide an even plane surface of uniform appearance.

3.5 PROTECTION

- .1 Maintain safe access to and egress from occupied areas adjoining the area of demolition.
- .2 Provide and maintain fire prevention equipment and alarms during demolition.

3.6 CLEANING

- .1 Develop Construction Waste Management Plan related to Work of this Section and in accordance and Section 01 74 19 - Waste Management and Disposal.

- .2 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal, and as follows:
- .3 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .4 Promptly as the Work progresses, and on completion, clean up and remove from the site all rubbish and surplus material. Remove rubbish resulting from demolition work daily.
- .5 Maintain access to exits clean and free of obstruction during removal of debris.
- .6 Provide cleaning and disposal of asbestos containing materials.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-O86:14 (R2019), Engineering Design in Wood.
 - .3 CSA O121-17, Douglas Fir Plywood.
 - .4 CSA O151-17, Canadian Softwood Plywood.
 - .5 CSA O153-19, Poplar Plywood.
 - .6 CSA-O325-16, Construction Sheathing.
 - .7 CSA O437 Series-(R2011), Standards for OSB and Waferboard.
 - .8 CSA S269.1-16, Falsework for Construction Purposes.
- .2 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings for formwork and falsework.
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
- .2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts.
- .3 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.
- .4 Indicate sequence of erection and removal of formwork/falsework as directed by Departmental Representative.

1.3 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 MATERIALS

- .1 Formwork materials:
 - .1 Use wood and wood product formwork materials to CSA-O86.
 - .2 Rigid insulation board: to CAN/ULC-S701.
- .2 Form ties:
 - .1 Use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
- .3 Form release agent: biodegradable, non-toxic.
- .4 Falsework materials: to CSA-S269.1.

Part 3 Execution

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .3 Fabricate and erect falsework in accordance with CSA S269.1.
- .4 Do not place shores and mud sills on frozen ground.
- .5 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .6 Fabricate and erect formwork to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
- .7 Align form joints and make watertight.
 - .1 Keep form joints to minimum.
- .8 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
- .9 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .10 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.
 - .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .11 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 REMOVAL

- .1 Leave formwork in place for following minimum periods of time after placing concrete.
 - .1 4 days

- .2 Remove formwork when concrete has reached 70% of design strength.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA A23.1-14 /A23.2-14 , Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA A23.3-14 , Design of Concrete Structures.
 - .3 CSA G30.18-09 (R2014) , Carbon Steel Bars for Concrete Reinforcement.
 - .4 CSA G40.20/G40.21-13 (R2014) , General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: convene pre-installation meeting one week prior to beginning concrete works.
 - .1 Ensure key personnel attend.
 - .1 Verify project requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in Cast-In-Place Concrete and additives and include product characteristics, performance criteria, physical size, finish, and limitations.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba.
 - .1 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.
 - .2 Indicate placing of reinforcement and:
 - .1 Bar bending details.
 - .2 Lists.
 - .3 Quantities of reinforcement.
 - .4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings.
 - .5 Indicate sizes, spacings and locations of chairs, spacers and hangers.

- .3 Detail lap lengths and bar development lengths to CAN/CSA A23.3.
 - .1 Provide Type B unless otherwise indicated.
- .4 Indicate position and size of openings in slabs and walls. Coordinate with trades requiring openings.

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 off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Reinforcing steel: billet steel, grade 400, deformed bars to CSA G30.18.
- .2 Reinforcing steel: weldable low alloy steel deformed bars to CSA G30.18.
- .3 Cold-drawn annealed steel wire ties: to ASTM A1064/A1064M.
- .4 Deformed steel wire for concrete reinforcement: to ASTM A1064/A1064M.
- .5 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.
- .6 Tie wire: 1.5 mm diameter annealed wire,.
- .7 Plain round bars: to CSA G40.20/G40.21.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

Part 3 Execution

3.1 FIELD BENDING

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

3.2 PLACING REINFORCEMENT

- .1 Cutting or puncturing vapour retarder is not permitted; repair damage and reseal vapour retarder before placing concrete.
- .2 Place reinforcing steel as indicated on placing drawings.
- .3 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .4 Maintain cover to reinforcement during concrete pour.

3.3 CLEANING

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA-A23.1/A23.2-14 , Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A3000-13 , Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .3 CAN/CSA-G30.18-09 (R2014) , Billet-Steel Bars for Concrete Reinforcement.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: convene pre-installation meeting prior to beginning concrete works.
 - .1 Ensure key personnel attend.
 - .2 Verify project requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals as required by the Departmental Representative .
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in Cast-In-Place Concrete and additives and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba.
 - .1 Submit placing drawings prepared in accordance with plans to clearly show size, shape, location and necessary details of reinforcing.
- .4 Provide reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters found.
- .5 Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete delivered to site of Work and discharged after batching.
- .6 Quality Assurance Submittals:
 - .1 Mill Test Report: upon request, submit to Departmental Representative certified copy of mill test report of reinforcing steel, prior to beginning reinforcing work.
 - .2 Upon request submit in writing to Departmental Representative proposed source of reinforcement material

1.4 QUALITY ASSURANCE

- .1 Provide to Departmental Representative valid and recognized certificate from plant delivering concrete.
- .2 Quality Control Plan: provide written report to Departmental Representative verifying compliance concrete in place meets performance requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
 - .1 Modifying maximum time limit without receipt of prior written agreement from Departmental Representative and concrete producer as described in CSA A23.1/A23.2 is prohibited.
 - .2 Deviations submitted for review by Departmental Representative.
- .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

1.6 AMBIENT CONDITIONS

- .1 Placing concrete during rain or weather events damaging to concrete is prohibited.
- .2 Protect newly placed concrete from rain or weather events in accordance with CSA A23.1/A23.2.
- .3 Cold weather protection:
 - .1 Maintain protection equipment, in readiness on Site.
 - .2 Use such equipment when ambient temperature below 5°C, or when temperature may fall below 5°C before concrete cured.
 - .3 Placing concrete upon or against surface at temperature below 5°C is prohibited.
- .4 Hot weather protection:
 - .1 Protect concrete from direct sunlight when ambient temperature above 27°C.
 - .2 Prevent forms of getting too hot before concrete placed. Apply accepted methods of cooling not to affect concrete adversely.
- .5 Protect from drying.

Part 2 Products

2.1 MATERIALS

- .1 Portland Cement: HS or HSB Sulphate Resistant.
- .2 Water: to CSA A23.1/A23.2 .
- .3 Reinforcing bars: to CSA-G30.18, Grade 400.
- .4 Premoulded joint filler:
 - .1 Bituminous impregnated fibreboard: to ASTM D1751.

- .5 Joint sealer/filler: grey to ASTM C 920, Type M, Grade NS.
- .6 Other concrete materials: to CSA A23.1/A23.2.

2.2 MIXES

- .1 Proportion concrete in accordance with CAN/CSA-A23.1.
- .2 Minimum compressive strength at 28 days 35 MPa.
- .3 Nominal maximum size of coarse aggregate: 20mm.
- .4 Slump: 80 +/- 20mm.
- .5 Air content: 5 +/- 1%.
- .6 Admixtures: to CAN/CSA-A23.1.

Part 3 Execution

3.1 PREPARATION

- .1 Provide Departmental Representative 24 hours notice before each concrete pour.
- .2 Place concrete reinforcing in accordance with Section 03 20 00- Concrete Reinforcing.
- .3 During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Concrete delivery and handling to facilitate placing with minimum of rehandling, and without damage to existing structure or Work.
- .4 Protect previous Work from staining.
- .5 Clean and remove stains prior to application of concrete finishes.

3.2 INSTALLATION/APPLICATION

- .1 Do cast-in-place concrete work in accordance with CSA A23.1/A23.2.
- .2 Sleeves and inserts:
 - .1 Cast in sleeves, ties, slots, anchors, reinforcement, frames, conduit, bolts, waterstops, joint fillers and other inserts required built-in.
 - .2 Sleeves and openings minimum 100 mm x 100 mm not indicated, reviewed by Departmental Representative.

3.3 FINISHES

- .1 Formed surfaces exposed to view: sack rubbed finish in accordance with CSA A23.1/A23.2.
- .2 Interior floor slabs left exposed requiring smooth surface: initial finishing operations followed by final finishing comprising mechanical floating and steel trowelling as specified in CSA A23.1/A23.2 to produce hard, smooth, dense trowelled surface free from blemishes.

- .3 Floor slabs to receive mortar bed for tile: screed to correct grade and provide broomed texture.
- .4 Equipment pads: provide smooth trowelled surface.
- .5 Pavements, walks, curbs and exposed site concrete:
 - .1 Screed to plane surfaces and use magnesium float.
 - .2 Provide round edges and joint spacings using standard tools.
 - .3 Trowel smooth and provide lightly brushed non-slip finish.

3.4 CONTROL JOINTS

- .1 Cut control joints in slabs on grade at locations indicated, to CSA A23.1/A23.2 and install specified joint sealer/filler.

3.5 EXPANSION AND ISOLATION JOINTS

- .1 Install premoulded joint filler in expansion and isolation joints full depth of slab flush with finished surface to CSA A23.1/A23.2.

3.6 CURING

- .1 Use curing compounds compatible with applied finish on concrete surfaces free of bonding agents and to CSA A23.1/A23.2.

3.7 SEALING APPLICATION

- .1 After curing complete, apply poly-siloxane resin blend sealer at 4 m²/L.

3.8 SITE TOLERANCES

- .1 Concrete floor slab finishing tolerance to CSA A23.1/A23.2.

3.9 FIELD QUALITY CONTROL

- .1 Concrete testing: to CSA A23.1/A23.2 by testing laboratory designated and paid for by Departmental Representative.

3.10 CLEANING

- .1 Use trigger operated spray nozzles for water hoses.
- .2 Designate cleaning area for tools to limit water use and runoff.
- .3 Dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CSA S16-14, Design of Steel Structures.
 - .4 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
 - .5 CSA W59-18, Welded Steel Construction (Metal Arc Welding), Metric.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, pipe, tubing, fasteners and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Manitoba.
 - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.3 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Steel sections and plates: to CSA G40.20/G40.21, Grade 350W.
- .2 Welding materials: to CSA W59.
- .3 Welding electrodes: to CSA W48 Series.
- .4 Bolts and anchor bolts: to ASTM A307.

2.2 FABRICATION

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.
- .3 Where possible, fit and shop assemble work, ready for erection.
- .4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164.

Part 3 Execution

3.1 EXAMINATION

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

3.2 ERECTION

- .1 Do welding work in accordance with CSA W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Supply components for work by other trades in accordance with shop drawings and schedule.
- .6 Make field connections with bolts to CSA S16.
- .7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.
- .8 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
 - .1 Primer: maximum VOC limit 250 g/L to GS-11.

3.3 CLEANING

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

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 INTRODUCTION

- .1 Work of this section consists of fire stopping and smoke sealing in fire separations.
- .2 All fire-stopping is to be installed in accordance with a ULC listed system and appropriate information is to be submitted at the shop drawing stage and included in O&M Manuals.
- .3 The Contractor is responsible for identifying fire rated walls, floors, and barriers, and providing a fire stopping system for all penetrations.

1.2 REFERENCES

- .1 Perform the work in accordance with the relevant codes and standards from the regulatory agencies and institutes listed below.
- .2 The latest issue of an individual code, standard or regulation at the time of contract signing shall govern.

 CAN/ULC-S115 (2018) Standard Method of Fire Tests of Firestop Systems.
- .3 In the event of conflict between the reference codes and standards, drawings, specifications, and/or the Purchase Order, obtain written clarification from the Departmental Representative before proceeding with the work.

1.3 DEFINITION

- .1 Fire Stop Material: Device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts, pipes, and poke-through termination devices including electrical outlet boxes along with their means of support through wall or floor openings.
- .2 Single Component Fire Stop System: Fire stop material that has listed systems design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: Exact group of fire stop materials that are identified within listed systems design to create on site fire stop system.
- .4 Tightly fitted penetrations without fire stopping are not allowed. All penetrations of fire separations must be fire-stopped.

1.4 SUBMITTALS

- .1 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 a fire stopping plan/system to CAN/ULC-S115 numbered tested standards, or engineering judgement.
 - .3 Submit 2 copies of WHMIS Material Safety Data Sheets (MSDS)
- .2 Shop Drawings:

- .1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings, and method of installation.
- .2 Construction details should accurately reflect actual job conditions.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, Shipping, Handling, and Unloading:
 - .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
 - .2 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.
- .2 Storage and Protection:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Fire Stopping and Smoke Seal Systems
 - .1 In accordance with CAN / ULC-S115.
 - .2 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of CAN / ULC-S115 and not to exceed opening sizes for which they are intended.
 - .3 Firestop System Rating: Match fire rating of assembly.
- .2 Service Penetration Assemblies: Certified by ULC in accordance with CAN / ULC-S115 and listed in ULC Guide No. 40 U19.
- .3 Service Penetration Firestop Components: Certified by ULC in accordance with CAN / ULC-S115 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC.
- .4 Fire-Resistance Rating: Fire-resistance rating of installed fire stopping assembly in accordance with NBC.
- .5 Fire Stopping and Smoke Seals at openings intended for ease of re-entry such as cables: Elastomeric seal. Do not use cementitious or rigid seals around penetrations for pipes, ductwork, or other mechanical items
- .6 At openings around penetrations for pipes, ductwork, and other mechanical items requiring sound and vibration control: Elastomeric seal
- .7 Primers: To manufacturer's recommendation for specific material, substrate, and end use.
- .8 Water (if applicable): Potable, clean, and free from injurious amounts of deleterious substances.
- .9 Damming and Backup Materials, Supports, and Anchoring Devices: To manufacturer's recommendations and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

- .10 Sealants for Vertical Joints: Non-sagging.

2.2 ACCESSORIES

- .1 Primer: Type recommended by firestopping manufacturer for specific substrate surfaces.
- .2 Select one or more of the following appropriate dam materials for specific project conditions ONLY where the dam material is to be left as a permanent part of the firestop assembly.
- .3 Forming/Packing Material: Permanent type, suitable for application.
- .4 Installation Accessories: Clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

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 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
 - .1 Ensure substrates and surfaces are clean, dry, and frost free.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces. Remove stains on adjacent surfaces.

3.3 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing (ULC listed system).
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to neat finish.
- .5 Remove excess compound promptly as work progresses and upon completion.
- .6 Tag all penetrations with appropriate information.
- .7 The Contactor shall pay and arrange for a 3rd party certified fire stop inspector (certified to International Firestop Council standard) to review the installation on site and provide a certificate that the installation has been installed in accordance with International Firestop

Council standards. Certificate to be provided to the Departmental Representative prior to concealment of installation.

3.4 CLEANING

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.
- .2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.5 SCHEDULE

- .1 Fire stop and smoke seal at:
 - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
 - .2 Around electrical assemblies penetrating fire separations.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C1396/C1396M-17, Standard Specification for Gypsum Wallboard.
 - .2 ASTM C475/C475M-17, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - .3 ASTM C514-04(2014), Standard Specification for Nails for the Application of Gypsum Board.
 - .4 ASTM C645-18, Standard Specification for Nonstructural Steel Framing Members.
 - .5 ASTM C754-18, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - .6 ASTM C840-13, Standard Specification for Application and Finishing of Gypsum Board.
 - .7 ASTM C954-18, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.84 mm to 2.84 mm in Thickness.
 - .8 ASTM C1002-18, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - .9 ASTM C1047-14a(2019), Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - .10 ASTM C1178/C1178M-18, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.
- .2 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum, framing, sealants 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 manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Handle materials to prevent damage to edges or surfaces. Protect metal accessories and trim from being bent or damaged.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Performance / Design Criteria:
 - .1 Partition assembly to match existing adjacent construction.
- .2 Gypsum Board:
 - .1 Standard board: to ASTM C1396/C1396M 12.7mm thick, 1200 mm wide x maximum practical length, ends square cut, edges tapered.
 - .2 Vinyl-faced board: to ASTM C1396/C1396M, 12.7mm thick 1200 mm wide x maximum practical length, covered with minimum 0.15 mm thick wall covering having maximum flame spread: 25, fuel contributed: 35, smoke developed: 50 when tested to CAN/ULC-S102.
 - .3 Glass mat water-resistant gypsum backing board: to ASTM C1178/C1178M.
 - .4 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
 - .5 Steel tapping screws: to ASTM C1002.
 - .6 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, zinc-coated by electrolytic process 0.5 mm base thickness, perforated flanges, one piece length per location.

2.2 ACCESSORIES

- .1 Acoustical insulation: type recommended by manufacturer to achieve STC rating specified.
- .2 Sealants to ASTM C475.
- .3 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self sticking permanent adhesive on one face, lengths as required.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions prior to partition installation.
 - .1 Visually inspect substrate in presence of Departmental Representative.

- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 ERECTION OF GYPSUM BOARD AND ACCESSORIES

- .1 Do application and finishing of gypsum board in accordance with ASTM C840.
- .2 Erect hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C840.
- .3 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .4 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles, equipment and appurtenances.
- .5 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.
- .6 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .7 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .8 Install wall furring for gypsum board wall finishes in accordance with ASTM C840, except where specified otherwise.
- .9 Install gypsum boards in direction that will minimize number of end-butt joints. Stagger end joints 250 mm minimum.

3.3 APPLICATION

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work are approved.
- .2 Apply single layer gypsum board to metal furring or framing using screw fasteners. Maximum spacing of screws 300 mm on centre.
- .3 Apply water-resistant gypsum board adjacent to where wall tiles or coating to be applied. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads.

3.4 INSTALLATION

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure using contact adhesive for full length.
- .2 Install casing beads around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .5 Install access doors to electrical and mechanical fixtures specified in respective sections.

- .1 Rigidly secure frames to furring or framing systems.
- .6 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
- .7 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
- .8 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
- .9 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

3.5 CLEANING

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

3.6 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .2 Maintenance Repainting Manual - current edition.
- .3 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for paint and coating products and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS.
- .3 Samples:
 - .1 Submit 200 x 300 mm sample panels of each coating, with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards.
- .4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials and equipment in well ventilated area within temperature as recommended by manufacturer.
- .4 Fire Safety Requirements:
 - .1 Supply dry chemical 9 kg fire extinguisher adjacent to storage area.
 - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

- .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada (NFC) requirements.

1.4 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces in.
 - .2 Co-ordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.
 - .3 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Apply paint finishes when ambient air and substrate temperatures at location of installation can be satisfactorily maintained during application and drying process, within MPI and paint manufacturer's prescribed limits.
 - .2 Test concrete, masonry and plaster surfaces for alkalinity as required.
 - .3 Apply paint to adequately prepared surfaces, when moisture content is below paint manufacturer's prescribed limits.
- .3 Additional application requirements:
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint in occupied facilities on a schedule approved by Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

Part 2 Products

2.1 MATERIALS

- .1 Supply paint materials for paint systems from single manufacturer.
- .2 Conform to latest MPI requirements for painting work including preparation and priming.
- .3 Materials in accordance with MPI - Architectural Painting Specification Manual "Approved Product" listing.
- .4 Colours:
 - .1 Submit proposed Colour Schedule to Departmental Representative.
- .5 Mixing and tinting:
 - .1 Perform colour tinting operations prior to delivery of paint to site, in accordance with manufacturer's written recommendations. Obtain written approval from Departmental Representative for tinting of painting materials.
 - .2 Use and add thinner in accordance with paint manufacturer's recommendations.
 - .1 Do not use kerosene or similar organic solvents to thin water-based paints.

- .3 Thin paint for spraying in accordance with paint manufacturer's written recommendations.
- .4 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.
- .6 Gloss/sheen ratings:
 - .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Gloss Level-Category	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish	Max. 5	Max. 10
Gloss Level 2 - Velvet	Max.10	10 to 35
Gloss Level 3 - Eggshell	10 to 25	10 to 35
Gloss Level 4 - Satin	20 to 35	min. 35
Gloss Level 5 - Semi-Gloss	35 to 70	
Gloss Level 6 - Gloss	70 to 85	
Gloss Level 7 - High Gloss	More than 85	

- .2 Gloss level ratings of painted surfaces as required to match.
- .7 Exterior painting:
 - .1 Concrete Vertical Surfaces: (including horizontal soffits)
 - .1 EXT 3.1A - Latex gloss level 4 finish.
 - .2 Concrete Masonry Units: smooth and split face block and brick
 - .1 EXT 4.2A - Latex gloss level 4 finish.
 - .3 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal.
 - .1 EXT 5.1D - Alkyd gloss level 6 finish.
 - .4 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
 - .1 EXT 5.3B - Alkyd gloss level 6 finish.
 - .5 Dimension Lumber: columns, beams, exposed joists, underside of decking, siding, fencing, etc.
 - .1 EXT 6.2B - Waterborne solid colour stain finish.
 - .2 EXT 6.2C - Alkyd gloss level 1 finish.
 - .3 EXT 6.2L - Semi-transparent stain finish.
 - .6 Dressed Lumber: doors, door and window frames, casings, battens, smooth facias, etc.
 - .1 EXT 6.3B - Alkyd gloss level 5 finish.
 - .2 EXT 6.3C - Solid colour stain finish.
 - EXT 6.3D - Semi-transparent stain finish.
 - .3
- .8 Exterior re-painting:
 - .1 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal.
 - .1 REX 5.1D - Alkyd gloss level 6.

- .2 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
 - .1 REX 5.3B - Alkyd gloss level 6.
 - .3 Dressed Lumber: doors, door and window frames, casings, battens, smooth fascias, etc.
 - .1 REX 6.3B - Alkyd gloss level 5.
 - .2 REX 6.3D - Semi-Transparent Stain.
- .9 Interior painting:
 - .1 Concrete horizontal surfaces: floors.
 - .1 INT 3.2B - Alkyd floor enamel low gloss finish.
 - .2 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal.
 - .1 INT 5.1E Alkyd - insert gloss level 6 finish.
 - .3 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
 - .1 INT 5.3C - Alkyd gloss level 5 finish (over cementitious primer).
 - .4 Dressed Lumber: doors, door and window frames, casings, mouldings, etc.:
 - .1 INT 6.3A - Latex gloss level 4 finish.
 - .2 INT 6.3B - Alkyd gloss level 4 finish.
 - .3 INT 6.3E - Polyurethane varnish gloss level 4 finish (over stain).
 - .4 INT 6.3K - Polyurethane varnish gloss level 4 finish.
 - .5 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock" type material, etc.
 - .1 INT 9.2A - Latex gloss level 3 finish (over latex sealer).
 - .2 INT 9.2C - Alkyd gloss level 3 finish (over latex sealer).
 - .3 INT 9.2M - Institutional low odour/low VOC gloss level 3 finish.
- .10 Interior re-painting:
 - .1 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal.
 - .1 RIN 5.1E - Alkyd gloss level 6.
 - .2 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
 - .1 RIN 5.3C - Alkyd gloss level 6.
 - .3 Plaster and Gypsum Board: gypsum wallboard, drywall, "sheet rock" type material, etc.
 - .1 RIN 9.2A - Latex gloss level 3.
 - .2 RIN 9.2C - Alkyd gloss level 3 finish.

Part 3 Execution

3.1 GENERAL

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.
- .2 Perform preparation and operations for interior painting in accordance with MPI - Architectural Painting Specifications Manual.

3.2 EXAMINATION

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

3.3 PREPARATION

- .1 Protection of in-place conditions:
 - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Departmental Representative.
 - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
 - .3 Protect factory finished products and equipment.
- .2 Surface Preparation:
 - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
 - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
 - .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Departmental Representative.
 - .4 Clean and prepare surfaces in accordance with MPI - Architectural Painting Specification Manual specific requirements and coating manufacturer's recommendations.
 - .5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
 - .6 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.

- .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
- .2 Apply wood filler to nail holes and cracks.
- .3 Tint filler to match stains for stained woodwork.
- .7 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
- .8 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements.
- .9 Touch up of shop primers with primer as specified.

3.4 APPLICATION

- .1 Paint only after prepared surfaces have been accepted by Departmental Representative.
- .2 Use method of application approved by Departmental Representative.
 - .1 Conform to manufacturer's application recommendations.
- .3 Apply coats of paint in continuous film of uniform thickness.
 - .1 Repaint thin spots or bare areas before next coat of paint is applied.
- .4 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .5 Sand and dust between coats to remove visible defects.
- .6 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .7 Finish inside of cupboards and cabinets as specified for outside surfaces.
- .8 Finish closets and alcoves as specified for adjoining rooms.
- .9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.
- .10 Mechanical/Electrical Equipment:
 - .1 Paint conduits, piping, hangers, ductwork and other mechanical and electrical equipment exposed in finished areas, to match adjacent surfaces, except as indicated.
 - .2 Do not paint over nameplates.
 - .3 Keep sprinkler heads free of paint.
 - .4 Paint fire protection piping red.
 - .5 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
 - .6 Paint natural gas piping yellow.
 - .7 Paint both sides and edges of backboards for telephone and electrical equipment before installation.
 - .1 Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.5 CLEANING

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

END OF SECTION

Part 1 General

1.1 GENERAL WORK

- .1 The general work includes, but is not limited to the following:
 - .1 Perform electrical work as part of a multi-trade team to execute the overall project construction.
 - .2 Refer to Specification Section 01 11 00 for additional details.
 - .3 All work as described in the specifications and the drawings.

1.2 QUALITY ASSURANCE

- .1 Complete the installation in accordance with the latest edition of the Canadian Electrical Code Part I (CSA C22.1), as well as Municipal and Provincial Codes and Regulations and the local authorities having jurisdiction. Where this specification is at variance with applicable Codes and Standards, the more stringent shall apply.
- .2 All references to Codes and Standards refer to the latest edition in force at the time of bid.
- .3 Under no circumstances shall the Codes and Standards referred to above and herein, be interpreted to allow a lower standard than specified elsewhere herein.
- .4 Complete all work in a neat and professional manner performed by qualified tradesmen. All work shall be completed under the on-site direction of a journeyman electrician.
- .5 Attend site meetings as required and as called for.
- .6 While not identified and specified by number in this Division, comply with CSA Electrical Bulletins in force at time of tender submission. Comply with the requirements of all Provincial and local laws, rules, ordinances and codes.
 - .1 Electrical installation shall be in accordance with the current edition of the Electrical Code, Provincial and other codes, rules and regulations. Supply material and labour required to meet the requirements of these codes, rules and regulations even though the work is not shown on the drawings or mentioned in the specifications.
 - .2 Where the electrical installation calls for better quality of materials or construction than the minimum requirements of these codes, rules and regulations, the electrical installation shall be to the higher standard.

1.3 COORDINATION WITH SUPPLY AUTHORITY

- .1 Co-ordinate and meet requirements of power supply authority. Ensure availability of power when required. The electric utility (Manitoba Hydro), will supply and install the service transformer and utility meter. The Contractor will provide all other equipment, and labour, including but not limited to the CSTE, CSTE Pad, conduit sleeves, meter enclosure, etc.
- .2 Prior to installation of the CSTE, the Contractor shall coordinate the placement and location of the CSTE on site. Allow for moving the CSTE a maximum of 10 meters in any direction from that shown on the drawings, at no additional cost.

- .3 The Contractor shall coordinate the installation of new electrical utility services (with Manitoba Hydro) at the site. Coordinate the placement of the CSTE with MB Hydro prior to installation of conduits and related systems.
- .4 Complete the request for service forms required by the utility on behalf of the Departmental Representative. Submit forms to the utility.

1.4 PERMITS, FEES

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Obtain and pay for all necessary permits required for the electrical installation.
- .3 Pay all fees for permits and inspections for completion of the electrical installation.

1.5 APPROVAL OF EQUIVALENTS / ALTERNATES

- .1 Approval of equivalent products may be granted by the Departmental Representative at their complete discretion. If approval for equivalent product is given, such approval does not relieve the Contractor and/or supplier from providing all necessary components and finishes for a complete and functioning facility, based on similar installation quality as the original design.
- .2 Request for equals must be received in the Departmental Representative's office not less than seven working days prior to bid closing date.
- .3 A detailed line-by-line compliance comparison of any product submitted for approval, must be submitted. Exceptions and non-compliance shall be clearly identified. Requests for equals must include the following:
 - .1 A detailed bill of materials correlating each item of equipment to those specified.
 - .2 Catalogue product data sheet for each proposed item of equipment. If more than one model is shown on the data sheet, indicate exactly which model is proposed.
 - .3 Copy of the specification section with each paragraph marked to show where on the product data sheet the specification requirement is satisfied (use specification cross reference numbers on the product data sheet).
 - .4 If compliance with any specification requirement cannot be substantiated by reference to published data provide a typewritten compliance statement signed by an executive officer of the manufacturer. Stating that the executive proposed products comply with all specified requirements.
- .4 The contractor must quote on materials or equipment approved in the contract documents.

1.6 OTHER TRADES

- .1 Include in cost all work by subtrades, such as painting, coring, plastering etc. to restore all finished areas to original finish.
- .2 Schedule execution of electrical work with associated work specified in other Divisions.
- .3 Coordinate electrical work to avoid conflicts with pipes, air ducts or other equipment.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver all materials to site in an orderly fashion and in accordance with schedule.
- .2 Provide additional protection such as tarps, padding, wood skids, etc., where such is required to ensure protection of equipment and as directed by the Departmental Representative.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Provide labour, materials, transportation, equipment and facilities, etc., required for the complete electrical installation as indicated or implied on the drawings and specifications.
- .2 Electrical equipment shall be new and of type and quality specified.
- .3 Equipment and material to be CSA certified, and manufactured to standards described. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from the appropriate Inspection Departments. Labels must be visible, and shall not be painted or hidden in any way.

2.2 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235-83 (R2015).
- .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.

Part 3 Execution

3.1 INSPECTION

- .1 Furnish a Certificate of Acceptance from the Inspection Authorities on completion of work. Copies of Certificate to be included in Maintenance Manuals.
- .2 Certificate of Inspection and Approval must be submitted before final payment may be considered to be due.
- .3 During the course of the project construction, the Departmental Representative will carry out periodic inspections and prepare a deficiency list for remedial action by the Contractor. When requested, the Contractor shall respond in writing to the Departmental Representative, stating corrective action and completion date for each item listed as deficient. This response shall be in the hands of the Departmental Representative within three working days of receipt of the Site Observation Report.

3.2 CARE, OPERATION AND START-UP

- .1 Instruct the facility maintenance personnel at Canada Revenue Agency in the operation, care and maintenance of equipment. Arrangement of such instructional sessions to be done at a time convenient to the Departmental Representative.

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

3.3 FINISHES

- .1 Shop finish metal enclosures by removal of rust and scale, cleaning, application of rust resistant primer inside and outside, and at least two coats of finished enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.
 - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.
- .2 Clean and touch up surfaces of shop-painted equipment, scratched or marred during shipment or installation, to match original paint.
- .3 Clean, prime and paint exposed hangers, racks, fastenings to prevent rusting.
- .4 All electrical fittings, supports, hanger rods, pull boxes, channel fittings, conduit racks, outlet boxes, brackets, clamps, etc. shall either have a galvanized finish, or be stainless steel.

3.4 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with lamacoid nameplates.
- .2 Provide lamacoid nameplates, 3 mm thick plastic engraving sheet, black face, white core, mechanically attached (self-tapping screwed or riveted) unless specified otherwise. Sizes as follows:

Size 0	10 x 38 mm	1 line, 3 mm high letters
Size 1	10 x 100 mm	1 line, 3 mm high letters
Size 2	13 x 75 mm	1 line, 5 mm high letters
Size 3	13 x 75 mm	2 lines, 3 mm high letters
Size 4	19 x 75 mm	1 line, 10 mm high letters
Size 5	19 x 100 mm	2 lines, 5 mm high letters
Size 6	25 x 100 mm	1 line, 13 mm high letters
Size 7	25 x 100 mm	2 lines, 6 mm high letters
- .3 Wording on nameplates to be approved prior to manufacture. Submit schedule of nameplates and wording to the Departmental Representative (where existing systems are modified or added to) and to the Departmental Representative for new construction.

- .4 Allow for average of twenty-five (25) letters per nameplate. Nameplates on panelboards will require additional letters.
- .5 Identification to be English.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system, circuit, loop numbers. All Junction boxes must be tagged indicating the circuit numbers within. No exceptions.
- .7 Use red nameplates with white lettering for fire alarm equipment and equipment fed from essential / emergency power circuits.
- .8 Use heat shrink type markers or CAB-3 cable marking system (Pass & Seymour) for all conductors and cables. Mark cables at both ends. Confirm labels with the Departmental Representative.

3.5 LOCATION OF OUTLETS

- .1 Change location of outlets at no extra cost or credit, providing distance does not exceed 3m and information is provided before installation.

3.6 MOUNTING

- .1 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise.
- .2 Mount indoor electrical distribution equipment utilizing one of:
 - .1 Modular metal support system: Unistrut, Cantruss, or similar.
 - .2 19mm thick plywood backboards c/w fire retardant gray paint.
 - .3 3.5 inch thick, concrete (steel re-inforced) pad for all floor mounted equipment
- .3 If mounting height of equipment is not indicated, verify with the Architect before proceeding with installation.
- .4 Install electrical equipment at the following heights (to bottom) unless indicated or directed otherwise.
 - .1 Panels: 2.0 m to top.
 - .2 Heights as above or at bottom of nearest block or brick course.
 - .3 Receptacles: to match existing.

3.7 CONDUIT SLEEVES AND HOLES

- .1 Make necessary arrangements for cutting of chases, coring of holes and other structural work required to install electrical conduits, cables, pullboxes and outlet boxes.
- .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 The contractor shall satisfy himself by X-Ray or other acceptable means that coring through the structural slab will not disturb existing systems or structural members. The contractor will be responsible for resulting disruptions and required refurbishments.

3.8 FIRE STOPPING

- .1 Fire stopping shall be performed by a fully trained fire stopping technician.
- .2 Refer to section 07 84 00 for requirements.

3.9 TESTS

- .1 Conduct and pay for tests of all installed and modified systems.
- .2 Refer to section 01 91 13 16 – Commissioning Forms.
- .3 Furnish Manufacturer's Certificate or letter confirming that entire installation, as it pertains to each system, has been installed to manufacturer's instructions. Include letters in maintenance manuals.
- .4 Carry out tests in presence of the Departmental Representative where directed. Notify the Departmental Representative prior to testing.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit test results in Maintenance Manuals.

3.10 CLEANING

- .1 Complete final cleaning in accordance with the requirements of General Conditions.
- .2 Protect all equipment and material from weather and the work of other trades. Remove waste periodically. Clean all materials and equipment prior to acceptance of the Work.
- .3 At time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt. The electrical installation shall be left in a clean and finished condition, to the satisfaction of the Departmental Representative.

3.11 CUTTING AND PATCHING

- .1 Include the costs of all cutting and patching required for the installation of electrical work.
- .2 Paint and restore surfaces to match existing surroundings for all conduit, junction boxes and equipment which is removed.

3.12 WORKMANSHIP

- .1 Install equipment, conduit and cables in a workmanlike manner to present a neat appearance to the satisfaction of the Departmental Representative. Install conduit and cable runs parallel and perpendicular to building lines in chases, behind furring or above ceilings, where such concealment is possible. In areas where systems are to be exposed, install neatly and group in a tidy appearance.
- .2 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement, with adequate clearances and accessibility for same.
- .3 Include, in the work, all requirements shown on the shop drawings or manufacturer's installation instructions.
- .4 Replace work unsatisfactory to the Departmental Representative without extra cost.

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END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CAN/CSA-C22.2 No.18.1 , Metallic Outlet Boxes.
 - .2 CAN/CSA-C22.2 No.65 , Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65 , with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65 , with current carrying parts of copper or copper alloy sized to fit and suitable for fixture conductors, 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for copper conductors.
 - .2 Clamp for copper bar.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper bar.
 - .5 Sized for conductors and bars as required.
- .4 Clamps or connectors for armoured cable, aluminum sheathed cable, flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2 No.18.
- .5 Provide fine stranded terminations for fine stranded (DLO or similar) cabling in accordance with CEC 12-406 (4) (c).

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 wire and box connectors installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of the Departmental Representative.
 - .2 Inform the 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 the Consultant.

3.2 INSTALLATION

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

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.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 CODES AND STANDARDS

- .1 CAN/CSA-C22.2 No. 38, Thermoset-Insulated Wires and Cables.
- .2 CAN/CSA-C22.2 No. 49, Flexible Cords and Cables
- .3 CAN/CSA-C22.2 No. 51, Armoured Cables.
- .4 CSA C22.2 No. 0.3, Test Methods for Electrical Wires and Cables.
- .5 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.
- .6 CAN/CSA C22.2 No. 174 Cables and Cable Glands for use in Hazardous Locations.
- .7 CAN/CSA C22.2 No. 230 Tray Cables.
- .8 CAN/CSA C22.2 No. 239 (2017) Control and Instrumentation Cables.
- .9 CAN/CSA-C22.2 No. 208, Fire Alarm and Signal Cable.
- .10 American Society for Testing and Materials (ASTM):
 - .1 B3, Standard Specification for Soft or Annealed Copper Wire.
 - .2 B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

Part 2 Products

2.1 GENERAL

- .1 All conductors shall be copper.
- .2 Conductors shall be stranded for #10 AWG and larger.
- .3 Size conductors in accordance with the electrical code. Conductor sizes shown are minimum sizes only, to be upsized to suit the actual installation.
- .4 Minimum conductor sizes:
 - .1 Branch circuit power conductors, minimum size is #12 AWG.
 - .2 Upsize minimum conductors as required in order to account the required load and for voltage drop.
- .5 Minimum bonding conductor size shall be #12 AWG for power circuits, and #14 AWG for control circuits, upsize as required to meet the Canadian Electrical Code requirements.
- .6 120V power cables fed from 15A circuits shall be a minimum of #10 AWG for runs longer than 30m. Upsize further to meet electrical code voltage drop requirements.
- .7 All wiring to be armoured, copper sheathed, or to be run in conduit as allowed by code and by design.
- .8 Acceptable cable manufacturer: TF Kable, Nexans, General Cable, Southwire, Belden, Texcan.

- .9 All wires shall be tagged with the same tag at both ends of each wire. Wire tags shall be in accordance with the drawing set and specifications. Tags shall be printed on heat shrink sleeve type. Allow for a minimum average of 30 letters per tag. Provide a list of tags to the Departmental Representative prior to fabrication.

2.2 RW90 WIRES

- .1 All wiring shall be FT-4 rated.
- .2 Insulation: 90°C, RW90, cross-linked thermosetting polyethylene (XLPE), 600V or higher.
- .3 All non-armored RW90 wiring to be run in conduit.
- .4 Provide highly flexible, stranded RW90 rated DLO cabling as indicated on the single line drawings in order to facilitate cable bending radius and space requirements.

2.3 ALUMINUM ARMOURED CABLE (TECK90)

- .1 Armored cabling may only be used for exterior cable runs where indicated on the drawings.
- .2 Insulation: RW90, cross-linked thermosetting polyethylene (XLPE), 600V, FT-4.
- .3 Armour: aluminum interlocked, with exterior covering.

2.4 INSTRUMENTATION AND CONTROL WIRING

- .1 Armoured Control and Instrumentation Cable (ACIC) and Control and Instrumentation Cable (CIC) to: CAN/CSA-C22.2 No. 239 and CAN/CSA C21.2.
- .2 Conductors: minimum size, #16 AWG, stranded, annealed (7 strand minimum), tinned copper, unless otherwise specifically noted on the drawings.
- .3 Insulation: chemically cross-linked thermosetting polyethylene (XLPE), rated type RW90, 300V.
- .4 Conductor identification: Each grouping (pair, triplet, quad) by consecutive number coding, permanently marked at regular intervals
- .5 Construction: twisted pair, triplet and quad grouping with staggered lay.
- .6 Shielding shall be in conformance with:
 - .1 Minimum 100% coverage aluminum foil or mylar tape shield with minimum 25% overlap.
 - .2 Separate drain wire, minimum size 18 AWG, bare, stranded tinned copper. Drain wire to be in direct, continuous contact with the shield.
 - .3 One or more twisted shielded pairs as indicated.
- .7 Jacket: PVC (-40° C to +90° C), low acid gas, minimum FT4 rated flame spread.
- .8 Armoured control and instrumentation cable (ACIC), to have aluminum, interlocked armour with overall PVC jacket.
- .9 Termination fittings: Type, configuration and gender required to connect cable directly to equipment without additional adapters or fittings.

2.5 INSULATED GROUND CONDUCTORS

- .1 Insulated copper ground conductors:
 - .1 Size: as indicated on the drawings, but in no case smaller than CEC required sizes.
 - .2 Type: soft drawn, stranded, flexible, high conductivity
 - .3 Shall meet the requirements of ASTM B8.
 - .4 Insulation: chemically cross-linked thermosetting polyethylene (XLPE) material, rated RW90
 - .5 Flame Test Rating:
 - .6 CSA FT4 (if exposed)
 - .7 CSA FT1 (if entirely within conduit)
 - .8 Insulation voltage rating: 600V
 - .9 Colour: green or green with yellow stripes as indicated on the drawings.

2.6 BARE GROUND CONDUCTORS

- .1 Bare copper ground conductors:
 - .1 Size: as indicated on the drawings, but in no case smaller than CEC required sizes.
 - .2 Type: soft drawn, stranded, flexible, high conductivity.
 - .3 Shall meet the requirements of ASTM B8.

Part 3 Execution

3.1 GENERAL

- .1 #12 AWG shall be the minimum wire size used for 15A branch circuits. All conductors shall be sized to allow for a maximum of 3% voltage drop. It is the responsibility of the Contractor to upsize conductors as required.
- .2 Provide separate, full size, separate neutral conductor for all circuits.
- .3 Neutral conductors shall be white, ground conductors green identification. Phase conductors shall be colour coded in accordance with the CEC.
- .4 Conductor length for parallel feeders shall be identical.
- .5 Identify all conductors (including neutral) with "Brady" marker to describe circuit number / source and load description, wherever they are terminated in a junction box or panelboard, plus at every 100 meters along the run.
- .6 Neutral conductors shall be as a minimum sized the same as the phase conductors – neutrals shall not be de-rated, neutrals shall not be shared between separate circuits.
- .7 Control wiring conductors shall be red in colour (except associated building neutral conductor shall be white in colour).

- .8 Bonding conductors shall be green in colour. A separate insulated (green) bonding conductor shall be installed in each conduit and cable system. The conduit or armour will not constitute an adequate ground or bond.
- .9 Install a separate insulated (green) bonding conductor for each motor circuit.
- .10 Insulation for all conductors installed exterior to the building shall be rated at minus 40 degrees Celsius.
- .11 Utilize waterproof connectors, couplings and fittings for all facility areas which are sprinklered.
- .12 Provide penetrations through existing structure and assemblies to route the required conductors. Position equipment, review, and scan existing structure as required to avoid damage to existing structure and reinforcing steel. Repair damage caused to the satisfaction of the Departmental Representative.
- .13 Perform fire stopping and weatherproof sealing of all penetrations.
- .14 Use of AC90 (BX) style wiring is not acceptable. Use of Lumex (NMD) type cabling is not acceptable.
- .15 Provide termination kits suitable for stranding of cabling used.

3.2 PENETRATION OF EXISTING CAST-IN-PLACE CONCRETE

- .1 Core holes through existing cast-in-place concrete using suitable equipment:
 - .1 Do not hammer, chip, grind or sawcut to accommodate penetrations.
- .2 Locate holes using bars scans to avoid existing reinforcing steel:
 - .1 Core the minimum diameter necessary to accommodate each penetration, to a maximum nominal diameter of 100 mm.
 - .2 Do not cut or damage existing reinforcing steel.
 - .3 Locate in centre one third of wall or slab.
 - .4 Maintain at least 20 mm concrete cover over existing reinforcing steel.
 - .5 Maintain at least 3 hole diameters spacing between penetrations, measured edge to edge horizontally.
- .3 Lay out proposed coring geometry and locations of existing reinforcing steel directly on the surface to be cored for the review of the Departmental Representative.
 - .1 Do not core holes prior to receiving the Departmental Representative's approval.
- .4 Repair concrete damaged during the installation of the penetrations to the satisfaction of the Departmental Representative.

3.3 INSTALLATION OF WIRES IN CONDUIT

- .1 Install wiring as follows:
 - .1 All non-armoured conductors shall be run in conduit systems in accordance with Section 26 05 34.
- .2 Lubricant for pulling conductors through shall be wax base insoluble in water and non-hardening.

- .3 For interior spaces: conductors drawn into conduit shall not be pulled more than 30 metres; or more than three 90° bends, without pullboxes.
- .4 For exterior spaces: conductors drawn into conduit - provide pullboxes in accordance with Canadian Electrical Code and AHJ requirements.
- .5 Conduits shall be sized as a minimum in accordance with the Canadian Electrical Code. Provide larger sized conduits where specified otherwise.

3.4 INSTALLATION OF TECK90

- .1 Group cables wherever possible, with the appropriate cable spacing to avoid de-rating. Pay careful attention to existing cables in the vicinity, and ensure that new cable installations do not impact existing cable installations.
 - .1 Terminate cables in accordance with manufacturer's recommendations.
- .2 Use of flexible armoured (Teck90) cables may be used for exterior cable runs as indicated on the single line drawing(s).

3.5 BACKFILL

- .1 Use clean backfill, free of rocks and debris. Return excavation area to the original condition.
- .2 Photograph all open trenches, with cabling, conduit, supports and spacers installed.
- .3 Do not backfill until inspected by the Departmental Representative.
- .4 Prior to excavation or directional boring, perform a complete site survey to ensure that the installation will not conflict with existing systems. Repair of damages to existing systems will be at the cost of the Contractor.
- .5 Coordinate work with other trades to ensure that the location and route of the buried systems does not conflict with the work of other trades.
- .6 Refer to the drawings for cable / trench details where applicable and coordinate with civil and mechanical trades.

3.6 BURIAL OF CABLES

- .1 Provide Universal GPS coordinates of all underground cable or conduit runs at every bend, and at a maximum of 6000mm intervals. Include coordinates on the As-Built drawings.
- .2 Employ soft dig excavation methods near and around any buried electrical system. An acceptable soft dig method is Hydrovac (water based) excavation method or hand dig where indicated on the drawings.
- .3 Perform excavation, and trenching. Provide sand bed in trench, and lay in cables, maintaining separation between cable runs. Maintain a minimum of 75 mm of clearance from each side of trench to the nearest cable. Do not pull cable into trench.
- .4 Provide offset for thermal action and minor earth movements. Offset 150 mm for each 60m run, maintaining minimum cable separation and bending radius requirements.
- .5 Make terminations and splices (splices - only where specifically approved by the Departmental Representative) leaving 0.6 m of surplus cable in each direction.

- .1 Terminations and splices shall be performed with approved kits, and in accordance with the manufacturer's instructions and with specific training.
- .6 Underground cable splices are not acceptable.
- .7 Minimum permitted radius at cable bends for rubber or plastic cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or greater in accordance with the manufacturer's instructions.
- .8 Cable separation:
 - .1 Maintain 300 mm minimum separation between low voltage cables of different circuits.
 - .2 Maintain 300 mm minimum horizontal, and 300 mm minimum vertical separation between for fire alarm and control cables when crossing other cables, with the fire alarm and control cables in the upper position.
 - .3 Install treated planks at cable crossings, between lower and upper cables, extending 600 mm in each crossing direction.
 - .4 The contractor must meet the minimum code clearance requirements when crossing of any other systems, such as mechanical or utility services.
- .9 Provide sand bed over cables, after the cables are laid into the trench. Minimum sand bedding below cables is 75 mm. Minimum sand bedding above cables is 75 mm. Supply and install mechanical protection of cables above sand bedding. Use clean fill, devoid of rocks or materials which can damage or deform the cable trench.
- .10 Repair surface to previous existing condition, or to new conditions specified on the drawings, and in the specifications.
- .11 Prior to closing up trench, and covering cables, photograph the open trench with the cables installed, and arrange for an inspection by the Purchaser. Do not close up trench without approval.
- .12 Minimum cable burial depth shall be in accordance with the CEC, table 53, or deeper as specified on the drawings.

END OF SECTION

Part 1 General

1.1 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).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper or aluminum alloy suitable for copper conductors, long or short barrel compression connectors to CSA C22.2 No.65 for conductors as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Bond and ground as required to CSA C22.2No.41.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps and connectors for grounding of conductor: size for conductors as indicated on the drawings.
- .2 Rod electrodes: copper clad steel, 19 mm diameter by minimum 3 m long.
- .3 Grounding conductors: bare stranded copper, soft annealed, size as indicated (and in no case smaller than that required by code) .

- .4 Insulated grounding conductors: green, copper conductors.
- .5 Ground bus: copper, 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 prior to covering. Provide photographs upon request.
 - .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. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to electrodes, using copper cadweld or bronze compression connectors to ANSI/IEEE 837 .
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install separate bonding wire in conduit system as required by Code.
- .8 Ground secondary services.
- .9 Ground genset system.

3.3 ELECTRODES

- .1 Install rod electrodes and make grounding connections.
- .2 Bond separate, multiple electrodes together.

- .3 Use size 2/0 AWG copper conductors (or alternatively as shown on the drawings where larger) for connections to electrodes.

3.4 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. service equipment, transformers, switchgear, control panels, generators, and distribution panels.

3.5 FIELD QUALITY CONTROL

- .1 Perform ground continuity using ductor tests method and ground resistance appropriate to site conditions and to the approval of Departmental Representative and local authority having jurisdiction over installation.
- .2 Perform tests before energizing electrical system.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.
 - .1 Leave Work area clean at end of each day.

END OF SECTION

Part 1 General

- .1 (NOT USED)

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 Support channels, length as required, U-shape, size 41 mm x 41 mm, 2.5 mm thick, surface mounted or suspended. Stainless steel or galvanized steel materials.

2.2 FASTENERS OR STRAPS

- .1 Fasteners Acceptable Fasteners: steel bolts and beam clamps
- .2 All fasteners and straps shall be of either galvanized steel, or stainless steel construction.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to masonry with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .4 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.
- .5 Suspended support systems:
 - .1 Support 2 or more cables or conduits on channels supported by 9 mm dia. threaded rod hangers where direct fastening to building construction is impractical.
- .6 For surface mounting of two or more conduits use channels at maximum of 1.5 m on center spacing, or less as indicated in the CEC.
- .7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .10 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.

- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

- .1 (NOT USED)

Part 2 Products

2.1 JUNCTION AND PULLBOXES

- .1 Galvanized steel (CSA enclosure type 12 or greater) or stainless sheet steel construction; with screw-on flat covers for surface or recessed mounting for interior installation.
- .2 CSA enclosure type 4x : Stainless steel, for exterior installations.
- .3 Provide CSA enclosure 4X where indicated on the drawings.
- .4 Covers suitable for the specific installation.

2.2 CABINETS

- .1 Type E: galvanized or stainless sheet steel (size and rating as per drawing & application), hinged door and return flange overlapping sides, handle, lock and catch, 2 keys, for surface-mounting.
- .2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys. Cabinets to be flush or surface-mounted as indicated.
- .3 Provide other systems' cabinets as specified in the Specifications and located on the electrical drawings or as recommended by the equipment manufacturer.
- .4 All exterior cabinets to be CSA enclosure type 4X, stainless steel.

2.3 CUSTOMER SERVICE TERMINATION ENCLOSURE (CSTE)

- .1 Main and branch lugs to match required size and quantity of incoming and outgoing conductors as indicated.
- .2 Customer service termination enclosures (CSTE) for connection of utility conductors to consumer service conductors shall have the following features:
 - .1 CSA approved for outdoor use (CSA enclosure type 4X or greater).
 - .2 Primed and painted to resist corrosion.
 - .3 Hinged door with three point latching, for each compartment.
 - .4 Handle with provision for padlocking (keyed handle not acceptable).
 - .5 Copper bus bars sized to accommodate 100% equipment rating.
 - .6 Bus bar terminals shall be arranged to allow for bending radius of conductors.
 - .7 Copper ground lugs for grounds conductors size to #2/0 AWG copper.
 - .8 Provide built in provisions (with enclosure) to accept a utility meter, in accordance with Manitoba Hydro - Customer Metering Standards (latest).
 - .9 Service entrance rated, complete with service entrance rated main breaker.

Part 3 Execution

3.1 LOCATION

- .1 Locate junction and pullboxes as indicated or as needed for each system, in accordance with Canadian Electrical Code requirements.
- .2 Junction boxes, and pull boxes are not shown on the drawings. The Contractor shall review the site, and shall determine suitable locations for this equipment.
- .3 Locate equipment so that it does not interfere with existing systems. Equipment must be installed so that:
 - .1 It does not obstruct or impede other equipment, maintenance or access to equipment.
 - .2 It does not obstruct maintenance, or removal of other systems.
 - .3 Covers are accessible for maintenance and installation.
 - .4 Does not impede travel or occupancy of personnel.

3.2 JUNCTION, PULLBOXES, CABINETS

- .1 Support boxes independently of connecting conduits. Secure boxes to building structure.
- .2 Pull boxes and junction boxes are not necessarily shown on the drawings. The contractor shall provide the required pull boxes to accomplish the cable run installed within a conduit system, in accordance with the requirements of the electrical code. Provide junction boxes in accordance with the requirements of the Canadian Electrical Code (CEC) to suit the installation.
- .3 Install pullboxes in inconspicuous but accessible locations.
- .4 Mount cabinets with top not higher than 74" (1.9 m) above finish floor.
- .5 Install terminal blocks, as required.
- .6 Provide pullboxes in conduit runs as described in Section 26 05 34.
- .7 Boxes and cabinets to be installed plumb and square with building lines.
- .8 Install junction and pullboxes clear of all mechanical ductwork and piping.

3.3 CSTE

- .1 Install equipment as indicated and mount plumb, true and square.
- .2 Provide exterior CSTE padmounted on a fiberglass pad complete with prepared base in accordance with the manufacturer's recommendations.

3.4 IDENTIFICATION

- .1 Identify junction boxes (larger than 100mm by 100mm), cabinets and CSTE with Size 5 nameplates. Indicate system name, circuit number – where suitable, ampacity, voltage and phase in accordance with Section 26 05 00
- .2 Identify 100mm and smaller square or octagonal junction boxes and pull boxes with the circuit number, using black felt marker on the exterior and interior of the cover plates.

END OF SECTION

Part 1 General

1.1 LOCATION OF CONDUIT

- .1 Drawings do not show conduit runs. The Contractor is responsible for determining the location, routing and size of conduits. The contractor is responsible for identifying, locating and providing all pull boxes, and handhole access points.
- .2 The Contractor to produce layout sketches of conduit in order to avoid any conflict with other construction elements and to determine the most efficient route to run conduit.

Part 2 Products

2.1 CONDUITS

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83.1 EMT shall be thin-walled electroplated steel. Minimum size 3/4" (21mm).
- .2 Rigid metal conduit: to CSA C22.2 No. 45.1.
- .3 Flexible metal conduit and liquid-tight flexible metal conduit: to CSA C22.2 No. 56.
- .4 Rigid PVC (Unplasticized) conduit: rigid, FT4 rated, to CSA C22.2 No. 211.2.

2.2 CONDUIT FASTENINGS

- .1 All fasteners shall be galvanized or stainless steel.
- .2 One hole steel straps to secure surface conduits 1 1/4" (35 mm) and smaller. Two hole steel straps for conduits larger than 1 1/4" (35 mm).
- .3 Beam clamps to secure conduits to exposed steel work.
- .4 Channel type supports for two or more conduits at the following maximum spacings:
 - .1 1500 mm for 21 mm conduits
 - .2 2000 mm for 27 mm and 35 mm conduits
 - .3 3000 mm for 41 mm and larger conduits
 - .4 Flexible conduit (where permitted) shall be supported at intervals not exceeding 1500 mm and within 300 mm of terminations or devices.
- .5 6 mm diameter threaded rods to support suspended channels.
- .6 Conduit clamps for conduits on channels.

2.3 CONDUIT FITTINGS

- .1 Fittings for raceways: to CSA C22.2 No. 18.2, No. 18.3.
- .2 Hardware supports: to CSA C22.2 No. 18.4
- .3 Fittings manufactured for use with conduit specified.
- .4 Manufacturer elbows where 90° bends are required for 2" (53 mm) and larger conduits.

- .5 Steel type water tight connectors and fittings, complete with O-rings for all metallic conduit. Water tight couplings to be used for all conduit installations. Provide conduit bonding straps to ensure bond continuity.
- .6 Rigid PVC or HDPE conduit fittings for buried conduit systems. Provide transition fittings for complete installation.

Part 3 Execution

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Use electrical metallic tubing (EMT) except where noted otherwise.
- .3 Use rigid PVC underground, under or through concrete slabs or for interior wet environment areas only.
- .4 Use liquid-tight flexible metal conduit and liquid-tight connectors for connection to all motors, transformers or vibrating equipment.
- .5 Provide a separate and dedicated bonding conductor in all conduit runs, sized in accordance with the Canadian Electrical Code.
- .6 Conceal conduits in new walls, behind drop ceilings, and wherever possible. The Contractor must make every effort to conceal conduits and wiring.
- .7 Provide penetrations through existing structure and assemblies to route the required conduit. Position equipment, review, and scan existing structure as required to avoid damage to existing structure and reinforcing steel. Repair damage caused to the satisfaction of the Departmental Representative.
- .8 Use rigid conduit in any location which is subjected to mechanical damage or corrosion.
- .9 Use liquid-tight flexible metal conduit and liquid-tight connectors for connection to motors.
- .10 Maximum length of flexible conduit or flexible cable run from a conduit system is 3000 mm (total length). Runs greater shall be EMT conduit.
- .11 Locate conduits not less than 3" (75 mm) parallel to steam or hot water lines with a minimum of 1" (25 mm) at crossovers.
- .12 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .13 Install a minimum of 2 polypropylene fish cord in empty conduits.
- .14 Where conduits become blocked, cut out, remove and replace blocked or kinked section.
- .15 The length of any conduit run shall not exceed 98' (30 m) and no conduit run shall have more than three 90E bends (or equivalent) before a pullbox is installed. Pullboxes shall be installed in accessible ceiling spaces at intervals in accordance with Code requirements. Conduits shall be supported within 12" (300 mm) of entering any junction box, pullbox, cabinet, or panelboard.
- .16 Conduit to be sized as per Canadian Electrical Code or as shown on drawings. Note that the sizes of branch circuit conductors scheduled and/or specified on the drawings are

minimum sizes and must be increased as required to suit length of run and voltage drop in accordance with Canadian Electrical Code. Where conductor sizes are increased to suit voltage drop requirements, increase the conduit size to suit at no extra cost.

- .17 For conduit runs with fiber optic cables within, provide suitable sweeping conduit bends to meet minimum cable bending radius requirements.
- .18 Provide accessible pull boxes for exterior conduit runs to meet code requirements. Exterior pullboxes installed on asphalt, shall be rated for roadway, semi-trailer load capacity.
- .19 Do not install conduits:
 - .1 On floors or at grade level,
 - .2 in a manner that blocks systems that require maintenance or removal,
 - .3 near or adjacent hot surfaces,
 - .4 in a manner that obstructs access into the space or through the space,
 - .5 in manner that impedes, prevents, or obstructs travel through the working space.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not locate conduits within 78" (2 m) of infrared or gas-fired heaters.
- .3 Group conduits wherever possible on suspended or surface channels.

3.3 CONCEALED CONDUITS

- .1 Do not install conduit home runs horizontally in masonry walls.
- .2 Do not install conduits in terrazzo or concrete toppings, unless otherwise indicated.

3.4 PENETRATION OF EXISTING CAST-IN-PLACE CONCRETE

- .1 Core holes through existing cast-in-place concrete using suitable equipment:
 - .1 Do not hammer, chip, grind or sawcut to accommodate penetrations.
- .2 Locate holes using bars scans to avoid existing reinforcing steel:
 - .1 Core the minimum diameter necessary to accommodate each penetration, to a maximum nominal diameter of 100 mm.
 - .2 Do not cut or damage existing reinforcing steel.
 - .3 Locate in centre one third of wall or slab.
 - .4 Maintain at least 20 mm concrete cover over existing reinforcing steel.
 - .5 Maintain at least 3 hole diameters spacing between penetrations, measured edge to edge horizontally.
- .3 Lay out proposed coring geometry and locations of existing reinforcing steel directly on the surface to be cored for the review of the Departmental Representative.
 - .1 Do not core holes prior to receiving the Departmental Representative's approval.
- .4 Repair concrete damaged during the installation of the penetrations to the satisfaction of the Departmental Representative.

3.5 CONDUIT / IDENTIFICATION

- .1 The Contractor shall confirm the existing color code on site at project initiation. Match the existing color code scheme on site, or in the event that there is none, utilize the scheme described below.

- .2 Color code coverplates of junction boxes and conduit systems as per the color code list below.

120/240V Normal / Standby	yellow
Power	
Controls	brown

Provide 50mm wide colour coded tape on all conduits at 10' (3 m) centers.

- .3 In addition to color coding, for power circuits, identify the circuit numbers / source of supply at all junction boxes on the outside of the cover plate using hard plastic lamacoids.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Insulated Cable Engineers Association, Inc. (ICEA)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for cables 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.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 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 pressure treated, coloured.

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.

3.2 DIRECT BURIAL OF CABLES

- .1 Provide 4.75mm screened sand bed in accordance with the Canadian Electrical Code, lay cables / conduits maintaining clearances from each side of the nearest cable.
- .2 Include offsets for thermal action and minor earth movements.
- .3 Make termination as indicated leaving 0.6 m minimum of surplus cable in each direction.
 - .1 Make terminations in accordance with manufacturer's written recommendations using manufacturer approved termination kits and appropriate connectors.
- .4 Underground cable splices not acceptable.
- .5 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 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.
 - .4 Install treated planks on lower cables in each direction at crossings.
- .6 After sand protective cover specified in by Code.

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 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 per manufacturer standard and consistent between cables.
- .5 Tests:
 - .1 After installing cable but before terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
 - .2 Check insulation resistance after each termination to ensure that cable system is ready for acceptance testing.
- .6 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .7 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.5 CLEANING

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

3.6 PROTECTION

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

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Perform 100% verification through commissioning inspections and testing of 100% of installed components/systems.
- .2 General inspection, testing and commissioning of all electrical equipment, including equipment supplied by other trades as part of the project.
- .3 Power distribution system testing, including insulation resistance testing, and voltage testing.
- .4 Submittal of test reports.
- .5 Instruction for maintenance staff in the cleaning, maintenance and operation of the systems, equipment, and finishes.
- .6 Specific equipment testing as specified herein or in other sections of the specifications.
- .7 Perform all work as required by other specification sections, including the requirements of the pre-functional and function check lists.

Part 2 Products

2.1 EQUIPMENT

- .1 Provide all instruments, meters, and equipment required to conduct tests during and at the conclusion of the project.

Part 3 Execution

3.1 INSPECTIONS

- .1 Visually inspect all equipment delivered to the site, to identify damage due to transportation, handling, or placing into position. Verify the content of the equipment with the bill of material and note any missing items. Document all defects or damage noted and submit to the Departmental Representative.
- .2 Check all bus connections, wiring, and other joints that are made at equipment shipping splits and ensure that the equipment sections are properly bolted together.
- .3 Ensure that the equipment is clean and free of debris before proceeding with testing or energization of the equipment.
- .4 Verify the phasing connections of the incoming and / or outgoing connections to the equipment.
- .5 Visually check air gap and surface clearances, phase to phase and phase to ground. Document any clearances that appear to be below the CSA standard for the equipment.
- .6 Ensure that ground connections are provided to C.E.C. requirements and as specified.

3.2 DISTRIBUTION EQUIPMENT

- .1 Randomly check 10% of bus connections for proper torque. If any connections fail the test, check and torque all connections.
- .2 Test and calibrate all component parts including instruments, control devices and instrument transformers.

3.3 GENSET AND TRANSFER SWITCH

- .1 Test the system to CSA C282.2 (latest) edition. Provide temporary mobile load bank for testing purposes.

3.4 SWITCHES AND FUSES

- .1 Check the switch for any physical damage, inspect all insulators and barriers, and ensure that the switch is properly lubricated.
- .2 Check fuse mounts, clamps, and holders for tightness and alignment.
- .3 Operate the switch and check safety interlocks for proper operation.

3.5 MOLDED CASE CIRCUIT BREAKERS

- .1 Operate each breaker and monitor the output to confirm that all of the contacts are operating properly.
- .2 Check the switch for any physical damage, inspect all insulators and barriers, and ensure that the switch is properly lubricated.

3.6 INSULATION TESTING

- .1 Megger test all branch circuits and feeders greater than #6 AWG. Megger equipment buswork prior to energization. Insulation resistance shall conform to the requirements of the Canadian Electrical Code, the local inspection authority, and the Departmental Representative.
 - .1 Test circuits and equipment rated up to 350 volt with a 500 volt instrument.
 - .2 Test 350 to 600 volt circuits and equipment with a 1000 volt instrument.
- .2 Insulation resistance less than 1.0 Megohm or that deviate more than 25% from similarly tested equipment - at the same insulation, on any circuit, feeder, or equipment shall be considered unacceptable. Clean, dry out, and replace equipment as required until acceptable resistance is achieved.

3.7 TEST REPORTING

- .1 Submit general equipment inspection report to confirm that equipment has been tested and noting any damage or defects.
- .2 Submit test documentation for all tests and certification performed. Include documentation in the O & M manuals.
- .3 Submit distribution system electrical test reports including:
 - .1 Insulation resistance test results for all power feeders.

.2 Power distribution system voltage readings

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No.29-15 , Panelboards and Enclosed Panelboards.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Include on drawings:
 - .1 Protective devices.
 - .2 Space for future protective devices.
 - .3 Voltage, frequency, and phase ratings.
 - .4 Enclosure type.
 - .5 Bus and terminal bar configurations and current ratings.
 - .6 Provisions for circuit terminations with wire range.
 - .7 Short circuit current rating of assembled panelboard at system voltage.
 - .8 Features, characteristics, ratings, and factory settings of auxiliary components.
 - .9 Panel schedules.
 - .10 Schematics / wiring diagrams for power meter and voltage monitor.
 - .11 Schematics / wiring diagrams for auxiliary devices
 - .12 Detailed panel interior and exterior layout diagram, including all dimensions.
 - .13 Wiring and schematic diagrams detailing control wiring, and differentiating between manufacturer-installed and field-installed wiring.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:

- .1 Store materials off ground, indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect panelboards from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PANELBOARDS, CDPs AND MAIN DISTRIBUTION EQUIPMENT

- .1 Equipment: 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. This includes but is not limited to panelboards with 100A mains.
- .2 Minimum enclosure environmental rating CSA type 12 or greater as specified on the drawings.
- .3 Bus and breakers rated for 250 VAC
- .4 Equipment shall be rated for a minimum withstand / interrupting rating of 22,000 Amps symmetrical or higher if indicated on the drawings. Series rated systems are not acceptable. All breakers to be fully rated.
- .5 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.
- .6 Equipment: mains, number of circuits, and number and size of branch circuit breakers as indicated on the drawings.
- .7 Minimum of 2 flush locks for each panel board.
- .8 Two keys for each panelboard and key panelboards alike.
- .9 Tin-platted copper bus with neutral of same ampere rating of mains.
- .10 Mains: suitable for bolt-on breakers.
- .11 Trim suitable for surface mount panelboard, front bolts and hinges.
- .12 Trim and door finish: baked enamel.
- .13 Include grounding busbar with terminals for bonding conductor equal to breaker capacity of the panel board.
- .14 Acceptable manufacturers: Eaton, Schneider, Siemens.

2.2 BREAKERS

- .1 Breakers: utilize standard size breakers to Section 26 28 16.02- Moulded Case Circuit Breakers. Half size or reduced size breakers are not accepted.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

- .4 Lock-on devices for breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.
- .5 Lock-on devices for fire alarm circuits.
- .6 Minimum interrupting rating of 22,000 Amps symmetrical or higher if indicated on the drawings.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical, size 7 lamacoid. Sample format of lamacoid nameplate shall be:
 - .1 PANEL XX
 - .2 FED FROM UPS-zz / MD-yy
- .2 Nameplate for each circuit in distribution panelboards (for each branch breaker) size 2 engraved.
- .3 Clear plastic protective sleeve on panelboard door for removable directory. Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

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.
 - .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. Paint backboard with fire retardant paint. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00- Common Work Results for Electrical.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

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.
- .3 Waste Management: separate waste materials for recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No. 5-16, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2016).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Include time-current characteristic curves for breakers with ampacity of 100A and over.
- .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 the 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 the Departmental Representative. Unless complying with this requirement, the Departmental Representative reserves the right to mandate the manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, at the 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: CBSA, Boissevain – Generator Replacement
 - .2 End user's reference number: R.094408.001

.3 List of circuit breakers

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store circuit breakers 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 Full size molded-case circuit breakers, accessory, ground-fault circuit-interrupters: to CSA C22.2 No. 5. Reduced size or half size breakers are not accepted.
- .2 Bolt-on molded case circuit breaker: quick- make, quick-break type, for manual and automatic operation.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Circuit breakers to have minimum 22 kAIC rating (fully rated) interrupting rating, or greater as shown on the drawings.

2.2 THERMAL MAGNETIC BREAKERS

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

2.3 SOLID STATE TRIP BREAKERS

- .1 Where indicated on the drawings (as LI, LSI, LSIG), molded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and Short time (S), Long time (L), Instantaneous (I) and Ground (G) fault, circuit protection.

2.4 OPTIONAL FEATURES

- .1 Include optional features (for all breakers greater than 100A):
 - .1 On-off locking device.

- .2 Handle mechanism.

2.5 ENCLOSURE

- .1 Provide suitable enclosure (to meet the environmental requirements) for all breakers. Exterior breakers shall be mounted within CSA enclosure type 4X enclosures. Interior circuit breakers shall be mounted within a minimum of CSA enclosure type 12.

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.
 - .1 Visually inspect substrate in presence of the Departmental Representative.
 - .2 Inform the 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 the Departmental Representative .

3.2 INSTALLATION

- .1 Install circuit breakers.
- .2 Set trip units to specified trip settings.
- .3 Provide torquing of cable connections to appropriate level.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 10 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 CODES AND STANDARDS

- .1 Comply with the most recent adopted version in effect of the following standards:
 - .1 Cenelec EN 61000-6-4:7 (BS EN 61000-6-4:2007+A1) – Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments.
 - .2 Cenelec EN IEC 61000-6-2 Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments.
 - .3 CSA C282 – Emergency Electrical Power Supply for Buildings.
 - .4 CSA B139 – Installation Code for Oil Burning Equipment.
 - .5 CAN/CSA-E61131-2 – Programmable Controllers - Part 2: Equipment Requirements and Tests (Adopted IEC 61131-2, with Canadian deviations).
 - .6 EEC 89/336/EEC, 91/368/EEC, 3/44/EEC, 93/68/EEC – Electromagnetic compatibility.
 - .7 Manitoba Building Code (MBC).
 - .8 NFPA 37 – Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
 - .9 NFPA 110 – Standard for Emergency and Standby Power Systems.
 - .10 ISO 8528 – Reciprocating internal combustion engine driven alternating current generating sets.
 - .11 UL 508 – Standard for Industrial Control Equipment.
 - .12 UL 508A – Standard for Industrial Control Panels.
 - .13 UL 60947-1– Low-Voltage Switchgear and Controlgear - Part 1: General rules,
 - .14 UL 60947-4-1A – Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-Starters - Electromechanical Contactors and Motor-Starters,
 - .15 UL 61131-2 – Programmable Controllers – Part 2: Equipment requirements and tests.

1.2 SUBMITTALS

- .1 Provide Submittals in accordance with the general project submittal procedures and Section 01 30 00 – Submittals.
- .2 Submit shop drawings:
 - .1 Complete set of dimensioned equipment drawings showing plan and elevations of the proposed generator set and drive system including anchoring requirements
 - .2 Provide the simulation of block loading (voltage, frequency recovery) within CSA C282 tolerances for block loading of 91 kVA minimum load in one step.
 - .3 Interconnecting wiring diagrams.
 - .4 Field wiring cable list, conduit list.
 - .5 Weight of all equipment.
 - .6 Engine mechanical data at varying loads up to full load, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, noise data, fuel consumption, etc.

- .7 Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
- .8 Material List.
- .9 Generator resistances, reactances (including transient and sub-transient), and time constants.
- .10 Generator current decrement curves.
- .11 Generator motor starting capability.
- .12 Generator thermal damage curve.
- .13 Jacket water heater and space heater connection diagram, heater wattage, voltage, breaker size.
- .14 Alternator space heater / enclosure heater connection diagram, heater wattage, voltage, breaker size.
- .15 Control panel schematics.
- .16 Load bank interconnection diagrams with genset system.
- .17 Interconnection diagram with transfer switches.
- .18 Generator set controller details and wiring schematic diagrams
- .19 Remote annunciator details, wiring, connections.
- .20 Control interconnection diagrams / interface with the switchgear
- .21 Manufacturer's and Vendor's written warranty.
- .22 Emissions data (sound and environmental).
- .23 Breaker specifications, including trip unit curves.
- .24 Complete list of accessories provided.
- .25 Handling, craning, lifting and transportation.
- .3 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, and limitations. Specific model shall be indicated.
- .4 O & M Manual:
 - .1 Paper and digital copies of the manual specific to the product supplied must be provided in accordance with the requirements of CSA C282. General operating instructions, preventative maintenance, wiring diagrams, schematics and parts exploded views specific to the supplied model must be included.

1.3 OPERATIONS & MAINTENANCE (O&M) MANUAL

- .1 Provide submittals in accordance with the general project requirements and Section 01 30 00 – Submittals.
- .2 Prepare installation, operating and maintenance (O&M) manuals in printed format and in digital formats: PFD format.
- .3 Each of the O&M Manuals shall include, at a minimum, the following:
 - .1 All Shop drawing information.
 - .2 Equipment "As Manufactured" drawings.
 - .3 Certified product test reports.
 - .4 Certificates of compliance.

- .5 CSA certificates of inspection for the provided equipment, or Manitoba Office of the Fire Commissioner, Inspection and Technical Services Manitoba "Special Inspection" certificate for the provided equipment.
- .6 Handling and installation instructions, including equipment anchorage information and provisions.
- .7 Operating and maintenance instructions.
- .8 Complete component list.
- .9 Recommended maintenance practices and procedures.
- .10 Recommended spare parts list.
- .11 Recommended system settings.
- .12 Protection curves and data sheets.
- .13 Equipment and component Manufacturer's detailed instructions, installation and maintenance manuals.
- .14 Standard cut sheets for OEM devices.
- .15 Component manuals for all devices/equipment/relays incorporated into the equipment.
- .16 Metering equipment settings and programming information.
- .17 Site Testing & Commissioning Procedures, and recommendations and precautions for setting into operation.
- .18 Test plan and inspection records.
- .19 Certified copies of all test reports.
- .20 Such additional information, instructions, data, recommendations, and procedures that the Manufacturer considers to be pertinent.
- .21 All system programming settings.
- .22 Recommended control system settings.

1.4 PROJECT CONDITIONS

- .1 Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - .1 Ambient Temperature: -45.0 deg C (-49.0 deg F) to +40.0 deg C (104.0 deg F).
 - .2 Relative Humidity: 0 to 95 percent.
 - .3 Altitude: Suitable for installation in Manitoba, Canada.
- .2 The genset and associated transfer switches and infrastructure shall meet the requirements of CSA C282 as an emergency genset / emergency power system.
- .3 The physical size (footprint) of the genset, and subsequent impact to the physical space, shall not exceed that shown on the drawings.

1.5 QUALITY ASSURANCE

- .1 The Contractor shall be trained and certified by the equipment manufacturer for the installation of units required for this Project.
- .2 Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

- .3 Prior to shipment, the manufacturer shall factory test the generator, load bank, and associated control and protection equipment.
- .4 A certified test and compliance report shall be submitted within 7 days of the successful completion of the tests.
- .5 Accept equipment on site and inspect for shipping damage.

Part 2 Products

2.1 GENERAL

- .1 Quality and Experience
 - .1 All materials and parts of the generator set shall be new and unused. Each component shall be of current manufacture from a firm regularly engaged in the production of such equipment. Units and components offered under these specifications shall be covered by the manufacturer's standard warranty on new machines, a copy of which shall be included in the submittal.
- .2 Torsional Vibration
 - .1 The system shall be free of injurious torsional and bending vibrations within a speed range from 1710 to 1890 RPM.
- .3 Guards
 - .1 The system shall be adequately guarded both physically and electrically for protection of operating personnel.
 - .2 Guards, and covers shall be removable to allow for maintenance of systems.
- .4 Layout
 - .1 The layout of the site, equipment position, structural equipment pad, wiring and connections diagrams contained in the contract documents is based on the generator model #C125D6D from Cummins.

2.2 DIESEL ENGINE

- .1 Fuel: ASTM D975 #2 Diesel Fuel
- .2 Rated Engine Speed: 1800RPM.
- .3 Lubrication System: The following items are mounted on engine or skid:
 - .1 Lube oil pump: shall be positive displacement, mechanical, full pressure pump.
 - .2 Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.
 - .3 Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- .4 Engine Fuel System: The engine fuel system shall be installed in strict compliance to the engine manufacturer's instructions.
- .5 Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.

- .6 Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system.
 - .1 Designed for operation on a single 120 VAC, single phase, 60Hz power connection.
 - .2 Installed with isolation valves to isolate the heater for replacement of the element without draining the engine cooling system or significant coolant loss.
 - .3 Provide thermal switch to maintain engine temperature as per manufacture's recommendation.
- .7 Governor: Adjustable isochronous, with speed sensing. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.
- .8 Cooling System: Closed loop, liquid cooled
 - .1 The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition.
 - .2 Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 - .3 Size of Radiator overflow tank: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 - .4 Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 - .5 Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 - .6 Duct Flange: Generator sets installed indoors shall be provided with a flexible radiator duct adapter flange.
- .9 Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. For generator sets with outdoor enclosures the silencer shall be inside the enclosure.
- .10 Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.
- .11 Starting System: 12 or 24V, as recommended by the engine manufacturer; electric, with negative ground.
 - .1 Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 - .2 Cranking Cycle: As required by referenced standards.
 - .3 Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.
 - .4 Battery Compartment: Factory fabricated of metal with acid-resistant finish.

- .12 Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.
- .13 Battery Chargers: Unit shall comply with UL 1236, provide fully regulated, constant voltage, current limited, battery charger for each battery bank. It will include the following features:
 - .1 Operation: Equalizing-charging rate based on generator set manufacturer's recommendations shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - .2 Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature to prevent overcharging at high temperatures and undercharging at low temperatures.
 - .3 Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - .4 Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - .5 Provide LED indication of general charger condition, including charging, faults, and modes. Provide a LCD display to indicate charge rate and battery voltage. Charger shall provide relay contacts for fault conditions as required by NFPA110.
 - .6 Enclosure and Mounting: Mounted within self heated, genset enclosure for outdoor installation.
- .14 Sensing elements shall be located on the engine for all required statuses, alarms and controls.
- .15 Sensors shall be connected to the control panel using a prefabricated wiring harness(es), each connector shall be sealed to prevent corrosion.
- .16 The system shall be a complete, self-contained package, suitable for outdoor installation.
- .17 The engine speed shall be controlled by an isochronous governor. Speed regulation during steady state operation shall be 0.25%.
- .18 The Generator set shall be capable of accepting a block load of 100% of the block load nameplate rating.
- .19 Generator set performance shall meet the requirements of the latest version in effect of CSA C282.
- .20 Approved manufacturer: Cummins model C125D6D. The Contractor may submit a request for approval for alternate equipment, contingent upon the alternate vendors meeting all the criteria within the drawings, and specifications. Alternate vendors which may be reviewed for compliance are Caterpillar and ONAN.

2.3 FUEL OIL STORAGE

- .1 Comply with NFPA 30.

- .2 Sub Base-Mounted Fuel Oil Tank: Provide a double wall secondary containment type sub base fuel storage tank. The tank shall be constructed of corrosion resistant steel and shall be CSA listed and labeled. The fuel tank shall include the following features:
 - .1 Capacity: Fuel for minimum of 24 Hour(s) continuous operation at 100 percent rated power output. The minimum tank size accepted shall be 1417 liters.
 - .2 Tank rails and lifting eyes shall be rated for the full dry weight of the tank, genset, and enclosure.
 - .3 Electrical stub up(s).
 - .4 Normal & emergency vents.
 - .5 Lockable fuel fill.
 - .6 Mechanical fuel level gauge.
 - .7 High and low level switches to indicate fuel level.
 - .8 Leak detector switch.
 - .9 Sub base tank shall include a welded steel containment basin, sized at a minimum of 110% of the tank capacity to prevent escape of fuel into the environment in the event of a tank rupture. Tank shall meet all applicable environmental standards and laws in effect in Manitoba, Canada.
 - .10 Tank design shall meet the regional requirements for the Project location.

2.4 CONTROL AND MONITORING

- .1 Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit.
- .2 Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. (Switches with different configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- .3 Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- .4 Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.
- .5 Indicating and protective devices and controls for the genset engine:
 - .1 All alarms / shutdowns / remote annunciation required by CSA C282 and NFPA 110 for Level 1 installations.
 - .2 AC battery charger failure.
 - .3 High battery voltage.

- .4 Low battery voltage.
- .5 Battery charger AC failure Lamp test.
- .6 Low water / coolant temperature.
- .7 High engine temperature pre-alarm.
- .8 High engine temperature.
- .9 Low lube oil pressure.
- .10 Low fuel main tank.
- .11 Low coolant level.
- .12 Emergency power system supplying load.
- .13 Control switch not in automatic position.
- .14 AC voltmeter (line to line and line to neutral values).
- .15 AC ammeter (all phases).
- .16 AC frequency meter.
- .17 Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
- .18 Emergency Stop Switch: Switch shall be a red “mushroom head” pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
- .19 Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
- .20 DC voltmeter (alternator battery charging).
- .21 Engine-coolant temperature gauge.
- .22 Engine lubricating-oil pressure gauge.
- .23 Running-time meter.
- .24 Over-speed.
- .25 Over crank.
- .26 Audible alarm silencing switch.
- .27 Air shutdown damper when used.
- .28 Remote emergency stop.
- .29 Contacts for local and remote common alarm.
- .30 Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjustment of these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.).
- .31 Fuel tank low alarm.
- .32 Fuel tank high-level shutdown of fuel supply alarm.
- .33 AC Protective Equipment: The control system shall include over/under voltage, reverse kVAR over current, loss of voltage reference, and over excitation shutdown protection. There shall be a overload warning, and overcurrent warning alarm.
- .34 Status LED indicating lamps to indicate remote start signal present at the control, existing shutdown condition, existing alarm condition, not in auto, and generator set running.

- .35 A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.
- .36 Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.
- .37 Data Logging: The control system shall log the latest 20 different alarm and shut down conditions, the total number of times each alarm or shutdown has occurred, and the date and time the latest of these shutdown and fault conditions occurred.
- .38 DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control, and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).

2.5 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- .1 Rated for: 120/240 VAC, 1Ø, 60 Hz, rated at 125 kW / 156 kVA (standby) and 112.5 / 141 (prime), 0.8 pf minimum (or greater to accept block loading in one step of 91 kVA).
- .2 Comply with NEMA MG 1.
- .3 Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- .4 Electrical Insulation: Class H
- .5 Temperature Rise: 120°C / Class H environment.
- .6 Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- .7 Permanent Magnet Generator (PMG) shall provide excitation power for optimum motor starting and short circuit performance.
- .8 Enclosure: Drip-proof.
- .9 Voltage regulator: SCR type, separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.
- .10 Windings: two-thirds pitch stator winding and fully linked amortisseur winding.
- .11 Subtransient reactance: 10 percent maximum, based on the rating of the engine generator set.

2.6 OUTDOOR GENERATOR-SET ENCLOSURE

- .1 Description: Sound attenuated / insulated aluminum housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within a weatherproof (CSA enclosure type 3R or greater) enclosure.
- .2 Construction:

- .1 Hinged Doors: With padlocking provisions. Restraint/Hold back hardware to prevent door to keep door open at 180 degrees during maintenance.
- .3 Space heaters, and louvers to achieve Level 2 enclosure rating.
- .4 Exhaust System:
 - .1 Muffler Location: Within enclosure.
- .5 Hardware: All hardware and hinges shall be stainless steel.
 - .1 Mounting Base: Suitable for mounting on sub-base fuel tank or housekeeping pad.
 - .2 A weather proof protective enclosure shall be provided which allows the generator set to operate at full rated load with a static pressure drop equal to or less than 0.5 inches of water.
- .6 Engine Cooling Airflow through Enclosure: Housing shall provide ample airflow for engine generator operation at rated load in an ambient temperature of 40 deg C.
 - .1 Motorized louvers: Fixed-engine, cooling-air inlet and discharge.
- .7 Sound Performance: Critical grade. Reduce the sound level of the engine generator while operating at full rated load to a maximum of 72 dBA measured at any location 7 m from the engine generator in a free field environment.
- .8 Site Provisions:
 - .1 Lifting: Complete assembly of engine generator, enclosure, and sub base fuel tank (when used) shall be designed to be lifted into place as a single unit, using spreader bars.

2.7 FINISHES

- .1 Indoor and Outdoor Enclosures and Components: Powder-coated and baked over corrosion-resistant pre-treatment and compatible primer. Manufacturer's standard color or as directed on the drawings.

2.8 GENERATOR ALTERNATOR

- .1 The alternator shall be a brushless, revolving field type, wired for 120/240 VAC, 1Ø, 60 Hz, rated at 125 kW / 156 kVA (standby) and 112.5 / 141 (prime), 0.8 pf minimum (or greater to accept block loading in one step of 91 kVA).
- .2 120 °C temperature Rise.
- .3 The alternator and regulator shall sustain at least 300% short circuit current for 10 seconds during phase-phase fault conditions.
- .4 The outgoing power connection terminal box shall be arranged for side and bottom connection of the outgoing load cable(s) and the neutral cable(s).

2.9 CONTROLS

- .1 The generator unit control system shall be a fully integrated control system enabling remote diagnostics and building management integration of all generator functions. The generator controller shall provide integrated and digital control over all generator functions including: engine protection, alternator protection, speed governing, voltage regulation and critical generator operations. The generator controller shall also provide seamless digital integration with the engine's electronic management system. Generator

controller shall utilize separate voltage regulators and speed governors to integrate with the engine management system.

- .2 Provide generator unit remote control panel, which shall include an "AUTO/OFF/TEST" selector switch (Unit Control Selector Switch).
- .3 When the transfer switch at the Service Building is running in test mode, with the load bank. A loss of utility power at any of the facilities will initiate a load dump signal, which will take the load bank off-line, and initiate power supply transfer to the facility load.
- .4 The generator control system shall meet all requirements of CSA C282 for standby engine generators.
- .5 The control system shall be environmentally sealed including encapsulated circuit boards and sealed automotive style plugs for all sensors and circuit board connections. The generator set control shall be tested and certified to the following environmental conditions:
 - .1 -45°C to 70°C operating range.
 - .2 95% humidity non-condensing, 30°C to 60°C.
 - .3 Worst case vibration from the genset.
 - .4 To MIL-STD-202C, Method 101.
 - .5 ASTM B117: Salt fog test.
- .6 Diagnostic capabilities shall include time-stamped event and alarm logs, ability to capture operational parameters during events, and simultaneous monitoring of all input and output parameters.
- .7 Provide a CSA C282 compliant alarm annunciator panel for remote indication per local and national code requirements (shipped loose). The annunciator shall be controlled using RS-485 communications from the generator controller. Annunciator panels requiring individual contacts and wires per indication point are not preferred. The alarm annunciator panel shall have an "Alarm Silence" pushbutton that when momentarily depressed silences the audible alarm, the audible alarm shall automatically re-trigger on receipt of a new or subsequent alarm. A "Test/Reset" pushbutton shall be provided to verify the indicator lights are functional and reset any alarm condition after it has cleared.

2.10 APPROVED GENERATOR SET MANUFACTURERS

- .1 Cummins or approved equal by Caterpillar, ONAN.
- .2 The Contractor is responsible for modifications to the system design and installation for any proposed equal, at no additional cost to the Contract.

2.11 LOAD BANK

- .1 The genset shall have a separate dedicated circuit breaker, for connection to an exterior mounted, portable load bank.

2.12 FACTORY TESTING

- .1 QA Requirements
 - .1 Submit an Inspection and Test Plan in accordance with this specification, applicable Standards and NETA Acceptance Testing Standards.
- .2 Shop Inspection and Testing

- .1 Equipment will be subject to inspection at the following stages of manufacture:
 - .1 Prior to shop testing,
 - .2 Prior to packaging for shipment.
 - .2 Test equipment to ensure satisfactory operation prior to shipping. Provide Certification of Satisfactory performance.
 - .3 Test and inspect all equipment, materials, works in accordance with scope of work, specifications, all applicable codes, standards, regulations, laws and provide Certification and Records.
 - .4 Provide the Departmental Representative or designate, with proper access to work, equipment, tools and facilities for carrying out such inspection, test, witness inspection or test points, surveillance or audit, whether it is in preparation or progress.
- .3 Factory Acceptance Tests (FAT)
- .1 The FAT for the equipment shall be carried out at the generator set Manufacturer's factory prior to packing and shipment to Site. Submit documentation proving successful test results.
 - .2 The Individual Engine Generator Set and Incorporated Controls FATs shall include, but not be limited to, the following for each engine generator set:
 - .1 Starting test.
 - .2 Verification of the correct functioning of all engine protection shutdowns and alarms.
 - .3 Engine speed governor functionality verification.
 - .4 Alternator excitation functionality verification.
 - .5 Alternator Voltage regulator functionality (no-load, 1/4 load, 1/2 load, 3/4 load, full load).
 - .6 A block load application test of the engine generator set at "block load" at rated nameplate capacity, the block load shall be applied in a single step.

Part 3 Execution

3.1 INSTALLATION

- .1 Comply with packaged engine-generator manufacturers' written installation, instructions and CSA C282.
- .2 Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
- .3 Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

- .4 Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.
- .5 Equipment shall be initially started and operated by representatives of the manufacturer. Breaker overcurrent settings shall be adjusted as instructed by the Departmental Representative.
- .6 All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.
- .7 On completion of the installation by the Contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

3.2 DEMONSTRATION AND TRAINING

- .1 Provide demonstration and training by factory trained representative in use and maintenance of Generator set Systems.
 - .1 This will take place at the site where the genset is installed (Canadian Border Crossing, South of Boissevain, Manitoba)
 - .2 Allocate a minimum of two separate 4-hour for training sessions. The date for each training session will be set by the Departmental Representative. Note that the training sessions will NOT be on 2 successive days. Training shall be for up to 20 persons per session. The contractor will be responsible for coordinating the exact days with the Departmental Representative.
 - .3 Training shall include, but not be limited to the following items:
 - .1 Overall system description and theory of operation.
 - .2 Automatic operation.
 - .3 Demonstration of equipment during simulated power failure.
 - .4 Manual operation.
 - .5 Safeties and protective relaying.
 - .6 Recommended system check lists and log sheets in accordance with the requirements of CSA C282.
 - .7 Recommended preventive maintenance.
 - .8 Instruction on methods and procedures for performing regular system tests in accordance with CSA C282.
 - .9 Instruction on the operation of the assembly and major components within the assembly.

3.3 ON-SITE ACCEPTANCE TEST

- .1 The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Departmental Representative shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system. Tests shall include:
- .2 Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.

- .3 Installation acceptance tests to be conducted on site shall include a "cold start" test, a two hour full load (resistive) test, and a one-step rated load pickup test in accordance with CSA C282.
- .4 Perform a power failure test on the entire installed system for each of the separate buildings. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.
- .5 Initial site installation performance tests shall be performed in accordance with the requirements of CSA C282, Section 10. Separate and complete testing shall be performed at each of the buildings connected to the genset power distribution system.
- .6 All test data shall be recorded in accordance with the requirements of CSA C282, and a detailed report shall be indicating a complete and successful system test.
- .7 Provide the Departmental Representative with detailed photos of the generator set, and generator set controls during and after construction.
- .8 Arrange for and provide fuel delivery for genset systems, and provide all fuel utilized during system testing. When turned over (after all successful testing and commissioning), provide full fuel tanks.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

3.5 SERVICE AND SUPPORT

- .1 The generator set supplier shall maintain service parts inventory for the entire power system at a central location which is accessible to the service location 24 hours per day, 365 days per year. The inventory shall have a commercial value of \$3 million or more. The manufacturer of the generator set shall maintain a central parts inventory to support the supplier, covering all the major components of the power system, including engines, alternators, control systems, paralleling electronics, and power transfer equipment.
- .2 The generator set shall be serviceable (at the discretion of the Departmental Representative) by a service organization located in Winnipeg, Manitoba, that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical power system replacement parts in the local service location. Service vehicles shall be stocked with critical replacement parts. The service organization shall be on call 24 hours per day, 365 days per year.

3.6 FINAL ACCEPTANCE

- .1 If required by final field testing/commissioning results make adjustments/or changes such that an efficient and fully operational installation is achieved. Such adjustments or requirements shall be to the suppliers account. Final acceptance by the Departmental Representative will be conditional upon fulfillment of all requirements.
- .2 For equipment subject to inspection by a government ministry, department, or agency, submit original copies of the test data reports and all other documentation required for the final field inspection of the equipment by the government ministry, department or agency.

- .3 Following completion of the work, issue a history docket comprised of the quality certificates, inspection and test records, and all other relevant documents related to manufacture and testing.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Certification to the following CSA group standards:
 - .1 CAN/CSA-C813.1-2014 (R2019) , Performance Test Method for Uninterruptible Power Supplies.
 - .2 CSA C22.2 No.107.3, Uninterruptible power systems (Bi-national standard, with UL 1778).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data: include information as follows:
 - .1 Catalogue information.
 - .2 Shipping weight.
 - .3 Schematic diagram showing interconnection of rectifier, inverter, battery, bypass switch, meters, controls and indicating lamps.
 - .4 Wiring diagram showing field connections to a remote panelboard.
 - .5 Wiring diagram showing manual by-pass interconnections to UPS and to remove panelboard.
 - .6 Description of system operation, referenced to schematic diagram, for:
 - .1 Manual control during initial start-up and load transfer to bypass and back to inverter output.
 - .2 Inverter.
 - .3 Bypass.
 - .7 Estimate with supporting data for Mean Time to Repair factor (MTTR).
 - .8 Full load kVA output at 0.8 lagging power factor.
 - .9 Efficiency of system at 25%, 50%, 75% and 100% rated load.
 - .10 Type of ventilation: natural or forced.
 - .11 Battery:
 - .1 Number of batteries.
 - .2 Maximum and minimum voltages.
 - .3 Type of battery.
 - .4 Type of plates.
 - .5 Catalogue data with battery trade name and type.
 - .6 Size and weight of each battery.
 - .7 Battery charge and discharge curves of voltage, current, time and capacity.
 - .8 Derating factor for specified temperature range.
 - .9 Nominal ampere hour capacity of each battery.
 - .10 Maximum short circuit current.

- .11 Maximum charging current expected for fully discharged condition.
- .12 Recommended low voltage limit for fully discharged condition.
- .13 Expected life.
- .12 Inverter:
 - .1 Type and catalogue number.
 - .2 DC current at minimum battery voltage to produce full load AC output.
- .13 Rectifier:
 - .1 Type and capacity, with catalogue number.
 - .2 Battery charging sequence.
 - .3 Current-time data for Silicon Controlled Rectifier (SCR) protective devices.
 - .4 Guaranteed noise level.
 - .5 Estimated life.
 - .6 Metering.
 - .7 Alarms.
- .14 Heat losses at no load, 25%, 50%, 75% and 100% of rated output, in kW.
- .15 Cooling air required in m³/s.
- .16 List of recommended spare parts, tools and instruments with catalogue numbers and current prices.
- .17 Typical operation and maintenance manual.
- .18 Description of factory test facilities.
- .19 Manufacturer's written installation recommendations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
 - .2 Include outline schematics showing arrangement of cubicles, meters, controls, recommended aisle spaces, battery rack, battery arrangement and dimensions.

1.3 PROTECTION OF SYSTEMS

- .1 Circuit breakers in system used to isolate it from load and from mains for safe working on equipment, and for manual blocking of bypass automatic control to prevent inadvertent operation of bypass during Work on inverter.
- .2 Automatic circuit breakers and protection included in:
 - .1 AC input to rectifier.
 - .2 Battery input.
 - .3 Bypass circuit input.
 - .4 Inverter output.
- .3 Surge suppressors:
 - .1 To protect system against supply voltage switching transients.
 - .2 To protect internal circuits where necessary against voltage transients.

- .4 Current limiting devices, with panel front indication of device operation, to protect inverter SCR's.
- .5 Suitable devices, with panel front indication of device operation, to protect rectifier diodes.
- .6 Failure of circuit or component not to cause equipment to operate in dangerous or uncontrolled mode.

1.4 QUALITY ASSURANCE

- .1 Submit for approval records, indicating and recording instruments calibration certificates, including meters installed as part of system, in accordance with Section 01 33 00- Submittal Procedures.

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 uninterruptible power systems static (UPS) for incorporation into manual.
- .3 Submit interim, draft final, and final Operation and Maintenance (OM) Manual. Final manual approved by the Departmental Representative. Submit interim copies before notification of factory test date.
- .4 Operation and Maintenance Manual to include:
 - .1 Operation and maintenance instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operations maintenance and repair.
 - .2 Technical data:
 - .1 Approved shop drawings.
 - .2 Characteristic curves for automatic circuit breakers and protective devices.
 - .3 Project data.
 - .4 Technical description of components.
 - .5 Parts lists with names and addresses of suppliers.

1.6 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 Adequately enclosed and protected from weather and shipping damage.
 - .2 In accordance with manufacturer's recommendation.
 - .3 Store materials off ground and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

1.7 WARRANTY

- .1 For the work of this Section, the warranty period shall be 24 months from the date of Substantial Completion.
- .2 Equipment manufacturer hereby warrants battery against defects in material and workmanship for 2 years. This warranty is for 100% replacement for two year period from Substantial Completion.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit maintenance materials in accordance with Section 01 78 00- Closeout Submittals.
- .2 Include:
 - .1 4 sets of each type and size of fuses used.
 - .2 4 sets of each type pf indicating lamps.

Part 2 Products

2.1 UNINTERRUPTIBLE POWER SUPPLY

- .1 Manufacturer: Eaton or equal by Schneider, APC.
- .2 Shall be suitable for connection, in accordance with the single line drawings.
- .3 Shall be sized to 15 kVA full load, with a full load run time of 29 minutes.
- .4 Conformance with CSA C22.2, No. 107.3.
- .5 CSA/cUL approved.
- .6 200% neutral.
- .7 UPS to be floor mounted. Provide concrete housekeeping pad.
- .8 Technology
 - .1 Online, double-conversion, solid state topology with static maintenance bypass switch.
- .9 Design Requirements – UPS Module
 1. Voltage. Input/output voltage specifications of the UPS shall be:
 - a. Rectifier Input: 240 volts, single-phase with neutral.
 - b. Output: 120/240 volts, single-phase, 3-wire plus ground.
 2. Output Load Capacity. Specified output load capacity of the UPS shall be as indicated on drawings at 0.9 lagging power factor.
- .10 Design Requirements – Battery
 3. Battery Cells: Sealed, lead-acid, valve-regulated
 4. Provide means (circuit breaker or switch) to isolate the battery from the UPS
 5. Runtime:
 - a. minimum 29 minutes at design full load

B. Modes of Operation

1. The UPS shall be designed to operate as an on-line system in the following modes:
 - a. Normal: The inverter and the rectifier shall operate in an on-line manner to continuously regulate the power to the critical load. The rectifier shall derive power from the AC input source and supply DC power to float charge the battery.
 - b. Emergency/Battery: Upon failure of utility AC power, the critical AC load shall continue being supplied by the inverter without any switching. The inverter shall obtain its power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the AC input source.
 - c. Recharge: Upon restoration of utility AC power, after a utility AC power outage, the UPS shall simultaneously recharge the battery and regulate the power to the critical loads.
 - d. Maintenance Bypass Cabinet: The external maintenance bypass switch shall be located in a separate enclosure along with the main power supply. This external switch shall be used to supply the load directly from the main supply, if the UPS system has to undergo maintenance or service.
- C. Performance Requirements
 - .1 AC Input to UPS
 - .1 Voltage Configuration for Standard Units: single-phase, 3-wire plus ground.
 - .2 Voltage Range: +10%, -15% of nominal.
 - .3 Frequency: Nominal frequency $\pm 5\%$.
 - .4 Power Factor: greater than 0.99 typical and greater than 0.96 for the frequency converter.
 - .5 Current Distortion: $< 5\%$ reflected THD maximum at full load.
 - .6 Surge Protection: Sustains input surges without damage per criteria listed in IEC 1000-4-5.
 - .2 AC Output, UPS Inverter
 - .1 Voltage Configuration: single-phase, 3-wire plus ground
 - .2 Voltage Regulation:
 - .1 $\pm 1\%$ static, $\pm 5\%$ dynamic at 100% resistive load change.
- D. Environmental Conditions
 1. The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:
 - a. Operating Ambient Temperature
 - 1) UPS Module: 0°C to 30°C .
 - 2) Battery: 15°C to 30°C .
 - b. Relative Humidity
 - 1) 0 to 95%, non-condensing.
- E. Audible Noise
 1. Noise generated by the UPS under any condition of normal operation shall not exceed 53 dBA at 1 meter (noise-less room).

- F. The UPS shall have provision for battery status monitoring, which shall include automatic battery tests on a scheduled basis, and be able to report on battery life remaining (estimate), total number of discharges, total time in discharge. The power to the load of the unit shall be completely protected from unanticipated battery failure during these tests
- G. The UPS shall have controls mounted in panel front.
- H. Factory Testing:
 - 1. Before shipment, the manufacturer shall fully and completely test the system to assure compliance with the specification.

2.2 EQUIPMENT IDENTIFICATION

- I. Provide equipment identification in accordance with Section 26 05 01 - Common Work Results – Electrical

2.3 FABRICATION

- .1 Shop assemble:
 - .1 Rectifier unit.
 - .2 Inverter unit.
 - .3 Maintenance bypass switch unit.
 - .4 Battery and battery enclosure.
- .2 Interconnect units, and add lights, alarms and controls to produce complete uninterruptible power system.

2.4 FINISHES

- .1 Cubicles:
 - .1 Inside finish: manufacturer standard
 - .2 Exterior finish: manufacturers standard.

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify equipment in accordance with Section 26 05 00- Common Work Results for Electrical.
- .2 Provide size 7 lamacoid nameplate for all separate equipment.

2.6 SOURCE QUALITY CONTROL

- .1 Complete system including rectifier, inverter, bypass switch, annunciator panel, controls and battery factory tested in presence of the Departmental Representative.
- .2 Tests:
 - .1 Visual inspection to determine:
 - .1 Materials, workmanship, and assembly conform with design requirements.
 - .2 Parts are new and free of defects.
 - .3 Battery and components are not damaged.

- .4 Battery cells are of identical construction.
- .5 Electrolyte in each cell is at manufacturer's recommended full level.
- .6 Each battery cell polarity and polarity of connections to inverter are correct.
- .7 Proper size fuses are installed.
- .8 Metres have suitable range.
- .9 Accessories are present.
- .10 Portable metres for acceptance tests are suitable and instrument transformers connected correctly.
- .2 Demonstrate:
 - .1 System start-up and shut down.
 - .2 Operation during mains power failure, recording output during failure and return of mains power.
 - .3 Adjustable settings.
 - .4 Record values measured at input and output using voltmeter.
 - .5 Bypass switch automatic operations.
- .3 Battery:
 - .1 Charge battery to ensure cells fully charged. When voltage reaches steady value at end of charge, record:
 - .1 Ambient temperature.
 - .2 Temperature of each cell.
 - .3 Voltage of each cell.
 - .4 Voltage of battery.
 - .5 Charging current.
 - .6 Specific gravity of each cell (lead acid battery only).
 - .2 Discharge battery by operating uninterruptible power system with AC mains open, at full rated output for duration quoted in design requirements. Record, at 5 minutes intervals:
 - .1 Voltage of battery.
 - .2 Current.
 - .3 Voltage of 10% random cells.
 - .4 Ambient temperature.
 - .5 Battery temperature.
 - .3 Recharge battery automatically by closing AC mains supply to system for 4 hours period, with dummy load connected. Record at 15 minutes intervals.
 - .1 Battery voltage.
 - .2 Charging current.
 - .4 At start and finish of charge record ambient and battery temperatures, and specific gravity of each cell (lead acid only).
 - .5 Repeat discharge test and readings to prove battery was at least 95% recharged in 4 hours charge period.

.6 Recharge battery.

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 uninterruptible power systems static (UPS) installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of the Departmental Representative.
 - .2 Inform the 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 the Departmental Representative.

3.2 INSTALLATION

- .1 Locate UPS cubicles, battery rack and battery as indicated.
- .2 Locate and install lights and alarm cabinets.
- .3 Assemble and interconnect components to provide complete UPS as specified.
- .4 Connect AC mains to main input terminal.
- .5 Connect UPS output to load.
- .6 Start-up UPS and make preliminary tests to ensure satisfactory performance.

3.3 TESTING

- .1 Perform tests in accordance with Section CAN/CSA-C813.1.
- .2 Provide:
 - .1 Competent field personnel to perform test, adjustments and instruction on UPS equipment.
- .3 Notify the Departmental Representative 10 working days in advance of test date.
- .4 Tests:
 - .1 Inspection of cubicles, battery rack and battery.
 - .2 Inspection of electrical connections.
 - .3 Inspection of installation of lights and alarms.
 - .4 Demonstration of system start-up and shut-down.
 - .5 Run UPS for minimum period of 4 hours at full rated load to demonstrate proper operation with AC mains input, emergency generator input, no AC input.
 - .6 Discharge battery by operating UPS with AC mains open for specified duration of full load. Record readings of temperature of each cell.
 - .7 Recharge battery automatically with full rated load on UPS for 4 hours and record readings of voltage of each cell.

3.4 START-UP

- .1 Arrange with the Departmental Representative:
 - .1 For factory service engineer to supervise start-up of system, checking, adjusting and testing on site.
 - .2 For instruction of UPS and bypass switch
 - .1 After installation and during site testing.

3.5 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.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

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

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
 - .1 Technical data on all major components of all transfer switches and other products described in this section. Data is required for the transfer switch mechanism, control system, cabinet, and protective devices specifically listed for use with each transfer switch. Include steady state and fault current ratings, weights, operating characteristics, and furnished specialties and accessories.
 - .2 Single-Line Diagram: Show connections between transfer switch, power sources, and load.
- .2 Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - .1 Dimensioned outline drawings of assembly, including elevations, sections, and details including minimal clearances, conductor entry provisions, gutter space, installed features and devices and material lists for each switch specified.
 - .2 Internal electrical wiring and control drawings.
 - .3 Interconnection wiring diagrams, showing recommended conduit runs and point-to-point terminal connections to generator set.
 - .4 Field wiring diagrams indicating the required cables, cable type, conductor count for all field run cabling between controllers, load bank, genset, transfer switches, etc.
 - .5 Installation and mounting instructions, including information for proper installation of equipment to meet seismic requirements.

1.2 MANUFACTURER AND SUPPLIER QUALIFICATION DATA

- .1 The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.
- .2 The manufacturer of this equipment shall have produced similar equipment for a minimum period of 10 years. When requested, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.3 OPERATION AND MAINTENANCE DATA

- .1 In addition to items specified other sections, provide the following:
 - .1 Features and operating sequences, both automatic and manual.
 - .2 List of all factory settings of relays, timers and protective devices; provide setting and calibration instructions where applicable.
 - .3 Warranty documents demonstrating compliance with the project's contract requirements.

1.4 QUALITY ASSURANCE

- .1 Only approved bidders shall supply equipment provided under this contract.

- .2 Manufacturer Qualifications: The equipment supplier shall maintain a service center capable of providing training, parts, maintenance and emergency repairs to equipment, including transfer switch generator sets and remote monitoring equipment (if applicable) within a response period of less than 24 hours time from time of notification.
- .3 Submit names, experience level, training certifications, and locations for technicians that will be responsible for servicing equipment at this site.
- .4 The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.
- .5 The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:
 - .1 Transfer switches and enclosures shall be UL 1008 listed and labeled as suitable for use in emergency, legally required, and optional standby applications.
 - .2 CSA 282, Emergency Electrical Power Supply for Buildings.
 - .3 CSA C22.1, Canadian Electrical Code, Part I.
 - .4 CSA C22.2, No. 14 (2019) Industrial Control Equipment.
 - .5 NFPA 70, National Electrical Code. Equipment shall be suitable for use in systems in compliance with Articles 700, 701 and 702.
 - .6 NEMA ICS 10-2005 Part 1, Electromechanical AC Transfer Switch Equipment.
 - .7 IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
 - .8 EN55011, Class ‘B’ Radiated Emissions and Class ‘B’ Conducted Emissions.
 - .9 IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity.
 - .10 IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity.
 - .11 IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity.
 - .12 IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity.
 - .13 IEC 1000-4-6 Conducted Field Immunity.
 - .14 IEC 1000-4-11 Voltage Dip Immunity.
 - .15 IEEE 62.41, AC Voltage Surge Immunity.
 - .16 IEEE 62.45, AC Voltage Surge Testing
- .6 Comply with NFPA 110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems, with loads transferred in less than 10 seconds.
- .7 The manufacturer shall warrant the material and workmanship of the transfer switch equipment for a minimum of two (2) year from the warranty start date. The warranty start date is the date of registered commissioning and start up or eighteen (18) months from date of shipment, whichever is sooner. Include the costs of all labor and travel to site under warranty.
- .8 The warranty shall be comprehensive. No deductibles shall be allowed for travel time, accommodation, vehicular costs, per diems, service hours, repair parts cost, and etc. during the minimum noted warranty period described above.

1.5 PROJECT CONDITIONS

- .1 Interruption of existing electrical service: Do not interrupt electrical service to facilities occupied by CBSA or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

- .1 Notify Departmental Representative no fewer than 21 days in advance of proposed interruption of electrical service.
- .2 Do not proceed with interruption of electrical service without the Departmental Representative's written permission.
- .3 Do not energize any new service or distribution equipment without notification and permission of the Departmental Representative.
- .2 The Contractor must satisfy himself that the transfer switch selected is capable of being transported into the basement area for install. Provide a transport / installation plan to the Departmental representative. Repair / patch and make good any modifications to the facility to bring the equipment into the basement area.
- .3 The transfer switch shall be compatible with, and achieve (or exceed) all performance criteria as outlined in CSA C282.

1.6 COORDINATION

- .1 Size and location of concrete bases and anchor bolt inserts shall be coordinated with the Civil works contractor and equipment shop drawings.
- .2 Arrange for and provide fuel delivery for genset systems, and replace all fuel utilized during system testing. When turned over to CBSA, fuel tanks shall be full.

Part 2 Products

2.1 MANUFACTURERS

- .1 Manufacturers: Subject to compliance with requirements (specs and drawings), provide products by:
 - .1 Cummins, ASCO, Caterpillar.
- .2 Transfer switches utilizing molded case circuit breakers do not meet the requirements of this specification and will not be accepted.
- .3 The contractor must confirm that the equipment selected from one of the vendors can be transported into the space (the basement), without significant alterations to walls, stairs, or structural members prior to bid submission.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- .1 Equipment to be floor mounted.
- .2 Provide transfer switches in the number and ratings that are shown on the drawings.
- .3 Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer.
- .4 Fault-Current Closing and Withstand Ratings: UL 1008 WCR ratings must be specifically listed as meeting the requirements for use with protective devices at installation locations, under specified fault conditions. Withstand and closing ratings shall be based on use of the same set of contacts for the withstand test and the closing test. The minimum acceptable close-in and withstand rating is 50,000 A RMS (or greater as per drawings) at 240VAC.
- .5 Solid-State Controls: All settings should be accurate to +/- 2% or better over an operating temperature range of - 40 to + 60 degrees C (- 40 to + 140 degrees F).

- .6 Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- .7 Electrical Operation: Accomplished by a non-fused, momentarily energized solenoid or electric motor operator mechanism, mechanically and electrically interlocked in both directions (except that mechanical interlock is not required for closed transition switches).
- .8 Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - .1 Switches using molded-case switches or circuit breakers, or insulated case circuit breaker components are not acceptable.
 - .2 Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the Source 1 and Source 2 positions.
 - .3 Main switch contacts shall be high pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
 - .4 Contacts shall be operated by a high-speed electrical mechanism that causes contacts to open or close within three electrical cycles from signal.
 - .5 Provision for manual operation of the automatic transfer switch shall be provided for maintenance use to be operated when de-energized.
 - .6 Transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.
 - .7 The transfer switch shall include the mechanical and control provisions necessary to allow for 3-cycle operating speed.
 - .8 Phase angle monitoring/timing equipment is not an acceptable substitute for this functionality
 - .9 Transfer switches shall have a full current-rated neutral bar with lugs.
- .9 Factory wiring: Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism
- .10 Terminals: Terminals shall be pressure type and appropriate for all field wiring. Control wiring shall be equipped with suitable lugs, for connection to terminal strips.
- .11 Enclosures: All enclosures shall be third-party certified for compliance to NEMA ICS 6 and UL 508, unless otherwise indicated:
 - .1 The enclosure shall provide wire bend space in compliance to the latest version of NFPA70, regardless of the direction from which the conduit enters the enclosure.
 - .2 Cabinet doors shall provide complete protection for the system's internal components. Doors must have permanently mounted key-type latches. Bolted covers or doors are not acceptable.
 - .3 Transfer switches shall be provided in enclosures that are third party certified for their intended environment, to CSA enclosure type 2.

2.3 AUTOMATIC TRANSFER SWITCHES

- .1 Comply with requirements of CSA C282.
- .2 Be equipped with fully rated maintenance by-pass.
- .3 Indicated current ratings:
 - .1 Refer to the project drawings for specifications on the sizes of transfer switch equipment, number of poles, voltage and ampere ratings, enclosure type.
 - .2 Main contacts shall be rated for 600 VAC.
 - .3 Transfer switches shall be rated to carry 100% of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C (-40 to +140 degrees F), relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000 meters).
- .4 Manual Switch Operation: ATS allow manual operation only when the ATS is de-energized.
- .5 Relay Signal: Control shall include provisions for addition of a pre-transfer relay signal, adjustable from 0 to 60 seconds, to be provided if necessary for elevator operation, based on equipment provided for the project.
- .6 Transfer switches shall be 3P to accommodate 120 / 240V, single phase, 3-wire, to accommodate line voltages, as well as neutral switching. The neutral bus shall be sized to carry 100% of the current designated on the switch rating.
- .7 Automatic Transfer Switch Control Features
 - .1 The transfer switch control system shall be configurable to accommodate 240 VAC. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
 - .2 All transfer switch sensing shall be configurable from an operator panel. Designs utilizing DIP switches or other electromechanical devices are not acceptable.
 - .3 The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device for load shedding purposes. On receipt of this signal, the transfer switch shall switch to a neutral position when connected to Source 2. If Source 1 is available when the load-shed signal is received, the transfer switch shall connect to Source 1.
 - .4 The transfer switch shall provide a relay contact signal prior to transfer or re-transfer. The time period before and after transfer shall be adjustable in a range of 0 to 60 seconds.
 - .5 The control system shall be designed, and prototype tested for operation in ambient temperatures from - 40 degrees C to + 60 degrees C (- 40 to +140 degrees F). It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
 - .6 The control shall have optically isolated logic inputs, high isolation transformers for AC inputs and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
 - .7 The transfer switch network monitoring equipment, when supplied, shall be provided with a battery-based auxiliary power supply to allow monitoring of the transfer switch when both AC power sources are non-operational.
 - .8 Transfer Switch Control Panel: The transfer switch shall have a microprocessor-based control with a sealed membrane panel incorporating pushbuttons for

- operator-controlled functions, and LED lamps for system status indicators. The panel shall also include an alphanumeric display for detailed system information. Panel display and indicating lamps shall include permanent labels.
- .9 Accept a control / blocking signal from the genset, which is used during genset load bank testing to prevent transfer switches from proceeding with load transfer during normal power outage while testing of the genset is being performed.
 - .10 The indicator panel LEDs shall display:
 - .11 Which source the load is connected to (Source 1 or Source 2).
 - .12 Which source or sources are available.
 - .13 When switch is not set for automatic operation, the control is disabled.
 - .14 When the genset is not available and is in test mode.
 - .15 The indicator shall have pushbuttons that allow the operator to activate the following functions:
 - .16 Override programmed delays, and immediately go to the next operation.
 - .17 Reset the control by clearing any faults.
 - .18 Test all of the LEDs by lighting them simultaneously.
 - .8 The alphanumeric digital display shall be vacuum fluorescent-type, clearly visible in both bright sunlight and no-light conditions over an angle of 120 degrees, and shall display the following:
 - .1 AC voltage for all phases, normal and standby power.
 - .2 Source status: connected or not connected.
 - .3 Load data, including voltage, AC current, frequency, KW, KVA, and power factor.
 - .9 The display panel shall be password-protected, and allow the operator to view and make adjustments:
 - .1 Set nominal voltage and frequency for the transfer switch.
 - .2 Adjust voltage and frequency sensor operation set points.
 - .3 Set up time clock functions.
 - .4 Set up load sequence functions.
 - .5 Enable or disable control functions including program transition.
 - .6 View real-time clock data, operation log (hours connected, times transferred, failures) and service history.
 - .10 Control Functions: Functions managed by the control shall include:
 - .1 Software adjustable time delays:
 - .1 Engine start (prevents nuisance genset starts in the event of momentary power fluctuation): 0 to 120 seconds (default 3 sec)
 - .2 Transfer normal to standby power (allows genset to stabilize before load is transferred): 0 to 120 seconds (default 3 sec)
 - .3 Re-transfer standby to normal (allows utility to stabilize before load is transferred from genset): 0 to 30 minutes (default 3 minutes)
 - .4 Engine cooldown: 0 to 30 minutes (default 10 min)
 - .5 Programmed transition: 0 to 60 seconds (default 3 sec)
 - .6 Undervoltage sensing: phase-phase normal, phase-phase standby source.
 - .7 Over-voltage sensing: phase-phase normal, phase-phase standby source.

- .8 Over/under frequency sensing:
 - .1 Pickup: +/- 5 to +/-20% of nominal frequency (default 10%)
 - .2 Dropout: +/-1% beyond pickup (default 1%)
 - .3 Dropout time delay: 0.1 to 15.0 seconds (default 5 sec)
 - .4 Accurate to within +/- 0.05 Hz
- .9 Voltage imbalance sensing:
 - .1 Dropout: 2 to 10% (default 4%)
 - .2 Pickup: 90% of dropout
 - .3 Time delay: 2.0 to 20 seconds (default 5 sec)
- .10 Loss of single-phase detection:
 - .1 Time delay: 100 msec
- .11 Control features shall include:
 - .1 Programmable genset exerciser: A field-programmable control shall periodically start and run the generator with or without transferring the load for a preset time period, then re-transfer and shut down the generator after a preset cool-down period.
 - .2 In event of a loss of power to the control, all control settings, real-time clock setting and the engine start-time delay setting will be retained.
 - .3 The system continuously logs information including the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. An event recorder stores information, including time and date-stamp, for up to 50 events.
 - .4 Re-Transfer Inhibit Switch: Inhibits automatic re-transfer control so automatic transfer switch will remain connected to standby power source as long as it is available regardless of condition of normal source.
 - .5 Transfer Inhibit Switch: Inhibits automatic transfer control so automatic transfer switch will remain connected to normal power source regardless of condition of standby source.
 - .6 Transfer inhibit contact: Inhibits automatic transfer control so automatic transfer switch will remain connected to normal power source regardless of condition of standby source. This will be used while the genset is in the test position.
- .12 Control Interface
 - .1 Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.
- .13 Engine Starting Contacts
 - .1 One isolated and normally closed pair of contacts rated 10A at 32 VDC minimum.

Part 3 Execution

3.1 INSTALLATION

- .1 Floor-Mounting Switch: Anchor to floor by bolting.
- .2 For floor-mounted equipment:

- .1 Provide concrete bases: minimum 89 mm high, reinforced, with chamfered edges. Extend base no more than 100 mm in all directions beyond the maximum dimensions of switch.
- .3 Annunciator Panel Mounting: flush, as part of the overall transfer switch.
- .4 Provide lamaroid nameplate, size 7 in accordance with Specification 26 05 00 Section "Equipment Identification".

3.2 CONNECTIONS

- .1 Wiring to other components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes, and provide all field wiring at no additional cost if necessary to accommodate required wiring, for a complete and working installation.
- .2 Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
- .3 Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.
- .4 Ground equipment according to drawings / specifications and code requirements.
- .5 Connect wiring according to drawings / specifications and code requirements.

3.3 SOURCE QUALITY CONTROL

- .1 Prior to shipping, factory shall test and inspect components, assembled switches, and associated equipment to ensure proper operation.
- .2 Factory shall check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements.
- .3 Factory shall perform dielectric strength test complying with NEMA ICS 1.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Service: The supplier of the transfer switch(es) and associated equipment shall inspect, test, and adjust components, assemblies, and equipment installations, including connections, and report results in writing.
- .2 Manufacturer's representative shall perform tests and inspections and prepare test reports.
- .3 After installing equipment and after electrical circuitry has been energized, the Contractor shall test for compliance with requirements.
- .4 Perform recommended installation tests as recommended in manufacturer's installation and service manuals.
- .5 After energizing circuits, demonstrate interlocking sequence and operational function for each transfer switch.
 - .1 Simulate power failures of normal source to automatic transfer switches and of genset source with normal source available.
 - .2 Verify time-delay settings.
 - .3 Verify that the transfer switch is accurately metering AC voltage and current.
 - .4 Test unit functional modes and related automatic transfer-switch operations.

- .5 Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
- .6 Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 - .1 Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
 - .2 Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - .3 Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5

DEMONSTRATION

- .1 After generator set installation, the Contractor shall engage the generator and transfer switch supplier who shall conduct 2 training sessions indicating complete operation, basic maintenance, and emergency service seminar covering generator set and transfer switch equipment. Each training session shall be performed on site and may be combined with the genset training session. Each session shall be 4 hours each, on non-consecutive days at the site, and shall accommodate up to 10 people as selected by the Departmental Representative.
 - .1 The seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, use of the PC based service and maintenance tools provided under this contract, and emergency operation procedures.
 - .2 Demonstration on transferring power, and load bank testing.
 - .3 Demonstrate and train on the use of system software and settings.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C127-15, Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate.
 - .2 ASTM D698-12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).
 - .3 ASTM D1557-12e1, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort 2,700 kN-m/m³).
 - .4 ASTM D4253-16, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

1.2 DEFINITIONS

- .1 Corrected maximum dry density is defined as:
 - .1 $D = D1 \times D2 / (F1 \times D2) + (F2 \times D1)$
 - .2 $D = (F1 \times D1) + (0.9 \times D2 \times F2)$
 - .3 Where: D = corrected maximum dry density kg/m³.
 - .1 F1 = fraction (decimal) of total field sample passing 4.75 mm sieve
 - .2 F2 = fraction (decimal) of total field sample retained on 4.75 mm sieve (equal to 1.00 - F1)
 - .3 D1 = maximum dry density, kg/m³ of material passing 4.75 mm sieve determined in accordance with Method A of ASTM D698.
 - .4 D2 = bulk density, kg/m³, of material retained on 4.75 mm sieve, equal to 1000G where G is bulk specific gravity (dry basis) of material when tested to ASTM C127.
 - .4 For free draining aggregates, determine D1 (maximum dry density) to ASTM D4253 dry method when directed by Departmental Representative.

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 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM D4791-10, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

1.2 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide Departmental Representative with samples of source and processed material for as requested.
- .3 Pay cost of sampling and testing of aggregates.

Part 2 Products

2.1 MATERIALS

- .1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.
- .2 Flat and elongated particles of coarse aggregate: to ASTM D4791.
 - .1 Greatest dimension to exceed five times least dimension.
- .3 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
 - .1 Natural sand.
 - .2 Manufactured sand.
 - .3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.
- .4 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
 - .1 Crushed rock.
 - .2 Gravel and crushed gravel composed of naturally formed particles of stone.
 - .3 Light weight aggregate, including slag and expanded shale.

2.2 SOURCE QUALITY CONTROL

- .1 Inform Departmental Representative of proposed source of aggregates and provide test results at least 4 weeks prior to commencing production.
- .2 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

Part 3 Execution

3.1 PREPARATION

- .1 Processing
 - .1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.
 - .2 Blend aggregates, if required, to obtain gradation requirements, percentage of crushed particles, or particle shapes.
 - .3 Wash aggregates, if required to meet specifications.
 - .4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate.
- .2 Handling
 - .1 Handle and transport aggregates to avoid segregation, contamination and degradation.
- .3 Stockpiling
 - .1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Departmental Representative.
 - .2 Stockpile aggregates in sufficient quantities to meet Project schedules.
 - .3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.
 - .4 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.
 - .5 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Departmental Representative within 48 h of rejection.
 - .6 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.
 - .7 Do not cone piles or spill material over edges of piles.
 - .8 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C117-17, Standard Test Method for Material Finer Than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136-14, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D422-63(2007), Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D698-12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort 600 kN-m/m³.
 - .5 ASTM D4318-17e1, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000-18, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-18, Cementitious Materials for Use in Concrete.
 - .2 CAN/CSA-A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

1.2 DEFINITIONS

- .1 Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- .2 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.
- .3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .4 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-8.2.
 - .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.

1.3 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Co-ordinate submittal requirements and provide submittals requested by Departmental Representative.
- .3 Preconstruction Submittals:
 - .1 Submit records of underground utility locates, indicating: location plan of existing utilities as found in field, clearance record from utility authority, location plan of relocated and abandoned services, as required.
 - .2 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of fill materials and submit third-party test reports of fill material testing to the Departmental Representative.

1.4 QUALITY ASSURANCE

- .1 Do not use soil material until written report of soil test results are reviewed and approved by Departmental Representative.
- .2 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Manitoba WS&H requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Storage and Protection:
 - .1 Protect existing features in accordance with applicable local regulations.
 - .2 Existing buried utilities and structures:
 - .1 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .2 Prior to beginning excavation Work, notify Departmental Representative and applicable authorities having jurisdiction and establish location and state of use of buried utilities and structures.
 - .3 Confirm locations of buried utilities.
 - .4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
 - .5 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing or re-routing.
 - .6 Record location of maintained, re-routed and abandoned underground lines.

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

Part 2 Products

2.1 MATERIALS

- .1 Granular 'A' and Granular 'C' fill to Section 31 05 17 - Aggregate Materials and 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-8.2.
 - .3 Table:

Passing Standard Sieves	Granular 'A'		Granular 'C'	
	Gravel	Limestone	Gravel	Limestone
37.5mm sieve			100%	100%
25mm sieve			85 – 100%	
19mm sieve	100%	100%		
16mm sieve	80 – 100%			
4.75mm sieve	40 – 70%	35 – 70%	25 – 80%	25 – 80%
2mm sieve	25 – 55%			
425um sieve	15 – 30%	10 – 30%	15 – 40%	
75um sieve	8 – 15%	8 – 17%	8 – 18%	8 – 20%
Minimum Crush Count	35%	100%	15%	100%
Maximum				
a) Los Angeles Abrasion Loss	35%	35%	40%	40%
b) Shale Content	12%		20%	
c) Clay Balls	10%			

Part 3 Execution

3.1 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.

3.2 STOCKPILING

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

3.3 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
- .2 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
- .3 Protect open excavations against flooding and damage due to surface run-off.
- .4 Dispose of water in a manner not detrimental to public and private property, or portion of Work completed or under construction.

3.4 EXCAVATION

- .1 Advise Departmental Representative at least 7 days in advance of excavation operations.
- .2 Excavate to lines, grades, elevations and dimensions as indicated.
- .3 Remove paving, walks and other obstructions encountered during excavation.
- .4 Excavation must not interfere with bearing capacity of adjacent foundations.
- .5 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.
- .6 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
- .7 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.
- .8 Restrict vehicle operations directly adjacent to open trenches.
- .9 Dispose of surplus and unsuitable excavated material off site.
- .10 Do not obstruct flow of surface drainage or natural watercourses.
- .11 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

- .12 Notify Departmental Representative when bottom of excavation is reached.
- .13 Obtain Departmental Representative approval of completed excavation.
- .14 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.
- .15 Correct unauthorized over-excavation as follows:
 - .1 Fill under slab with Granular 'C' fill compacted to not less than 98% of Standard Proctor maximum dry density.
 - .2 Fill under walk slab with Granular 'A' fill compacted to not less than 98% of Standard Proctor maximum dry density.
- .16 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Compact foundation soil to 98% of corrected Standard Proctor maximum dry density.

3.5 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.
 - .1 Under slab: provide minimum 500 mm compacted thickness granular 'C' fill to underside of slab compacted to not less than 98% of Standard Proctor maximum dry density.
 - .2 Under walk: provide minimum 100 mm compacted thickness granular 'A' fill to underside of walk compacted to not less than 98% of Standard Proctor maximum dry density.
 - .3 Subgrade: compact subgrade to not less than 98% Standard Proctor Density.

3.6 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.

3.7 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 150 mm compacted thickness. Compact each layer before placing succeeding layer.
- .5 Place recycled fill in areas as indicated.

3.8 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris, trim slopes, and correct defects as directed by Departmental Representative.
- .2 Replace topsoil as required in accordance with the specifications.
- .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 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CAN/CSA-G30.18-09 (R2019), Billet Steel Bars for Concrete Reinforcement.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheet.
- .3 Shop Drawings:
 - .1 Indicate: reinforcing dimensions, sizes, layouts and material grades.
 - .2 Submit each drawing complete with signature and stamp of qualified professional engineer registered or licensed in Province of Manitoba.
- .4 Quality assurance submittals:
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .3 Records and reports: submit concrete tests.

Part 2 Products

2.1 MATERIALS

- .1 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Reinforcing steel: to CAN/CSA-G30.18 and in accordance with Section 03 20 00 - Concrete Reinforcing, grade 400.

2.2 SOURCE QUALITY CONTROL

- .1 Mill report to CAN/CSA-S16.
- .2 Concrete tests: to CSA-A23.1/A23.2.

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 Bore holes to diameters and depths indicated.
- .2 Protective steel casing:
 - .1 Where required, use steel protective casing approved by Departmental Representative.
 - .1 Ensure penetration of casing to required depths either by self mass or driving.
- .3 Dispose of excavated materials off site.
- .4 Remove loose material, foreign matter and water.
- .5 Install steel reinforcement in accordance with Section 03 20 00 - Concrete Reinforcing.
- .6 Fill pile excavations with concrete to elevations as indicated.
 - .1 Place concrete in one continuous pour in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .7 Steel protective casing may be removed at option of Contractor, unless otherwise specified.
- .8 Where steel protective casing is to be removed, provide concrete with minimum slump of 125 mm and with retarder to prevent arching or setting of concrete.
 - .1 Withdraw casing in conjunction with concrete placing, keeping bottom of casing 600 mm below level of concrete.
 - .2 Do not vibrate concrete internally.
- .9 Where steel protective casing is left in place, fill void space between casing and shaft excavation with concrete.

3.3 CLEANING

- .1 On completion of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 QUALITY ASSURANCE

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements.

Part 2 Products

2.1 TOPSOIL

- .1 Topsoil for seeded areas (lawns): mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.
 - .1 Shall consist of a screened clay-textured or loam-textured dark topsoil, a fertile, friable material neither of heavy clay nor of very light sandy nature containing by volume, a minimum of four (4%) percent for clay loams and two (2%) percent for sandy loams to a maximum twenty-five (25%) percent organic matter (peat, rotted manure or composted material) and capable of sustaining vigorous plant growth. Topsoil shall be free of subsoil contamination, roots, stones over 25mm in diameter, baler twine or subsoil clay lumps over 25mm in diameter and other extraneous matter. Topsoil shall not contain quackgrass rhizomes, Canada thistle roots or other noxious weeds. Upon delivery or thirty (30) days following delivery, salinity rating shall be less than 4.0mm hos/cm on a saturated paste basis. The pH range shall be between 6.0 - 8.0.
 - .2 Contain no toxic elements or growth inhibiting materials.
 - .3 Finished surface free from:
 - .1 Debris and stones over 50 mm diameter.
 - .2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
 - .4 Consistence: friable when moist.

2.2 FERTILIZER

- .1 Fertilizer:
 - .1 Chemical fertilizer with an N-P-K analysis of 1-2-1 ratio at a rate to provide 48 kg actual Nitrogen, 96 kg actual Phosphate and 48 kg actual Potassium per hectare.
 - .2 Fertilizer shall be standard commercial brands meeting the requirements of the Canada Fertilizer Act and the Canadian Fertilizer Quality Assurance Program.

- .3 All fertilizers shall be granular, pelletized or pill form, and shall be dry and free flowing.

2.3 SOURCE QUALITY CONTROL

- .1 Advise Departmental Representative of sources of topsoil to be utilized.
- .2 Contractor is responsible for fertilizer to supply topsoil as specified.

Part 3 Execution

3.1 PREPARATION OF EXISTING GRADE

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

3.2 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

- .1 Place topsoil after Departmental Representative has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm.
- .3 Spread topsoil to following 150 mm minimum depth after settlement.
- .4 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

3.3 FINISH GRADING

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

3.4 ACCEPTANCE

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

3.5 SURPLUS MATERIAL

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

3.6 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Product Data:
 - .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Provide product data for:
 - .1 Seed.
 - .2 Fertilizer.

1.2 QUALITY ASSURANCE

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements.

1.3 SCHEDULING

- .1 Schedule completion of work immediately prior to hydraulic mulching.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Do not dispose of unused fertilizer into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

Part 2 Products

2.1 GRASS SEED

- .1 Canada "Certified" seed, "Canada No. 1 or No. 2 Lawn Grass Mixture" in accordance with Government of Canada "Seeds Act" and "Seeds Regulations".
 - .1 Grass seed mixture.
 - .1 60% Kentucky Bluegrass, 30% Creeping Red Fescue, 10% Perennial Ryegrass.
- .2 In packages individually labelled in accordance with "Seeds Regulations" and indicating name of supplier.

2.2 WATER

- .1 Free of impurities that would inhibit germination and growth.
- .2 Supplied by Departmental Representative at designated source.

2.3 FERTILIZER

- .1 To Canada "Fertilizers Act" and "Fertilizers Regulations".
- .2 Complete synthetic fertilizer with guaranteed minimum analysis as specified.

Part 3 Execution

3.1 QUALITY OF WORK

- .1 Do not perform work under adverse field conditions as determined by Departmental Representative.
- .2 Remove and dispose of weeds; debris; stones 50 mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials off site.

3.2 SEED BED PREPARATION

- .1 Verify that grades are correct. If discrepancies occur, notify Departmental Representative and do not commence work until instructed by Departmental Representative.
- .2 Fine grade surface free of humps and hollows to smooth, even grade, to tolerance of plus or minus 15 mm, surface draining naturally.
- .3 Cultivate fine grade approved by Departmental Representative to 25 mm depth immediately prior to seeding.

3.3 SEED PLACEMENT

- .1 For mechanical seeding:
 - .1 Use "Brillion" type mechanical landscape seeder which accurately places seed at specified depth and rate and rolls in single operation.
 - .2 Use equipment and method acceptable to Departmental Representative.
- .2 For manual seeding:
 - .1 Use "Cyclone" type manually operated seeder.
 - .2 Use manually operated, water ballast, landscaping type, smooth steel drum roller.
 - .3 Use equipment and method acceptable to Departmental Representative.
- .3 On cultivated surfaces, sow seed uniformly at rate of:
 - .1 Minimum 2.0 kg/ 100 m².
- .4 Blend applications 150 mm into adjacent grass areas and previous applications to form uniform surfaces.
- .5 Sow half of required amount of seed in one direction and remainder at right angles as applicable.
- .6 Incorporate seed by light raking in cross directions.

- .7 Consolidate mechanically seeded areas by rolling area if soil conditions warrant immediately after seeding.

3.4 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Perform following operations from time of seed application until acceptance by the Departmental Representative:
 - .1 Water and fertilize seeded area to maintain optimum soil moisture level for germination and continued growth of grass. Control watering to prevent washouts.
 - .2 Repair and reseed dead or bare spots to allow establishment of seed prior to acceptance.
 - .3 Cut grass to 75 mm whenever it reaches height of 110 mm. Remove clippings which will smother grass.
 - .4 Fertilize seeded areas after first cutting in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles.
 - .5 Control weeds by mechanical or chemical means utilizing acceptable integrated pest management practices.

3.5 FINAL ACCEPTANCE

- .1 Seeded areas will be accepted by Departmental Representative provided that:
 - .1 Areas are uniformly established, and turf is free of rutted, eroded, bare or dead spots and free of weeds.
 - .2 Areas have been cut at least twice.
 - .3 Areas have been fertilized.
- .2 Areas seeded in fall will be accepted in following spring, one month after start of growing season provided acceptance conditions are fulfilled.

3.6 MAINTENANCE DURING WARRANTY PERIOD

- .1 Perform following operations from time of acceptance until end of warranty period.
 - .1 Water and fertilize seeded area to maintain optimum soil moisture level for continued growth of grass. Control watering to prevent washouts.
 - .2 Repair and reseed dead or bare spots to satisfaction of Departmental Representative.
 - .3 Cut grass to 75 mm whenever it reaches height of 110 mm. Remove clippings which will smother grass.
 - .4 Fertilize seeded areas as required. Spread half of required amount of fertilizer in one direction and remainder at right angles.
 - .5 Control weeds by mechanical or chemical means utilizing acceptable integrated pest management practices.

3.7 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION