



Public Works and Government Services Canada

Requisition No. _____

DRAWINGS & SPECIFICATIONS
For

SSC - West Saanich NRC UPS Replacement
5071 W. Saanich Road, Victoria, BC

Project No. R.095211.003

May 07, 2021

APPROVED BY:

Regional Manager, A&E Services Date

Construction Safety Coordinator Date

TENDER:

Project Manager Date

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END OF SECTION 00 00 10

CONSULTANTS – SEAL & SIGNATURE

Discipline

Seal / Signature / Date

Electrical
(Prime)



2021-07-21

Mechanical



2021-05-07

END OF SECTION

1.1 CODES

- .1 Perform work to CURRENT Codes, Construction Standards and Bylaws, including Amendments up to the TENDER closing date.

1.2 DESCRIPTION OF WORK

- .1 Work of this Contract comprises installation of a new UPS systems, demolition of the old equipment and coordination with the clients and site users and further identified as:

**WEST SAANICH NRC UPS REPLACEMENT
5071 W Saanich Rd, Victoria, BC V9E 2E7
Job No. R.095211.003**

- .2 Work to be performed under this Contract includes, but is not limited to, the following items covered further in the Contract documents:
 - .1 Retrofit of existing low voltage Panelboards with new breakers, feeders and junction boxes
 - .2 Installation of new UPS units in existing electrical room.
 - .3 Demolition of old UPS units in existing electrical and mechanical rooms.
 - .4 Demolition of all duct, conduit, cables and equipment made redundant during this upgrade.
 - .5 Installation of mechanical ventilation system and controls.
 - .6 Coordination and temporary generator power to maintain site operations and minimize disruption. Generator to be suitable for use in maintaining data center infrastructure. With voltage variation of <1% and THD <2%.
 - .7 Demonstration and training of personnel as directed by the Departmental Representative. Refer to Section 01 79 00 Demonstration and Training.
- .3 "Green" requirements:
 - .1 Use only environmentally responsible green materials/ products with no VOC emissions or minimum VOC emissions of indoor off-gassing contaminants for improved indoor air quality - subject of Departmental Representative's approval of submitted MSDS Product Data.
 - .2 Use materials/products containing highest percentage of recycled and recovered materials practicable - consistent with maintaining cost effective satisfactory levels of competition.
 - .3 Adhere to waste reduction requirement for reuse or recycling of waste materials, thus diverting materials from landfill.
- .4 Perform all work in accordance with National Building Code of Canada (NBC) 2018, WorkSafeBC/Workers' Compensation Board (WCB) Regulations and these Contract Documents. Where there is a conflict between Contract Documents and referenced standards, the most stringent will be applied.

1.3 CONTRACT DOCUMENTS

- .1 The Contract documents, drawings and specifications are intended to complement each other, and to provide for and include everything necessary for the completion of the work.
- .2 Drawings are, in general, diagrammatic and are intended to indicate the scope and general arrangement of the work.

1.4 DIVISION OF SPECIFICATIONS

- .1 The specifications are subdivided in accordance with the current 6-digit National Master Specifications System.
- .2 A division may consist of the work of more than 1 subcontractor. Responsibility for determining which subcontractor provides the labour, material, equipment and services required to complete the work rests solely with the Contractor.
- .3 In the event of discrepancies or conflicts when interpreting the drawings and specifications, the specifications govern.

1.5 HOURS OF WORK

- .1 Restrictive as follows:
 - .1 Schedule deconstruction, removal and construction work in offices and lab spaces after normal working hours of the building and during the day on weekends and/or holidays. Normal weekday working hours of the building are 0800 – 1630 hours, Monday to Friday. Work in common spaces, corridors or building exterior may be completed during the noted regular working hours.
 - .2 Notify Departmental Representative of all after hours work, including weekends and holidays.
 - .3 All work impacting provision of power to the building and its users must be fully coordinated to the benefit of the building occupants. Contractor shall assume that all outages will be during weekends or evenings.

1.6 WORK SCHEDULE

- .1 Do not change approved Schedule without notifying Departmental Representative.
- .2 Interim reviews of work progress based on work schedule will be conducted as decided by Departmental Representative and schedule updated by Contractor in conjunction with and to approval of Departmental Representative.

1.7 TIME TO COMPLETION

- .1 Completion of this project shall be no later than 24 weeks from award of contract.
- .2 Construction work on site shall take no longer than 4 weeks from start of construction work to final New Ups connection.
- .3 Site visits to review installations or confirm dimensions do not count as construction work.

1.8 COST BREAKDOWN

- .1 Before submitting the first progress claim, submit a breakdown of the Contract lump sum prices in detail as directed by the Departmental Representative and aggregating Contract price.
- .2 Provide a projection of project billing as proposed on a month by month basis accounting for expected delivery of equipment, project phasing and mobilisation.

1.9 CODES, BYLAWS, STANDARDS

- .1 Perform work in accordance with the Canadian Electrical Code 2018, and other indicated Codes, Construction Standards and/or any other Code or Bylaw of local application.

- .2 Comply with applicable local bylaws, rules and regulations enforced at the location concerned.
- .3 Meet or exceed requirements of Contract documents, specified standards, codes and referenced documents.
- .4 In any case of conflict or discrepancy, the most stringent requirements shall apply.

1.10 DOCUMENTS REQUIRED

- .1 Maintain 1 copy each of the following at the job site:
 - .1 Contract drawings.
 - .2 Contract specifications.
 - .3 Addenda to Contract documents.
 - .4 Copy of approved work schedule.
 - .5 Reviewed/approved shop drawings.
 - .6 Change orders.
 - .7 Other modifications to Contract.
 - .8 Field test reports.
 - .9 Reviewed/approved samples.
 - .10 Manufacturers' installation and application instructions.
 - .1 This shall include a lamacoid nameplate with the following information.
 - .1 MAKE:
 - .2 MODEL:
 - .3 SERIAL #:
 - .4 DATE IN SERVICE:
 - .5 OEM SUPPORT PHONE NUMBER
 - .2 There shall also be lamacoid labels for common bypass procedure and return to normal procedure, and all breakers clearly labeled.
 - .11 One set of record drawings and specifications for "as-built" purposes.
 - .12 Canadian Electrical Code 2018.
 - .13 Current construction standards of workmanship listed in technical Sections.
 - .14 Contractor Safety Plan.

1.11 REGULATORY REQUIREMENTS

- .1 Obtain and pay for - Building Permit, Certificates, Licenses and other permits required by regulatory municipal, provincial or federal authorities to complete the work.
- .2 Provide inspection authorities with plans and information required for issue of acceptance certificates.
- .3 Furnish inspection certificates in evidence that the work installed conforms with the requirements of the authority having jurisdiction.

1.12 CONTRACTOR'S USE OF SITE

- .1 Use of site:
 - .1 Shared with users, complete with coordination for execution of work.

- .2 Assume responsibility for assigned premises for performance of this work.
- .3 Be responsible for coordination of all work activities on site, including the work of other contractors engaged by the Departmental Representative such as moving contractors and furniture installers.
- .2 Perform work in accordance with Contract documents. Ensure work is carried out in accordance with indicated phasing.
- .3 Do not unreasonably encumber site with material or equipment.
- .4 A 1-hour site safety orientation to be completed by all workers. Personnel that do not successfully complete the required training are not permitted to enter the site to perform work.
- .5 Limit use of premises for Work, for storage and for access to allow for continuous occupancy of building.
- .6 Co-ordinate use of premises under direction of the Departmental Representative.
- .7 Assume full responsibility for protection and safekeeping of Products under this Contract.
- .8 Do not use any other part of property unless approved in writing by the Departmental Representative.
- .9 Store materials and equipment only where directed by the Departmental Representative. Obtain and pay for use of additional storage and work areas if required.
- .10 Ensure access to assigned lay down or construction areas is maintained for fire and emergency access at all times.
- .11 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .12 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work.
- .13 Condition of existing work at completion of operations to be equal to or better than that which existed before new work started.
- .14 Provide necessary protection and hoarding to prevent unauthorized entry into areas of work at all times by staff and public.
- .15 Inform the Departmental Representative 3 working days prior to performing work inside the building. Entry into areas of work will be by authorized personnel only and must be delineated during execution of work.
- .16 The contractor can have limited access to the site from 7:00 to 17:00 and after hours with prior notification. The Departmental Representative will provide and coordinate site access requirements with the Contractor at time of award.
- .17 Adjacent portions of building and property will remain in use during Work.
- .18 Co-operate with the Departmental Representative by scheduling operations to minimize conflict and to facilitate continuous use of building. Do not impede, restrict or obstruct use of building or adjacent portions of property.
- .19 Do work in a manner that will minimize creation of noise that would disturb day-to-day operation of building and adjacent property.
- .20 Locate stationary noise generating equipment as far away as practical from occupied parts of building, or where directed by the Departmental Representative.

- .21 Co-ordinate with the Departmental Representative for necessary shutdown of services affecting occupied parts of building and adjacent property where serviced from building. Provide a minimum of 14 days of notice prior to shutdown. Minimize occurrences and durations of shutdowns.
- .22 Co-ordinate with the Departmental Representative to ensure that construction activities do not compromise security of building and site.
- .23 Ensure that construction activities do not compromise other active systems within the building and site.

1.13 EXAMINATION

- .1 Examine site and be familiar and conversant with existing conditions likely to affect work.
- .2 Provide photographs of surrounding properties, objects and structures liable to be damaged or be the subject of subsequent claims.

1.14 LOCATION OF EQUIPMENT AND FIXTURES

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

1.15 CUTTING AND PATCHING

- .1 Cut existing surfaces as required to accommodate new work.
- .2 Remove items so shown or specified.
- .3 Do not cut, bore, or sleeve load-bearing members.
- .4 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.
- .5 Patch and make good surfaces cut, damaged or disturbed, to Departmental Representative's approval. Match existing material, colour, finish and texture.
- .6 Making good is defined as matching construction and finishing materials and the adjacent surfaces such that there is no visible difference between existing and new surfaces when viewed from 1.5 metres in ambient light, and includes painting the whole surface to the next change in plane.
- .7 Provide temporary dust screens, barriers, warning signs in locations where renovation and alteration work is adjacent to areas used by public or government staff.
- .8 Protect adjacent surfaces. Make good or replace damaged surfaces and equipment to satisfaction of the Departmental Representative, at no cost to Contract.
- .9 Provide barricade warning tape to mark perimeter of work area, as directed by the Departmental Representative.

1.16 SETTING OUT OF WORK

- .1 Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.
- .2 Provide devices needed to lay out and construct work.
- .3 Supply such devices as templates required to facilitate Departmental Representative's inspection of work.

1.17 ACCEPTANCE OF SUBSTRATES

- .1 Each trade shall examine surfaces prepared by others and job conditions which may affect his work, and shall report defects to the Departmental Representative. Commencement of work shall imply acceptance of prepared work or substrate surfaces.

1.18 QUALITY OF WORK

- .1 Ensure that quality workmanship is performed through use of skilled tradesmen, under supervision of qualified journeyman.
- .2 The workmanship, erection methods and procedures to meet minimum standards set out in the National Building Code of Canada 2010 and local Construction Standards.
- .3 In cases of dispute, decisions as to standard or quality of work rest solely with the Departmental Representative, whose decision is final.

1.19 WORKS COORDINATION

- .1 Coordinate work of subtrades:
 - .1 Designate one person to be responsible for review of contract documents and shop drawings and managing coordination of Work.
- .2 Convene meetings between subcontractors whose work interfaces and ensure awareness of areas and extent of interface required.
 - .1 Provide each subcontractor with complete plans and specifications for Contract, to assist them in planning and carrying out their respective work.
 - .2 Develop coordination drawings when required, illustrating potential interference between work of various trades and distribute to affected parties.
 - .1 Pay particularly close attention to overhead work above ceilings and within or near to building structural elements.
 - .2 Identify on coordination drawings, building elements, services lines, rough-in points and indicate location services entrance to site.
- .3 Facilitate meeting and review coordination drawings. Ensure subcontractors agree and sign off on drawings.
- .4 Publish minutes of each meeting.
- .5 Plan and coordinate work in such a way to minimize quantity of service line offsets.
- .6 Submit copy of coordination drawings and meeting minutes to Departmental Representative for information purposes.

- .3 Submit shop drawings and order of prefabricated equipment or rebuilt components only after coordination meeting for such items has taken place.
- .4 Work cooperation:
 - .1 Ensure cooperation between trades in order to facilitate general progress of Work and avoid situations of spatial interference.
 - .2 Ensure that each trade provides all other trades reasonable opportunity for completion of Work and in such a way as to prevent unnecessary delays, cutting, patching and removal or replacement of completed work.
 - .3 Ensure disputes between subcontractors are resolved.
- .5 Departmental Representative is not responsible for, or accountable for extra costs incurred as a result of Contractor's failure to coordinate Work.
- .6 Maintain efficient and continuous supervision.

1.20 APPROVAL OF SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- .1 In accordance with Section 01 33 00, submit the requested shop drawings, product data, MSDS sheets and samples indicated in each of the technical Sections.
- .2 Allow sufficient time for the following:
 - .1 Review of product data.
 - .2 Approval of shop drawings.
 - .3 Review of re-submission.
 - .4 Ordering of approved material and/or products - refer to Sections of Divisions 2 to 48.

1.21 SECURITY CLEARANCES

- .1 Refer to Section 01 14 10 – Security Requirements

1.22 COVID-19 PROTOCOLS

- .1 Contractor shall follow COVID-19 procedures in accordance with Canadian Constructors Association COVID-19 Standardized Protocols. Furthermore, Contractor will address PPE and hygiene issues as per Worksafe BC regulations, and Provincial guidelines. Costs associated and required with COVID-19 protocols shall be included in base bid.

1.23 PROJECT MEETINGS

- .1 Departmental Representative will arrange project meetings and assume responsibility for setting times and recording and distributing minutes.

1.24 TESTING AND INSPECTIONS

- .1 The Contractor will appoint and pay for the services of the factory technical representative for the following:
 - .1 Inspection and testing required of individual door controllers.
 - .2 Inspection and testing of the system software.
 - .3 Testing, adjustment and balancing of overhead door/gate and associated electrical equipment and systems.
 - .1 Tests specified to be carried out by Contractor under the Departmental Representative's supervision.

- .2 Contractor shall furnish labour and facilities to:
 - .1 Notify Departmental Representative in advance of planned testing.
- .3 Pay costs for uncovering and making good work that is covered before required inspection or testing is completed and approved by Departmental Representative.
- .4 Provide Departmental Representative with 2 copies of testing and commissioning reports as soon as they are available.

1.25 AS-BUILT DOCUMENTS

- .1 The Departmental Representative will provide 2 sets of drawings, 2 sets of specifications, and 2 copies of the original AutoCAD files for "as-built" purposes.
- .2 As work progresses, maintain accurate records to show all deviations from the Contract documents. Note on as-built specifications, drawings and shop drawings as changes occur.

1.26 CLEANING

- .1 Daily conduct cleaning and disposal operations. Comply with local ordinances and anti-pollution laws.
- .2 **Ensure cleanup of the work areas each day after completion of work.**
- .3 Clean interior building areas when ready to receive finish painting and continue cleaning on an as-needed basis until building is sufficiently completed or ready for occupancy.
- .4 In preparation for interim and final inspections:
 - .1 Examine all sight-exposed interior and exterior surfaced and concealed spaces.
 - .2 Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces, including glass and other polished surfaces.
- .5 Use cleaning materials and methods in accordance with instructions of the manufacturer of the surface to be cleaned.

1.27 DUST CONTROL

- .1 Provide temporary dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of work and public.
- .2 Protect furnishings within work area with polyethylene film during construction. Remove film during non- construction hours and leave premises in clean, unencumbered and safe manner for normal daytime function.
- .3 Maintain and relocate protection until such work is complete.

1.28 ENVIRONMENTAL PROTECTION

- .1 Prevent extraneous materials from contaminating air beyond construction area, by providing temporary enclosures during work.
- .2 Do not dispose of waste or volatile materials into water courses, storm or sanitary sewers.
- .3 Ensure proper disposal procedures in accordance with all applicable territorial regulations.

1.29 MAINTENANCE MATERIALS, SPECIAL TOOLS AND SPARE PARTS

- .1 Specific requirements for maintenance materials, tools and spare parts are specified in individual technical sections of Divisions 02 to 48, where required.

1.30 ADDITIONAL DRAWINGS

- .1 The Departmental Representative may furnish additional drawings for clarification. These additional drawings have the same meaning and intent as if they were included with plans referred to in the Contract documents.
- .2 Upon request, Departmental Representative may furnish up to a maximum of 10 sets of Contract documents for use by the Contractor at no additional cost. Should more than 10 sets of documents be required the Departmental Representative will provide them at additional cost.

1.31 BUILDING SMOKING ENVIRONMENT

- .1 Smoking on the site is not permitted.

1.32 SYSTEM OF MEASUREMENT

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

1.33 SUBMISSION OF TENDER

- .1 Submission of a tender is deemed to be confirmation of the fact that the Tenderer has analyzed the Contract documents and is fully conversant with all conditions.

END OF SECTION

Part 1 General

1.1 FACILITY OPERATIONS AND SECURITY PROCEDURES

- .1 All construction staff shall become thoroughly familiar with and abide by all provisions and requirements of the facility, Safety and Security Procedures and Restrictions.
 - .1 There are no available parking locations on site. Contractor will be required to coordinate all travel to and from site.
 - .2 Equipment deliveries will need to be coordinated with building operators.
 - .3 Speed limits are posted on site. Failure to abide by site speed limits may result in removal of employee and vehicle from site.

1.2 ACCESS AND EGRESS

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant Federal, municipal, provincial and other regulations.
- .2 Provide hoarding, and scaffolding plan for Departmental Representative to review 5 business days prior to installation.

1.3 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work, provide temporary means to maintain security as per Departmental Representatives direction.
- .4 Closures: protect work temporarily until permanent enclosures are completed.
- .5 Coordinate with Departmental Representative in scheduling operations to minimize conflict and to facilitate use of space.

1.4 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

1.5 EXISTING SERVICES

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 3 working days of notice for necessary interruption of civil, mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.
 - .1 Optimize and plan shut-downs so that services are restored in time for normal facility operation hours. Coordinate all shut-downs with utility providers and facility users.

- .2 Contractor shall be held responsible for damages to facility equipment as the result of service shut-downs.
- .3 Contractor shall be held responsible for any and all unscheduled shut-downs of building utilities and services.
- .4 Contractor will not be allowed to connect to Departmental Representative's existing data and communication services.
- .5 Submit a "Fire Alarm Bypass" request to Departmental Representative 3 working days in advance for approval.
- .6 Obtain permission from Departmental Representative for access to restricted areas outside the construction zones 3 working days in advance.
- .3 Provide for personnel and vehicular traffic.
- .4 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.6 NOISE CONTROL

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

1.7 PARALLEL PROJECTS

- .1 Additional projects will be underway at the NRC Observatory during completion of this project. The contractor shall work around and coordinate access, material deliveries, etc with other projects to ensure traffic congestion or delays do not occur.
- .2 Any additional delays, coordination or other costs shall be included by the contractor as part of this project.

END OF SECTION

Part 1 General

1.1 PURPOSE

- .1 To ensure that both the construction project and the facility operations may proceed without undue disruption or hindrance and that the security of the facility is maintained at all times.

1.2 DEFINITIONS

- .1 "Contraband" means.
 - .1 an intoxicant, including alcoholic beverages, drugs/ narcotics, other regulated or controlled substances,
 - .2 a weapon, or a component thereof,
 - .3 an explosive material or compound, or a component thereof, and,
 - .4 any item not described in paragraphs (.1) to (.3) that could jeopardize the security or the safety of workers or facility persons, when that item is possessed without prior authorization.
- .2 "Commercial Vehicle" means any motor vehicle used for the shipment of material, equipment and tools required for the construction project.
- .3 "SSC" means Shared Services Canada.
- .4 "NRC" means National Research Council (of Canada) .
- .5 "Construction employees" mean persons working for the General Contractor, the sub- Contractors, equipment operators, material suppliers, testing and inspection companies and regulatory agencies.
- .6 "Departmental Representative" is defined as: the Technical Authority, Departmental Representative whom will provide final directions concerning the project.
- .7 "Perimeter" means the fenced & parking compound limits of the IOS facility site.
- .8 "Construction limits" means the area, as indicated in the contract documents, that the Contractor will be allowed to work. This area may or may not be isolated from the Hangar areas of the IOS facility site. Limits to be confirmed at the construction start-up meeting.

1.3 PRELIMINARY PROCEEDINGS

- .1 At construction start-up meeting:
 - .1 Discuss the nature and extent of all activities involved in the Project.
 - .2 Establish mutually acceptable security procedures in accordance with this instruction and the facility's particular requirements.
- .2 The Contractor's responsibilities:
 - .1 Ensure that all construction employees are aware of the security requirements;
 - .2 Co-operate with the facility's personnel in ensuring that security requirements are observed by all construction employees.

1.4 CONSTRUCTION EMPLOYEES

- .1 All tradesmen, workers, other contractor employee's, and subcontractors whom are designated to perform the site work or attend site are required possess a valid, PSPC 'Reliability Status' (RS) security clearance or higher, prior to contract award. Provide documentation to the Departmental Representative upon request.
- .2 Entry to facility's property will be refused to any person there may be reason to believe may be a health or security risk.
- .3 Any person employed on the construction site will be subject to immediate dismissal from site if they:
 - .1 appear to be under the influence of alcohol, drugs or narcotics;
 - .2 behave in an unusual or disorderly manner;
 - .3 are in possession of 'contraband'.

1.5 VEHICLES

- .1 All unattended vehicles on property must have windows closed, doors and trunks locked and keys removed. The keys must be securely in the possession of the owner or an employee of the company that owns the vehicle in the event the vehicle is required to be moved.
- .2 The Departmental Representative may limit at any time the number and type of vehicles allowed on the premises.
- .3 Drivers of delivery vehicles for material required by the project will be allowed on the premises to coordinate the delivery with the Contractor. Upon delivery they will be required to move their vehicles.
- .4 Where Departmental Representative allows construction trailers to be left inside the construction area of the site perimeter, the trailer doors must be locked at all times. All windows must be securely locked when left unoccupied.

1.6 PARKING

- .1 The parking area(s) to be used by construction employees will be designated by the Departmental Representative. Parking in other locations will be prohibited and vehicles may be subject to removal.

1.7 SHIPMENTS

- .1 To avoid confusion with the facility's own shipments, address all shipments of project material, equipment and tools in the Contractors name and have a representative on site to receive any deliveries or shipments. The Contractor is responsible for the unloading of the delivery and providing any required lifting apparatus, equipment or specialized vehicles. DFO, IOS or Departmental Representatives personnel will NOT accept receipt of deliveries or shipments of any material, equipment or tools.

1.8 TELEPHONES

- .1 The installation of telephones, facsimile machines and computers with internet connections maybe permitted within the facility with the approval of the Departmental Representative.
- .2 Wireless cellular and digital telephones, including but not limited to devices for telephone messaging, pagers, telephones used as 2-way radios are permitted within the construction area.

- .3 The Departmental Representative may limit the use of 2-way radios, where a disruption to facility operation could occur.

1.9 WORK HOURS

- .1 Conform to Section 01 11 00 — Summary of Work.
- .2 A minimum of seventy-two (72) hours advance notice will be required to obtain permission for work on weekends. In case of emergencies or other special circumstances, this advance notice may be waived at the discretion of the Departmental Representative.

1.10 OVERTIME WORK

- .1 Conform to Section 01 11 00 — Summary of Work.
- .2 Provide seventy-two (72) hours advance notice to Departmental Representative for all work to be performed after normal working hours of the facility. Notify the Departmental Representative immediately if emergency work is required, such as to complete remediation's or make the construction site safe and secure.

1.11 SECURITY ESCORT

- .1 General
 - .1 For all on-site work, the Contractor is at all times required to have a valid, Reliability Status (RS) security clearance issued or approved by the PSPC Contract Security Program. Refer to the Supplementary Conditions for further information.
 - .2 Provisions
 - .1 For Contractor's tradesmen that do not hold a valid RS security clearance, they will be required to be accompanied at all times by a Commissionaire from Commissionaires BC, or by a third-party, security escort/ patrol with the valid RS security clearance.
 - .1 Retain Cornmissionaire services and coordinate directly with the Commissionaires agent by contacting the service at: operationscentre@cornmissionaires.bc.ca
 - .3 Schedule
 - .1 The Contractor to be responsible for scheduling security services if required. The Contractor shall provide to the Departmental Representative a minimum of forty- eight (48) hour written notice in advance of when either a Commissionaire or the security patrol/ escort services will be required.
 - .4 Payment
 - .1 The Contractor is responsible to pay all costs for the Corninissionaires service or the third-party security escort/ patrol services.

1.12 TOOLS AND EQUIPMENT

- .1 Where requested maintain a complete list of all tools and equipment to be used during the construction project.
- .2 Keep all tools and equipment under constant supervision, particularly power-driven and cartridge-driven tools, cartridges, files, saw blades, rod saws, wire, rope, ladders and any sort of jacking device.
- .3 Store all tools and equipment in approved locations.

- .4 Lock all tool boxes when not in use. Keys to remain in the possession of the employees of the Contractor. Secure and lock scaffolding when not erected and when erected secure in a manner agreed upon with the Departmental Representative.

1.13 CONTRABAND

- .1 Weapons, explosive materials, alcoholic beverages, drugs and narcotics are prohibited on the site.
- .2 The discovery of contraband on the construction site and the identification of the person(s) responsible for the contraband shall be reported immediately to the Departmental Representative.
- .3 Contractors should be vigilant with both their employees and the employees of their subcontractors, vendors and suppliers that the discovery of contraband may result in immediate dismissal of the identified individual(s).

1.14 ACCESS TO AND REMOVAL OF FACILITY PROPERTY

- .1 Construction personnel and commercial vehicles will not be admitted to the facility after normal working hours, unless arranged and approved by the Departmental Representative.

1.15 STOPPAGE OF WORK

- .1 The Departmental Representative may request at any time that the Contractor, his employees, subcontractors and their employees stop work or leave the site immediately due to any situation occurring within the facility. The Contractor's site supervisor shall note the name of the facility personnel making the request and the time of the request and follow all given directions.
- .2 The Contractor shall advise the Departmental Representative within twenty-four (24) hours of this delay to the progress of the work.

END OF SECTION

Part 1 General

- .1 This section includes the following:
 - .1 Coordination of Work under administration of Departmental Representative.
 - .2 Scheduled Pre-construction and Site meetings.
 - .3 Project planning and construction schedule.
 - .4 Site progress monitoring and control.

1.1 DESCRIPTION

- .1 Coordinate and manage construction schedule, submittals, use of site, temporary utilities, construction facilities, quality control program, and construction Work, with progress of Work of subcontractors, other contractors and Departmental Representative.

1.2 PRE-CONSTRUCTION MEETING

- .1 Pre-construction Meeting:
 - .1 Within 10 days after award of Contract, Departmental Representative will arrange pre-construction meeting.
 - .2 Departmental Representative, Contractor and members of facility operations will be in attendance.
 - .3 Departmental Representative will establish time and location of meeting and notify parties concerned.
 - .4 The Departmental Representative will chair the meeting, record minutes and issue minutes to all attendees.
 - .1 Agenda of meeting is generally as follows:
 - .1 Project team introductions including main construction personnel, PWGSC personnel, NRC/SSC and Departmental Representatives.
 - .2 Communication protocol for submittals.
 - .3 Start date on site.
 - .4 Site security requirements.
 - .5 Construction Organization and Start-up:
 - .1 Comply with Departmental Representative's allocation of mobilization areas of site; for access, traffic, and parking facilities.
 - .2 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.
 - .3 Comply with instructions of Departmental Representative for use of temporary utilities and construction facilities.
 - .4 Coordinate layout of construction barrier with Departmental Representative.

1.3 PROJECT PLANNING

- .1 Plan construction activities, submittals and field reviews ahead of time for efficient and effective management to ensure timely completion of project.

1.4 SCHEDULES

- .1 Submit preliminary construction schedule to Departmental Representative during Pre-Construction meeting.
- .2 After review, revise and resubmit schedule. Submit final full schedule within 2 weeks after Pre-Construction meeting.
- .3 During progress of Work revise and resubmit as directed by Departmental Representative.

1.5 CONSTRUCTION SITE MEETINGS

- .1 During course of Work and prior to project completion, Departmental Representative will request Construction Site Meetings as required.
- .2 Departmental Representative will record minutes of meetings and circulate to attending parties and affected parties not in attendance.
- .3 Agenda to include following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Review of Health and Safety including any incidents, near misses, and WorkSafe BC visits.
 - .5 Problems which impede construction schedule.
 - .6 Review of off-site fabrication delivery schedules.
 - .7 Corrective measures and procedures to regain projected schedule.
 - .8 Revision to construction schedule.
 - .9 Progress schedule, during succeeding work period.
 - .10 Review submittal schedules: expedite as required.
 - .11 Update of Red Line As-Built Drawings.
 - .12 Maintenance of quality standards.
 - .13 Review proposed changes for effect on construction schedule and on completion date.
 - .14 Other business.

1.6 WALK THROUGH FIELD REVIEW BY DEPARTMENTAL REPRESENTATIVE

- .1 Departmental Representative will carry out the following:
 - .1 Walk-through field review of the work with contractor's representatives.
 - .2 Preparation and distribution of the Walk-through field review Reports. Reports will be distributed within 5 days of field review.

1.7 SUBMITTALS

- .1 Submit requests for interpretation of Contract Documents, and obtain instructions through Departmental Representative.
- .2 Process substitutions through Departmental Representative.
- .3 Deliver closeout submittals for review and inspections, for transmittal to Departmental Representative.

1.8 CLOSEOUT PROCEDURES

- .1 Notify Departmental Representative when Work is considered Substantially Complete. Contractor to prepare list of defects, deficiencies and incomplete work prior to inspection by Departmental Representative. Follow procedures as outlined in Section 01 78 00 – Closeout Submittals.
- .2 Accompany Departmental Representative on preliminary inspection to determine items listed for completion or correction.
- .3 Comply with Departmental Representative's instructions for correction of items of Work listed in deficiency list. completion or correction.
- .4 Notify Departmental Representative of instructions for completion of items of Work determined in Departmental Representative's final inspection.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

- .1 Schedule and administer site meetings throughout the progress of the work on a regular basis or at the call of Departmental Representative.
- .2 Prepare and distribute agenda at least three (3) days prior to the meetings.
- .3 Distribute written notice of each meeting seven (7) days in advance of meeting date to Departmental Representative.
- .4 Meeting space can be held in the meeting room at the site, location to be determined. Book meeting or room in advance through Departmental Representative.
- .5 Preside at meetings.
- .6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .7 Reproduce and distribute copies of minutes within five (5) days after meetings and transmit to meeting participants and affected parties not in attendance and Departmental Representatives.
- .8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRE- CONSTRUCTION MEETING

- .1 Within 15 days after award of Contract: Departmental Representative will request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Attendance will include, but is not limited to, the Departmental Representative, members of the NRC Observatory, PSPC, and Contractor.
- .3 Departmental Representative to establish time and location of preconstruction meeting, Contractor to notify parties concerned a minimum of 4 working days before meeting.
- .4 Departmental Representative will chair the meeting, record minutes and issue minutes.
- .5 Agenda to include:
 - .1 Introduction of official representative of participants in the Work.
 - .2 Start date on site.
 - .3 Communication Protocol for submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 51 00 - Temporary Facilities.
 - .5 NRC Security requirements.
 - .6 Site safety in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
 - .7 Communication Protocol for proposed changes, change orders, procedures, approvals required.
 - .8 Owner's Work.

- .9 Record drawings in accordance with Section 01 78 00 - Closeout Submittals.
- .10 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
- .11 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
- .12 Monthly progress claims, administrative procedures, photographs, hold backs.
- .13 Appointment of inspection and testing agencies or firms.

1.3 PROGRESS MEETINGS

- .1 During course of Work and two weeks prior to Project Completion, schedule progress meetings bi-weekly.
- .2 Attendance to include but is not limited to Departmental Representative, members of the Pacific Forestry Centre and Contractor.
- .3 Contractor responsible to record minutes of meetings and circulate to attending parties and affected parties not in attendance within five (5) days after meeting.
- .4 Record next meeting dates in the meeting minutes or notify parties minimum of seven (7) days in advance for other ad-hoc meetings.
- .5 Agenda to include, at a minimum, the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Health and Safety including any incidents, near misses, and WorkSafe BC visits.
 - .3 Review of Work progress since previous meeting.
 - .4 Coordination discussions with site operators.
 - .5 Construction schedule review.
 - .6 Review of off-site fabrication delivery schedules.
 - .7 Corrective measures and procedures to regain projected schedule.
 - .8 Request for Information (RFI) log review.
 - .9 Engineering Disciplines Reviews.
 - .1 Electrical
 - .10 Change order log review.
 - .11 Review submittal schedule.
 - .12 Review updated as built.
 - .13 Review and resolve site issues.
 - .14 New business.

END OF SECTION

1.1 SCHEDULES REQUIRED

- .1 Submit schedules as follows.
 - .1 Construction progress schedule.
 - .2 Submittal schedule for shop drawings and product data.
 - .3 Product delivery schedule.

1.2 FORMAT

- .1 Prepare schedule in form of horizontal bar chart (GANTT).
- .2 Provide a separate bar for each major item of work, trade or operation.
- .3 Provide horizontal time scale identifying first work day of each week.
- .4 Format for listings: chronological order of start of each item of work.
- .5 Identification of listings: by Specification subjects or system descriptions.

1.3 SUBMISSION

- .1 Submit initial schedule within 7 working days after award of Contract.
- .2 Submit minimum of 3 copies to be retained by the Departmental Representative.
- .3 The Departmental Representative will review schedule and return review copy within 7 working days after receipt.
- .4 Re-submit finalized schedule within 3 working days after return of review copy.
- .5 Submit revised progress schedule with each application for payment.
- .6 Distribute copies of revised schedule to:
 - .1 Subcontractors.
 - .2 Other concerned parties.
- .7 Instruct recipients to report to Contractor within 5 working days, any problems anticipated by timetable shown in schedule.

1.4 SCHEDULING

- .1 Include complete sequence of construction activities.
- .2 Include dates for commencement and completion of each major element of construction as follows.
- .3 Show projected percentage of completion of each item as of first day of week.
- .4 Indicate progress of each activity to date of submission schedule.
- .5 Show changes occurring since previous submission of schedule:
 - .1 Major changes in scope.
 - .2 Activities modified since previous submission.
 - .3 Revised projections of progress and completion.
 - .4 Other identifiable changes.
- .6 Provide a narrative report to define:
 - .1 Problem areas, anticipated delays and impact on schedule.
 - .2 Corrective action recommended and its effect.

1.5 PROGRESS REPORTS

- .1 Maintain accurate record of the progress of the Work. Submit progress reports at times requested by the Departmental Representative.
- .2 Include in reports dates of commencement and percentage of work completed for different parts of the Work.

1.6 STAFFING AND OVERTIME

- .1 Cease work at any particular point and transfer workers to other designated points, when so directed, should the Departmental Representative judge it necessary to expedite the Work.
- .2 Should the Work fail to progress according to the approved progress schedule, work such additional time (including weekends and holidays), employ additional workers, or both, as may be required to bring the Work back on schedule, at no additional cost to Contract.

1.7 SUBMITTALS SCHEDULE

- .1 Include schedule for submitting shop drawings, product data and samples.
- .2 Indicate dates for submitting, review time, re-submission time, last date for meeting fabrication schedule.
- .3 Include dates when reviewed submittals will be required from the Departmental Representative.

END OF SECTION

1.1 APPROVALS

- .1 Approval of shop drawings and samples: Refer to Section 01 11 55 - General Instructions.

1.2 GENERAL

- .1 This Section specifies general requirements and procedures for Contractor's submissions of shop drawings, product data, samples and other requested submittals to Departmental Representative for review. Additional specific requirements for submissions are specified in individual technical sections.
- .2 Present shop drawings, product data and samples in SI Metric units.
- .3 Where items or information is not produced in SI Metric units, converted values are acceptable.
- .4 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submissions.
- .5 Notify Departmental Representative in writing at time of submission, identifying deviations from requirements of Contract documents and stating reasons for deviations.
- .6 Contractor's responsibility for deviations in submission from requirements of Contract documents is not relieved by Departmental Representative's review of submission unless Departmental Representative gives written acceptance of specific deviations.
- .7 Make any changes in submissions which Departmental Representative may require consistent with Contract documents and resubmit as directed by Departmental Representative.
- .8 Notify Departmental Representative in writing, when resubmitting, of any revisions other than those requested by Departmental Representative.
- .9 Do not proceed with work until relevant submissions are reviewed and approved by Departmental Representative.

1.3 SUBMISSION REQUIREMENTS

- .1 Co-ordinate each submission with requirements of work and Contract documents. Individual submissions will not be reviewed until all related information is available.
- .2 Allow 10 working days for Departmental Representative's review of each submission, unless noted otherwise.
- .3 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.

- .4 Submissions to include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative, certifying approval of submissions, verification of field measurements and compliance with Contract documents.
- .5 Details of appropriate portions of work as applicable.
 - .1 Fabrication.
 - .2 Layout, showing dimensions (including identified field dimensions and clearances).
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .6 After Departmental Representative's review, distribute copies.

1.4 SHOP DRAWINGS

- .1 Shop drawings: original drawings or modified standard drawings provided by Contractor to illustrate details of portion of work which are specific to project requirements.
- .2 Maximum sheet size: 850 x 1050 mm.
- .3 Shop drawings shall be submitted electronically.
- .4 Cross-reference shop drawing information to applicable portions of Contract documents.

1.5 SHOP DRAWINGS REVIEW

- .1 Review of shop drawings by Department Representative is for the sole purpose of ascertaining conformance with the general concept.
- .2 This review will not mean the Department Representative approves detail design inherent in shop drawings, responsibility for which remains with Contractor submitting same.
- .3 This review will not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of construction and Contract documents.

- .4 Without restricting the generality of the foregoing, Contractor is responsible for:
 - .1 Dimensions to be confirmed and correlated at job site.
 - .2 Information that pertains solely to fabrication processes or to techniques of construction and installation.
 - .3 Co-ordination of work of all sub-trades.

1.6 PRODUCT DATA

- .1 Product data: manufacturers' catalogue sheets, MSDS sheets, brochures, literature, performance charts and diagrams, used to illustrate standard manufactured products or any other specified information.
- .2 Delete information not applicable to project.
- .3 Supplement standard information to provide details applicable to project.
- .4 Cross-reference product data information to applicable portions of Contract documents.
- .5 Submit 6 copies of product data.

1.7 SAMPLES

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

1.8 PROGRESS SCHEDULE

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

END OF SECTION

1 GENERAL

PWGSC Update on Asbestos Use

Effective April 1, 2016, all Public Works and Government Services of Canada (PWGSC) contracts for new construction and major rehabilitation will prohibit use of asbestos-containing materials.

COVID 19

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

1.1 REFERENCES

- .1 Government of Canada.
 - .1 Canada Labour Code - Part II (as amended)
 - .2 Canada Occupational Health and Safety Regulations. (as amended)
- .2 National Building Code of Canada (NBC): (as amended)
 - .1 Part 8, Safety Measures at Construction and Demolition Sites.
- .3 The Canadian Electrical Code (as amended)
- .4 Canadian Standards Association (CSA) as amended:
 - .1 CSA Z797-2018 Code of Practice for Access Scaffold.
 - .2 CSA S269.1-2016 Falsework for Construction Purposes.
 - .3 CSA S350-M1980 (R2003) Code of Practice for Safety in Demolition of Structures.
 - .4 CSA Z1006-10 Management of Work in Confined Spaces.
 - .5 CSA Z462-18 Workplace Electrical Safety Standard
- .5 National Fire Code of Canada 2015 (as amended)
 - .1 Part 5 – Hazardous Processes and Operations and Division B as applicable and required.
- .6 American National Standards Institute (ANSI): (as amended)
 - .1 ANSI/ASSP A10.3-2013, Operations – Safety Requirements for Powder-Actuated Fastening Systems.
- .7 Province of British Columbia:
 - .1 Workers Compensation Act Part 3-Occupational Health and Safety. (as amended)
 - .2 Occupational Health and Safety Regulation (as amended)
- .8 Include Hazardous Building Materials Reports in this section

1.2 RELATED SECTIONS

- .1 Refer to the following current NMS sections as required:
 - .1 Section 01 11 55 - General Instructions

1.3 WORKERS' COMPENSATION BOARD COVERAGE

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

1.4 COMPLIANCE WITH REGULATIONS

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

1.5 SUBMITTALS

- .1 Submit to Departmental Representative submittals listed for review in accordance with Section 01 01 50.
- .2 Work affected by submittal shall not proceed until review is complete.
- .3 Submit the following:
 - .1 Organizations Health and Safety Plan.
 - .2 Site Specific Safety Plan or Health and Safety Plan (SSSP or HASP)
 - .2 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.
 - .3 Copies of incident and accident reports.
 - .4 Complete set of Material Safety Data Sheets (SDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
 - .5 Emergency Response Procedures.
- .4 The Departmental Representative will review the Contractor's Site Specific Safety Plan or Health and Safety Plan (SSSP/HASP) and emergency response procedures, and provide comments to the Contractor within 5 days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.
- .5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.
- .6 Submission of the Site Specific Safety Plan or Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:
 - .1 Be construed to imply approval by the Departmental Representative.
 - .2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.
 - .3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

1.6 RESPONSIBILITY

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

1.7 HEALTH AND SAFETY COORDINATOR

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

1.8 GENERAL CONDITIONS

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

1.9 PROJECT/SITE CONDITIONS

- .1 Work at site will involve contact with:
 - .1 Multi-employer work site.
 - .2 Federal employees and general public.
 - .3 Energized electrical services.
 - .4 Working from heights.
 - .5 Hazards - PWGSC Preliminary Hazard Assessment included as an Appendix to Specifications

1.10 UTILITY CLEARANCES

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

1.11 REGULATORY REQUIREMENTS

- .1 Comply with specified codes, acts, bylaws, standards and regulations to ensure safe operations at site.

- .2 In event of conflict between any provision of the above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Departmental Representative will advise on the course of action to be followed.

1.12 WORK PERMITS

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

1.13 FILING OF NOTICE

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

1.14 SITE SPECIFIC HEALTH AND SAFETY PLAN

- .1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.
- .2 Prepare and comply with the Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP) based on the required hazard assessment, including, but not limited to, the following:
 - .1 Primary requirements:
 - .1 Contractor's safety policy.
 - .2 Identification of applicable compliance obligations.
 - .3 Definition of responsibilities for project safety/organization chart for project.
 - .4 General safety rules for project.
 - .5 Job-specific safe work, procedures.
 - .6 Inspection policy and procedures.
 - .7 Incident reporting and investigation policy and procedures.
 - .8 Occupational Health and Safety Committee/Representative procedures.
 - .9 Occupational Health and Safety meetings.
 - .10 Occupational Health and Safety communications and record keeping procedures.
 - .11 COVID 19 Protocols and Procedures
 - .2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.
 - .3 List hazardous materials to be brought on site as required by work. SDS required for all products.
 - .4 Indicate Engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.
 - .5 Identify personal protective equipment (PPE) to be used by workers.
 - .6 Identify personnel and alternates responsible for site safety and health.
 - .7 Identify personnel training requirements and training plan, including site orientation for new workers.
- .3 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.
- .4 Revise and update Site Specific Safety Plan (SSSP) and/or Health and Safety Plan (HASP) as required, and re-submit to the Departmental Representative.

- .5 Departmental Representative's review: the review of Site Specific Safety Plan and/or Health and Safety Plan by Public Works and Government Services Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Site Specific Safety Plan and/or Health and Safety Plan of responsibility for meeting all requirements of construction and Contract documents and legislated requirements.

1.15 EMERGENCY PROCEDURES

- .1 List standard operating procedures and measures to be taken in emergency situations. Include an emergency response and emergency evacuation plan and emergency contacts (i.e.names/telephone numbers) of:
 - .1 Designated personnel from own company.
 - .2 Regulatory agencies applicable to work and as per legislated regulations.
 - .3 Local emergency resources.
 - .4 Departmental Representative.
 - .5 A route map with written directions to the nearest hospital or medical clinic.
- .2 Include the following provisions in the emergency procedures:
 - .1 Notify workers and the first-aid attendant, of the nature and location of the emergency.
 - .2 Evacuate all workers safely.
 - .3 Check and confirm the safe evacuation of all workers.
 - .4 Notify the fire department or other emergency responders.
 - .5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
 - .6 Notify Departmental Representative.
- .3 Provide written rescue/evacuation procedures as required for, but not limited to:
 - .1 Work at high angles.
 - .2 Work in confined spaces or where there is a risk of entrapment.
 - .3 Work with hazardous substances.
 - .4 Underground work.
 - .5 Work on, over, under and adjacent to water.
 - .6 Workplaces where there are persons who require physical assistance to be moved.
- .4 Design and mark emergency exit routes to provide quick and unimpeded exit.
- .5 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.
- .6 Contractors must not rely solely upon 911 for emergency rescue in a confined space, working at heights, etc.

1.16 HAZARDOUS PRODUCTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS 2015) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of Safety Data Sheets (SDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.

- .2 Where use of hazardous and toxic products cannot be avoided:
 - .1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable SDS and WHMIS 2015 documents as per Section 01 01 50.
 - .2 In conjunction with Departmental Representative schedule to carry out work during "off hours" when tenants have left the building.
 - .3 Provide adequate means of ventilation in accordance with Section 01 51 00.
 - .4 The contractor shall ensure that the product is applied as per manufacturers recommendations.
 - .5 The contractor shall ensure that only pre-approved products are bought onto the work site in an adequate quantity to complete the work.

1.17 ASBESTOS HAZARD

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

1.18 PCB REMOVALS

- .1 Mercury-containing fluorescent tubes and ballasts which contain polychlorinated biphenyls (PCBs) are classified as hazardous waste.
- .2 Remove, handle, transport and dispose of as indicated in Division 2 specifications.

1.19 REMOVAL OF LEAD-CONTAINING PAINT

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

1.20 ELECTRICAL SAFETY REQUIREMENTS

(Reference: Worksafe BC OHS Regulation Part 19 – Electrical Safety)

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

1.21 ELECTRICAL LOCKOUT

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

1.22 OVERLOADING

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

1.23 FALSEWORK

- .1 Design and construct falsework in accordance with CSA S269.1-1975 (R2003) (as amended)

1.24 SCAFFOLDING

- .1 Design, construct and maintain scaffolding in a rigid, secure and safe manner, in accordance with CSA Z797-2009 (as amended) and B.C. Occupational Health and Safety Regulations. (as amended)

1.25 CONFINED SPACES

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

1.26 POWDER-ACTUATED DEVICES

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

1.27 FIRE SAFETY AND HOT WORK

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

1.28 FIRE SAFETY REQUIREMENTS

- .1 Store oily/paint-soaked rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
- .2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada. (as amended)
- .3 Portable gas and diesel fuel tanks are not permitted on most federal work sites. Approval from the Departmental Representative is required prior to any gas or diesel tank being brought onto the work site.

1.29 FIRE PROTECTION AND ALARM SYSTEM

- .1 Fire protection and alarm systems shall not be:
 - .1 Obstructed.
 - .2 Shut off.
 - .3 Left inactive at the end of a working day or shift.
- .2 Do not use fire hydrants, standpipes and hose systems for purposes other than firefighting.
- .3 Be responsible/liable for costs incurred from the fire department, the building owner and the tenants, resulting from false alarms.

1.30 UNFORESEEN HAZARDS

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

1.31 POSTED DOCUMENTS

- .1 Post legible versions of the following documents on site:
 - .1 Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP)
 - .2 Sequence of work.
 - .3 Emergency procedures.
 - .4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station, and the emergency transportation provisions.
 - .5 Notice of Project.
 - .6 Floor plans or site plans. Must be posted in a non-inmate access area and locked up when not being used.
 - .7 Notice as to where a copy of the Workers' Compensation Act and Regulations are available on the work site for review by employees and workers.
 - .8 Workplace Hazardous Materials Information System (WHMIS 2015) documents.
 - .9 Material Safety Data Sheets (SDS).
 - .10 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.
 - .11 All Hazardous Material and Substance Reports including Lab Analysis.
- .2 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.
- .3 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

1.32 MEETINGS

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

1.33 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.

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

2 PRODUCTS

- .1 Not used.

3 EXECUTION

- .1 Not used.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prior to commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Departmental Representative. Environmental Protection Plan is to present comprehensive overview of known or potential environmental issues which must be addressed during construction.
- .3 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .4 Environmental protection plan to include:
 - .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Names and qualifications of persons responsible for manifesting contaminated soils and hazardous waste to be removed from site.
 - .3 Names and qualifications of persons responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.
- .5 Erosion and sediment control plan which identifies type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- .6 Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plans include measures to minimize amount of mud transported onto paved public roads by vehicles or runoff.
- .7 Spill Control Plan: including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .8 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .9 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, do not become air borne and travel off project site.

- .10 Contaminant prevention plan that: identifies potentially hazardous substances to be used on job site; identifies intended actions to prevent introduction of such materials into air, water, or ground; and details provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
- .11 Waste water management plan that identifies methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
- 1.3 FIRES**
 - .1 Fires and burning of rubbish on site is not permitted.
- 1.4 DISPOSAL OF WASTES**
 - .1 Do not bury rubbish and waste materials on site.
 - .2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways.
- 1.5 DRAINAGE**
 - .1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.
 - .2 Do not pump water containing suspended materials into waterways, sewer or drainage systems.
 - .3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.
- 1.6 WORK ADJACENT TO WATERWAY**
 - .1 Do not dump excavated fill, waste material or debris in waterways.
- 1.7 POLLUTION CONTROL**
 - .1 Maintain temporary erosion and pollution control features installed under this contract.
 - .2 Control emissions from equipment and plant to local authorities' emission requirements.
 - .3 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.
- 1.8 HISTORICAL/ARCHAEOLOGICAL CONTROL**
 - .1 Give immediate notice to the Departmental Representative if evidence of archaeological finds are encountered during construction and await written instructions before proceeding with work in the vicinity of any such finds.
 - .2 Relics, antiquities and items of historical or scientific interest shall remain the property of the Crown. Protect such articles and request directives from the Departmental Representative.

1.9 NOTIFICATION

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

1.10 SPILLS OR RELEASE OF DELETERIOUS SUBSTANCES

- .1 Measures to be implemented to prevent, control or mitigate spills or release of deleterious substances:
 - .1 Contractor shall take due care to ensure no deleterious materials enter any surface drainage pathways located in the project area.
 - .2 Emergency response procedure for spills of deleterious substances must be in place. In the event of a spill, the contractor will immediately implement their Spill Response Protocol.
 - .3 The Contractor is responsible for all costs associated with a spill or release as a result of their actions. This will include but not limited costs of spill response equipment and materials, associated sampling, analysis and any required restoration of the impacted area.
 - .4 Response equipment to be on site at all times (i.e. spill kits) and workers trained in their location and use. The resources on hand must be sufficient to respond effectively and expediently to any spill that could occur on site.
 - .5 All construction equipment brought onto the site will be clean and properly maintained.
 - .6 Any equipment maintenance must occur in a designated area and must be conducted away from any surface water drains or collection points.
 - .7 Any equipment remaining on site overnight shall have appropriately placed drip pans.
 - .8 Waste generated will be prevented from entering the environment.
 - .9 Prevent discharges containing asphalt, grout, concrete or other waste materials from reaching storm drains or the marine environment. This includes, but is not limited to:
 - .1 Cleaning equipment off site; and
 - .2 Protection of any other drainage structures not identified here with filter fences and/or silt socks, if required.
 - .10 Protection of the roadways from tracking of mud, soil and debris needs to be maintained throughout the work.

- .11 Limit of work activities to normal business hours to minimize noise outside of those hours. Ensure that equipment and machinery is properly maintained to minimize unnecessary noise pollution. Consider local municipal noise bylaws when mobilizing equipment.
- .12 All utilities must be located prior to excavation.

1.11 IMPORT OF FILL MATERIAL

- .1 Prior to import of any material used for surfacing, backfilling or any other use requiring fill material the Contractor will provide sufficient documentation, as agreed on by Departmental Representative, to ensure that the imported material meets the Canadian Council of Ministers of the Environment (CCME) Residential/Parkland (RL/PL) Land Usage Soil Quality Guidelines.
- .2 Environmental characterization of fill material must be conducted in accordance with the following: British Columbia, Ministry of Environment, Technical Guidance Document #1 – Site Characterization and Confirmation Testing.
- .3 Prior to import of any material the Contractor must inform the Departmental representative of the proposed fill source(s) and identify the nature of current and historic activities conducted at the source.
- .4 The Departmental Representative reserves the right to request additional testing of imported material at the source and at the deposit site to satisfy their requirements. All testing will be done at the Contractor's cost.
- .5 All material brought to the site that does not meet the CCME RL/PL Guidelines will be removed from the property immediately at the Contractors cost.

END OF SECTION

1.1 INSPECTION

- .1 Be responsible for quality control during execution of Work.
- .2 Allow the 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.
- .3 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by the Departmental Representative's instructions, or law of Place of Work.
- .4 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.
- .5 The Departmental Representative may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Canada will pay cost of examination and replacement.

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 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 the Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of the Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, the Departmental Representative may deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by the Departmental Representative.

1.4 REPORTS

- .1 Submit 3 copies of inspection and test reports to the Departmental Representative.
- .2 Provide copies to Subcontractor of work being inspected or tested, manufacturer or fabricator of material being inspected or tested.

END OF SECTION

Part 1 General

1.1 ACCESS AND DELIVERY

- .1 Contractor is required to use only the designated entrance to access the work site, for deliveries to site, and as the exit for offsite disposal.
 - .1 Maintain for duration of contract.
 - .2 Make good damage resulting from Contractor's use.
- .2 Use of the NRC facility will be granted to the Contractor through the Departmental Representative.
 - .1 The contractor's work site is to be used for loading and unloading purposes.
- .3 Provide and maintain access roads, sidewalk crossing ramps and construction runways as may be required for access to the work. All roadways and walkways outside of the Contractor's work site must be kept clear of materials and equipment at all times.
- .4 Provide and maintain competent flag operators, traffic signals, barricades and flares, lights or lanterns as may be required to perform work and protect other users of the Facility.

1.2 CONSTRUCTION PARKING

- .1 Construction staff shall be responsible for their own parking in nearby private facilities.

1.3 STORAGE FACILITIES

- .1 Confine work and operations of employees to areas indicated on Contract Documents. Do not unreasonably encumber premises with products. Storage space to be limited to the area of construction.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work or existing structure or elements.
- .3 Provide and pay for all off-site storage as required. Note that storage space is limited on site. Refer to site plan for location of Contractor's site storage and lay-down area.

1.4 SANITARY FACILITIES

- .1 Contractor does not need to provide their own sanitary facilities, Contractor to coordinate with Facility for use of a washroom dedicated to their forces to comply with COVID-19 restrictions.

1.5 HEATING AND VENTILATION

- .1 Do not begin work until arrangements have been made with the Departmental Representative for protection of on-floor heating, ventilating and air conditioning.
- .2 If there is any dirt in the heating and ventilation system, at the completion of work, it will be the Contractor's responsibility to return system to its original state in accordance with the Departmental Representative's directions.

- .3 Prevent dust and odour migration to other occupied areas.
 - .1 Do not deactivate HVAC system to occupied floors. Purge air from construction floors only when directed by Departmental Representative, where dust and fumes will be generated.
 - .2 Change filters in existing HVAC system frequently.

1.6 SCAFFOLDING

- .1 Construct and maintain scaffolding in rigid, secure and safe manner.
- .2 Erect scaffolding independent of walls. Remove promptly when no longer required.

1.7 HOISTING

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

1.8 HOARDING

- .1 Prior to all demolition and construction, install plywood hoarding or protective barrier as detailed. Maintain in safe and clean condition throughout duration of project. Submit hoarding plan to Departmental Representative for approval.
- .2 Erect and maintain safety barricades around all openings and other danger areas as required by Building Code and WCB.
- .3 Installation of hoarding must not create permanent damage to existing wall cladding or flooring finish which is of heritage value.

1.9 SITE OFFICE

- .1 Contractor to provide their own trailer as temporary site office in an area to be designated by the Departmental Representative.
- .2 Contractor should clear and demolish site office at end of project according to contract requirement.

1.10 REMOVAL OF TEMPORARY FACILITIES

- .1 Remove temporary facilities from site when directed by the Departmental Representative.

1.11 SIGNS AND NOTICES

- .1 Signs and notices for safety and instruction shall be in both official languages or graphic symbols conforming to CAN/CSA-Z321.
- .2 Maintain approved signs and notices in good condition for duration of Project, and dispose of offsite on completion of Project when directed by Departmental Representative.

1.12 CLEAN-UP

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt of mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.

- .4 Stack stored new or salvaged material not in construction facilities.
- .5 At completion of Project: Remove and dispose of all debris, thoroughly clean and restore site to condition found at commencement of Work. Repair and make good to all damage caused by construction activities.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 N/A

1.2 REFERENCES

- .1 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: 2012-01-18.

1.3 INSTALLATION AND REMOVAL

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

1.4 GUARD RAILS AND BARRICADES

- .1 Provide secure, rigid guard rails and barricades around deep excavations.
- .2 Provide warning signs, tape and bollards around any running machinery that is to be left unattended such as generators.

1.5 ACCESS TO SITE

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

1.6 PUBLIC TRAFFIC FLOW

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

1.7 FIRE ROUTES

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

1.8 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

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

1.9 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.

1.10 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

Part 2 Products

2.1
 .1 **NOT USED**
 Not Used.

Part 3 Execution

3.1
 .1 **NOT USED**
 Not Used.

END OF SECTION

Part 1 General

1.1 PRODUCTS/MATERIAL AND EQUIPMENT

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

1.2 QUALITY OF PRODUCTS

- .1 Products, materials and equipment (referred to as products) incorporated into work to be new, not damaged or defective and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

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

1.3 AVAILABILITY OF PRODUCTS

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

1.4 MANUFACTURER INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer instructions.
 - .1 Do not rely on labels or enclosures provided with products.
 - .2 Obtain written instructions directly from manufacturer.
- .2 Notify Departmental Representative in writing of conflicts between specifications and manufacturer instructions so that Departmental Representative may 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 either Contract price or Contract time.

1.5 CONTRACTOR'S OPTIONS FOR SELECTION OF PRODUCTS FOR TENDERING

- .1 Products are specified by "Prescriptive" specifications: select any product meeting or exceeding specifications.

- .2 Products specified under "Acceptable Products" (used for complex Mechanical or Electrical Systems): select any one of the indicated manufacturers, or any other manufacturer meeting or exceeding Prescriptive specifications and indicated Products.
- .3 Products specified by performance and referenced standard: select any product meeting or exceeding referenced standard.
- .4 Products specified to meet particular design requirements or to match existing materials: use only material specified Approved Product. Alternative products may be considered provided full technical data is received in writing by Departmental Representative in accordance with "Special Instructions to Tenderers".
- .5 When products are specified by referenced standard or by Performance specifications, upon request of Departmental Representative obtain from manufacturer and independent laboratory report showing that product meets or exceeds specified requirements.

1.6 SUBSTITUTION AFTER CONTRACT AWARD

- .1 No substitutions are permitted without prior written approval of Departmental Representative.
- .2 Proposals for substitution may only be submitted after Contract award. Such request must include statements of respective costs of items originally specified and proposed substitution.
- .3 Proposals will be considered by Departmental Representative if:
 - .1 Products selected by tenderer from those specified are not available;
 - .2 Delivery date of products selected from those specified would unduly delay completion of Contract, or
 - .3 Alternative product to that specified, which is brought to attention of Departmental Representative is considered by Departmental Representative as equivalent to product specified and will result in a credit to Contract amount.
- .4 Should the proposed substitution be accepted either in part or in whole, assume full responsibility and costs when substitution affects other work on project. Pay for design or drawing changes required as result of substitution.
- .5 Amounts of all credits arising from approval of substitutions will be determined by Departmental Representative and Contract price will be reduced accordingly.

END OF SECTION

Part 1 General

1.1 EXISTING SERVICES

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
- .2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.

1.2 LAYOUT

- .1 Confirm all project requirements prior to starting work.
- .2 Make no changes or relocations without prior written notice to Departmental Representative.
- .3 Confirm all structural, electrical, civil and mechanical work prior to starting construction.

1.3 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.

1.4 RECORDS

- .1 Maintain a complete, accurate log of work as it progresses.
- .2 Record locations of maintained, re-routed and abandoned service lines.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

1.1 SUBMITTALS

- .1 Submit written request in advance of cutting or alteration which affects any of following.
 - .1 Structural integrity of any part of Project.
 - .2 Efficiency, maintenance or safety of any operational element.
 - .3 Visual qualities of sight-exposed elements.
 - .4 Interior and exterior building finishes.

1.2 INCLUDE IN REQUEST

- .1 Identification of Project.
- .2 Location and description of affected Work.
- .3 Statement on necessity for cutting or alteration.
- .4 Description of proposed Work and products to be used.
- .5 Alternatives to cutting and patching.
- .6 Effect on work of Other Contractor.
- .7 Written permission of affected Other Contractor.
- .8 Date and time work will be executed.

1.3 MATERIALS

- .1 Required for original installation.

1.4 PREPARATION

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Cover adjacent surfaces and finishes with clean and dry drop sheets, kraft paper, cardboard or other suitable coverings during minor demolition.

1.5 EXECUTION

- .1 Execute cutting, fitting and patching required to perform work. Perform minor demolition required for alterations with care not to damage adjacent construction, fittings, fixtures, surfaces and finishes scheduled to remain.
- .2 Obtain Departmental Representative's approval before cutting, boring or sleeving load-bearing members
- .3 Fit several parts together, to integrate with other work.
- .4 Uncover work to install ill-timed work, at no cost to Contract.
- .5 Remove and replace defective and non-conforming work, at no cost to Contract.
- .6 Execute work by methods to avoid damage to other work, and which will provide proper surfaces to receive patching and finishing. Make cuts with clean, true, smooth edges.

- .7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .8 Restore work with new products in accordance with requirements of Contract Documents.
- .9 Include cost of making good all surfaces, substrates and work disturbed by removal of existing work and by installation of new work.

1.6 MATCHING TO EXISTING WORK

- .1 Make new work in existing areas and all alteration/renovation work match in every respect similar items in existing areas.
- .2 Use new materials to match existing items. Where perfect matches cannot be made as to quality, texture, colour and pattern remove existing materials and replace with new materials of comparable quality selected by the Departmental Representative, to extent directed by the Departmental Representative.
- .3 Execute Work carefully wherever existing work is being re-used. Make repairs to such reused items after re-installation to properly restore them. Where proper restoration is impractical, such items will be rejected and replaced to the Departmental Representative's approval.
- .4 After removal of reusable items, carefully patch and repair original location.
- .5 Wherever existing work is being altered to make way for new work, perform such cutting and patching neatly and make finished installations equal to quality and appearance.
- .6 Where new work is a continuation or an extension of existing work take care to blend both together with complete regard to appearance. Obvious joints and visible patches not acceptable.

1.7 SETTING OUT OF WORK

- .1 Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.
- .2 Provide devices needed to lay out and construct work.
- .3 Supply such devices as straight edges and templates required to facilitate the Departmental Representative's inspection of work.
- .4 Review layouts with the Departmental Representative prior to commencement of work.

1.8 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 the Departmental Representative of impending installation and obtain his approval for actual location.

- .4 Submit field drawings to indicate relative position of various services and equipment when required by the Departmental Representative.

END OF SECTION

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 regularly scheduled times or dispose of as directed by the Departmental Representative. Refer to Section 01 35 43 - Environmental Procedures for additional requirements.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris. Locate where directed by the Departmental Representative.
- .5 Provide and use clearly marked separate bins for recycling wherever facilities are available. Refer to Section 01 74 21 - Waste Management and Disposal for additional requirements.
- .6 Remove waste material and debris from site and deposit in waste containers at end of each working day.
- .7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .8 Use only cleaning materials recommended by manufacturer of surface to be cleaned and as recommended by cleaning material manufacturer.
- .9 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 completed, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris.
- .3 Prior to final review, remove surplus products, tools, construction machinery and equipment.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Remove stains, spots, marks and dirt from decorative work, electrical/mechanical fixtures, furniture fitments; walls, floors and ceilings.
- .6 Clean lighting reflectors, lenses and other lighting surfaces.
- .7 Vacuum clean and dust room interiors.
- .8 Sweep and power wash pavement around building and all pavement parking/storage areas used by Contractor to remove all traces of construction spillage, stains and residue. Do not blast dirty water onto adjacent buildings and site features.

END OF SECTION

1.1 RELATED WORK

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

1.2 DEFINITIONS

- .1 Waste Reduction Workplan: written report which addresses opportunities for reduction, re-use or recycling of materials.
- .2 Materials Source Separation Program: consists of series of ongoing activities to separate re-usable and recyclable waste material into material categories from other types of waste at point of generation.

1.3 MATERIALS SOURCE SEPARATION

- .1 Before project start-up, prepare Materials Source Separation Program. Provide separate containers for re-usable and/or recyclable materials of following:
 - .1 Construction waste: including but not limited to following types.
 - .1 Uncontaminated packaging (wood, metal banding, cardboard, paper, plastic wrappings, polystyrene).
 - .2 Wood pallets (recycle or return to shipper).
 - .3 Metals (pipe, conduit, ducting, wiring, miscellaneous cuttings)
 - .4 Wood (uncontaminated).
 - .5 Paint, solvent, oil.
 - .6 Other materials as indicated in technical sections.
 - .2 Administration/worker waste (uncontaminated): including but not limited to following types.
 - .1 Paper, cardboard.
 - .2 Plastic containers and lids marked types 1 through 6.
 - .3 Glass and aluminum drink containers (recycle or return to vendor).
- .2 Implement Materials Source Separation Program for waste generated on project in compliance with approved methods and as approved by Departmental Representative.
- .3 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .4 Locate separated materials in areas which minimize material damage.

1.4 DIVERSION OF MATERIALS

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

1.5 STORAGE, HANDLING AND APPLICATION

- .1 Do work in compliance with Waste Reduction Workplan.
- .2 Handle waste materials not re-used, salvaged, or recycled in accordance with appropriate regulations and codes.
- .3 Materials in separated condition: collect, handle, store on site and transport off-site to approved and authorized recycling facility.
- .4 Materials must be immediately separated into required categories for re-use or recycling.
- .5 Unless specified otherwise, materials for removal become Contractor's property.
- .6 On-site sale of salvaged/recyclable material is not permitted.
- .7 On-site burning of material is not permitted.
- .8 Provide Departmental Representative with receipts indicating quantity of material delivered to landfill.
- .9 Provide Departmental Representative with receipts indicating quantity and type of materials sent for recycling.

END OF SECTION

Part 1 General

1.1 INSPECTION AND DECLARATION

- .1 Contractor's inspection: Contractor and all Subcontractors will conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify the Departmental Representative in writing of satisfactory completion of Contractor's inspection and that corrections have been made.
 - .2 Request the Departmental Representative's inspection.
- .2 The Departmental Representative's inspection: the Departmental Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor will correct Work accordingly.
- .3 Completion: submit written certificate that following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Certificates required by authorities having jurisdiction have been submitted.
 - .4 Work is complete and ready for Final Inspection.
- .4 Final inspection: when items noted above are completed, request final inspection of Work by the Departmental Representative and Contractor. If Work is deemed incomplete by the Departmental Representative, complete outstanding items and request re-inspection.

END OF SECTION

1.1 SUBMISSION

- .1 Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- .2 Revise content of documents as required before final submittal.
- .3 Phasing of submission:
 - .1 5 working days before substantial performance of work submit to Departmental Representative 4 final copies of operation and maintenance manuals.
 - .2 5 working days before substantial performance of work submit to Departmental Representative 4 final copies of supplements to operation and maintenance manuals for each subsequent phase.
- .4 Ensure that spare parts, maintenance materials and special tools provided are new, neither damaged nor defective and of same quality and manufacture as products provided in work.
- .5 If requested, furnish evidence as to type, source and quality of products provided.
- .6 Defective products will be rejected, regardless of previous inspections. Replace defective products at no cost to Contract.

1.2 FORMAT

- .1 Organize data in the form of an instructional manual.
- .2 Binders: vinyl, hard covered, 3 D-ring, loose leaf 219 x 279 mm size with spine and face pockets.
- .3 Cover: identify each binder with typed or printed title "Project Record Documents"; list title of project and identify subject matter of contents.
- .4 Arrange content by systems under section numbers and sequence of Specifications Index.
- .5 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .6 Text: manufacturer's printed data, or typewritten data.
- .7 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

1.3 CONTENTS, EACH VOLUME

- .1 Table of contents - provide the following:
 - .1 Title of project.
 - .2 Date of submission.
 - .3 Names, addresses, and telephone numbers of Department Representative and Contractor with name of responsible parties.
 - .4 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system, list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product data: mark each sheet to clearly identify products and component parts, and data applicable to installation. Delete inapplicable information.

- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

1.4 RECORD DOCUMENTS

- .1 Contract drawings and shop drawings: legibly mark each item to record actual construction, including:
 - .1 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .2 Field changes of dimension and detail.
 - .3 Changes made by change orders.
 - .4 Details not on original Contract drawings.
 - .5 References to related shop drawings and modifications.
- .2 Contract specifications: legibly mark each item to record actual "Workmanship of Construction", including;
 - .1 Manufacturer, trade name and catalogue number of each "Product/Material" actually installed, particularly optional items and substitute items.
 - .2 Changes made by addenda and change orders.
- .3 Recording information:
 - .1 Record changes in red ink.
 - .2 Mark on one (1) set of drawings, specifications and shop drawings with changes during progress of work.
 - .3 Provide one (1) set of CDs in AutoCAD dwg. file format with all as-built information on the CDs.
 - .4 Submit all sets for the Departmental Representative.

1.5 EQUIPMENT AND SYSTEMS

- .1 Operating procedures - include the following:
 - .1 Start-up, break-in, and routine normal operating instructions and sequences.
 - .2 Regulation, control, stopping, shutdown, and emergency instructions.
 - .3 Summer, winter and any special operating instructions.
- .2 Provide servicing schedule required.
- .3 Include manufacturer printed operation and maintenance instructions.
- .4 Include sequence of operation by controls manufacturer.
- .5 Provide original manufacturer parts list, illustrations, assembly drawings and diagrams required for maintenance.
- .6 Provide installed control diagrams by controls manufacturer.
- .7 Additional requirements: as specified in individual specification Sections.

1.6 MANUFACTURER DOCUMENTATION REPORTS

- .1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and system, instruct Departmental Representative's indicated facility personnel and provide detailed written report that demonstration and instructions have been completed.

- .2 UPS OEM must commission the UPS and provide their report. Electrician to transfer load onto the UPS shortly after OEM gives approval both with minimal and later with full loads.
- .3 Departmental Representative will provide list of personnel to receive instructions and will co-ordinate their attendance at agreed upon times.

1.7 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 on-site location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to the Departmental Representative. Include approved listings in maintenance manual.
- .5 Obtain receipt for delivered products and submit to Departmental Representative.

1.8 MAINTENANCE MATERIALS

- .1 Provide maintenance and extra materials in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in work.
- .3 Provide all software, licenses, interface and cabling devices required to setup or maintain all equipment as installed in this project, whether specifically requested or not. Software shall be fully operational and not time-limited or demonstration versions. All passwords, keys or hardware locks will be provided to the Owner.
- .4 Deliver to on-site location as directed; place and store.
- .5 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in maintenance manual.
- .6 Obtain receipt for delivered products and submit to Departmental Representative.

1.9 WARRANTIES, BONDS, TEST REPORTS, INSPECTION REPORTS

- .1 Obtain Warranties, Bonds, Test Results, Inspection Reports executed in duplicate by subcontractors, suppliers, manufacturers and inspection agencies within 10 working days after completion of applicable item of work.
- .2 Except for items put into use with Departmental Representative's permission, leave date of beginning of time of warranty until date of substantial performance is determined.
- .3 Verify that documents are in proper form, contain full information and are notarized.
- .4 Co-execute submittals when required.
- .5 Retain warranties and bonds until time specified for submittal.

1.10 COMPLETION

- .1 Submit written certificate that following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract documents.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested and adjusted and are fully operational.
 - .4 Certificates required by Technical Safety BC have been submitted.

- .5 Work is complete and ready for final inspection.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Procedures for demonstration and instruction of equipment and systems to Owner's personnel.

1.2 RELATED SECTIONS

- .1 Section 01 78 00 - Closeout Submittals.
- .2 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .3 Section 01 91 31 –Commissioning (Cx) Plan.
- .4 Section 01 91 33 – Commissioning: Forms.
- .5 Section 01 91 41 – Commissioning: Training.

1.3 DESCRIPTION

- .1 Demonstrate operation and maintenance of equipment and systems to Departmental Representative two weeks prior to date of final inspection.
- .2 Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.4 QUALITY CONTROL

- .1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstration and instructions have been completed.

1.5 SUBMITTALS

- .1 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Departmental Representative's approval.
- .2 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .3 Give time and date of each demonstration, with list of persons present.

1.6 CONDITIONS FOR DEMONSTRATIONS

- .1 Equipment has been inspected and put into operation in accordance with Manufacturer's recommendations.
- .2 Testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements and equipment and systems are fully operational.
- .3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.7 PREPARATION

- .1 Verify that conditions for demonstration and instructions comply with requirements.
- .2 Verify that designated personnel are present.

1.8 DEMONSTRATION AND INSTRUCTIONS

- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled times, at the equipment location.
- .2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
- .3 Review contents of manual in detail to explain all aspects of operation and maintenance.
- .4 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.
- .5 Training and demonstration will be performed by manufacturers representative and will include actual interaction with all systems requiring software or computer interface.

1.9 TIME ALLOCATED FOR INSTRUCTIONS

- .1 Contractor shall provide for a total of 1 working day of demonstration and training for all systems in the project, including but not limited to:
 - .1 Panelboards and distribution
 - .2 UPS System operation and maintenance

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:
General requirements relating to commissioning of project's components and systems, specifying general requirements to Performance Verification of components, equipment, sub-systems, systems, and integrated systems.

.2 Related Sections:

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 91 31- Commissioning (Cx) Plan
- .4 Section 26 05 00 - Common Work Results - Electrical.
- .5 Section 26 24 16 – Panelboards Breaker Type
- .6 Section 26 05 44 - Installation of Cables in Trenches and Ducts
- .7 Section 26 33 53 – Static Uninterruptible Power Supply

.3 Acronyms:

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

1.2 REFERENCE

- .1 Public Works and Government Services Canada (PWGSC)
 - .1 CSA Z320.11
 - .2 ANSI/NETA Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 GENERAL

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

- .2 Cx is to be performed by an independent third party after work is completed and prior to energizing any equipment, with the exception of the UPS which is to be commissioned by the OEM Technician. The General Contractor is to engage and hire the services of the independent third party Commissioning Authority and commissioning Provider. The independent third party must have performed similar work for a minimum of 5 years. Contractor shall provide documentation attesting to the qualifications and experience of the proposed Testing Agency(ies) performing all commissioning work and preparing commissioning documents. These references shall be reviewed by the Departmental Representative confirming the suitability of the Testing Agencies. The Testing Agency may only be engaged after review and approval of these documents by the Departmental Representative.
- .3 Retain the services of a qualified Testing Agency to carry out the tests and calibration as required herein. Testing Agency shall be familiar with NETA Standards as specified herein and shall have accreditation equivalent to a full NETA member company:
 - .1 This project shall only be undertaken by firms familiar with and having a long and demonstrable successful track record in the field of switchgear and transformer modification and installation, protection and control, and arc flash mitigation. The proponent shall be experienced in working with an industrial type primary voltage distribution system using parallel feeders. Provide documented experience on projects of this type.
 - .2 All protection settings must be reviewed by a Professional Engineer registered in British Columbia who is an employee of Testing Agency. Provide documentation naming this individual along with their credentials.
 - .3 All work must be performed by qualified technicians/electricians with applicable accreditation for the appropriate permitting required. Provide a list of all personnel and their qualifications.
 - .4 Provide three references, including contact information for completed projects similar to this in scope and technical content.
- .4 Furnish Independent Testing agency professional engineer's letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions. The letter is to be submitted stamped by a Professional Engineer, registered in BC, and provided to the Departmental Representative
- .5 Employ only personnel who are qualified and experienced in required field of work. Personnel must be familiar with the equipment and procedures necessary to complete the work as specified herein.
- .6 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems 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.
- .7 Design Criteria: as per client's requirements or determined by designer to meet Project functional and operational requirements.

1.4 COMMISSIONING OVERVIEW

- .1 Cx to be a line item of General Contractor's cost breakdown.
- .2 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .3 Cx is to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .4 Complete all start-up and verification of systems prior to review by Commissioning Agent.
 - .1 To bring mechanical, electrical and building architectural systems and components from a state of static completion to a state of dynamic operation.
 - .2 To verify conformance to contract requirements.
 - .3 To confirm installations meet requirements of Contract Documents.
 - .4 To provide all testing documents and records.
 - .5 To ensure completed facility meets contract requirements.
 - .6 To provide a documented operator training program.
 - .7 To verify accuracy of project record drawings and operating and maintenance manuals.
- .5 Departmental Representative will issue Interim Acceptance Certificate of Substantial Completion when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.5 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

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

1.6 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review contract documents, confirm by writing to 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 Have completed Cx Plan up-to-date.
 - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
 - .3 Fully understand Cx requirements and procedures.
 - .4 Have Cx documentation shelf-ready.
 - .5 Understand completely design criteria and intent and special features.
 - .6 Submit complete start-up documentation to Departmental Representative.
 - .7 Have Cx schedules up-to-date.
 - .8 Ensure systems have been cleaned thoroughly.
 - .9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
 - .10 Submit factory testing report of Electrical Equipment to Departmental Representative for review and approval.
 - .11 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.7 CONFLICTS

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

1.8 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit no later than 4 weeks after award of Contract:
 - .1 Name of Cx Authority and General Contractor's Cx Provider.
 - .2 Draft Cx documentation.
 - .3 Preliminary Cx schedule.
 - .2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
 - .3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 8 weeks prior to start of Cx.
 - .4 Provide additional documentation relating to Cx process required by Departmental Representative, specifically;
 - .1 Cx Plan and Schedule
 - .2 Accepted Shop drawings
 - .3 Completed PI forms
 - .4 Approved TAB report
 - .5 Approved PV forms
 - .6 Approved O&M manuals
 - .7 Approved System and Integrated System Test Report
 - .8 Approved Factory testing reports

- .9 Approved Training and Attendance forms
- .10 Accepted "As-built" Plans and Specifications
- .11 Final Cx Report

1.9 COMMISSIONING DOCUMENTATION

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.
- .2 General Contractor to review and approve Cx documentation submitted by Cx Provider prior to submission to Departmental Representative for review.
- .3 Provide completed and approved Cx documentation to Departmental Representative.

1.10 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 17 Construction Progress Schedule Bar (GANNT Chart).
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training.

1.11 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings: Section 01 32 17 Construction Progress Schedule Bar (GANNT Chart) and as specified herein.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage. Section 01 32 17 Construction Progress Schedule Bar (GANNT Chart). General Contractor to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
 - .1 Review duties and responsibilities of General Contractor and subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by General Contractor with their Commissioning Provider, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.12 STARTING AND TESTING

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

1.13 WITNESSING OF STARTING AND TESTING

- .1 Provide 14 days' notice prior to commencement.
- .2 Cx Authority and Departmental Representative to witness of start-up and testing.
- .3 Cx Authority and Departmental Representative shall be advised of and shall be in attendance during energization of any and all equipment as part of this project.
- .4 General Contractor's Cx Provider to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.
 - .1 Minimum of 5 years experience in design, installation and operation of equipment and systems.
 - .2 Ability to interpret test results accurately.
 - .3 To report results in clear, concise, logical manner.

1.14 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and general testing in following distinct phases:
 - .1 Included in delivery and installation
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .2 Prior to startup:
 - .1 Insulation resistance test and continuity test of all new cables and all cables with connections changed during construction
 - .2 Startup: 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 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system communications.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

- .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
- .3 Check resistance to ground before energizing.
- .4 Correct deficiencies and obtain approval from Cx Authority and Departmental Representative after distinct phases have been completed and before commencing next phase.
- .5 Document requires tests on approved PV forms.
- .6 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by 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 Departmental Representative.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.
 - .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
 - .1 Rejected equipment to be removed from site and replace with new.
 - .2 Subject new equipment/systems to specified start-up procedures.

1.15 START-UP DOCUMENTATION

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

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

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

1.17 TEST RESULTS

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

1.18 START OF COMMISSIONING

- .1 Notify Cx Authority and Departmental Representative at least 4 weeks prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.19 INSTRUMENTS / EQUIPMENT

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

1.20 COMMISSIONING PERFORMANCE VERIFICATION

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

1.21 WITNESSING COMMISSIONING

- .1 Cx Authority to witness activities and verify results. Departmental Representative to witness activities and verify results as required.

1.22 AUTHORITIES HAVING JURISDICTION

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

- .4 Authorities having jurisdiction in this project include Township of Esquimalt and BC Safety Authority.

1.23 EXTRAPOLATION OF RESULTS

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

1.24 SUNDRY CHECKS AND ADJUSTMENTS

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

1.25 DEFICIENCIES, FAULTS, DEFECTS

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

1.26 COMPLETION OF COMMISSIONING

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

1.27 ACTIVITIES UPON COMPLETION OF COMMISSIONING

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

1.28 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.29 OCCUPANCY

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

1.30 INSTALLED INSTRUMENTATION

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

1.31 PERFORMANCE VERIFICATION TOLERANCES

- .1 Application tolerances:
 - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.
- .2 Instrument accuracy tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
 - .1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

1.32 OWNER'S PERFORMANCE TESTING

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Description of overall structure of Cx Plan and roles and responsibilities of Cx team.

1.2 REFERENCES

- .1 PWGSC Cx manual CP-1 with CSA Z320-11.
- .2 Public Works and Government Services Canada (PWGSC)
 - .1 PWGSC - Commissioning Guidelines CP.3 -3rd edition-03.
- .3 Underwriters' Laboratories of Canada (ULC)
- .4 ANSI/NETA Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 GENERAL

- .1 Provide fully functional facilities:
 - .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 Facility user and O&M personnel have been fully trained in aspects of installed systems.
 - .3 Optimized life cycle costs.
 - .4 Complete documentation relating to installed equipment and systems.
- .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 design requirements.
 - .5 Produces a complete functional system prior to issuance of Certificate of Substantial Performance.
 - .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 BMM - Building Management 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.

1.4 DEVELOPMENT OF 100% CX PLAN

- .1 Cx Plan to be 100% completed within 12 weeks of award of contract 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 Contractor's, sub-contractor's, suppliers' requirements.
 - .6 Project construction team's and Cx team's requirements.
- .2 Submit completed Cx Plan to Cx Authority for review and obtain written approval from and Departmental Representative.

1.5 REFINEMENT OF CX PLAN

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

1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

- .1 General Contractor to maintain overall responsibility for project and is sole point of contact between members of commissioning team.
- .2 General Contractor is to engage and hire the services of an independent third party Commissioning Authority to ensure Cx activities are carried out to ensure delivery of a fully operational project including:
 - .1 Organizing Cx.
 - .2 Monitoring operations Cx activities.
 - .3 Review of Cx documentation from operational perspective.
 - .4 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.

- .5 Protection of health, safety and comfort of occupants and O&M personnel.
- .6 Monitoring of Cx activities, training, development of Cx documentation.
- .7 Work closely with members of Cx Team.
- .8 Certifying accuracy of reported results
- .9 Certifying tabs and other results
- .10 Developing BMM.
- .11 Ensuring implementation of final Cx Plan.
- .12 Implementation of Training Plan
- .3 Departmental Representative is responsible for:
 - .1 Witnessing reported results.
 - .2 Witnessing TAB and other tests.
 - .3 Provides basis of design data not included in the Contract Documents.
 - .4 Reviews commissioning checklists and test forms to ensure applicability to the project and provide comments to the Commissioning Agent.
 - .5 Attends commissioning activities as required to certify the site adaptation and related work meet the design intent and the project requirements.
- .4 Construction Team: contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:
 - .1 Testing.
 - .2 TAB.
 - .3 Performance of Cx activities.
 - .4 Delivery of training and Cx documentation.
 - .5 Assigning one person as point of contact Departmental Representative for administrative
 - .6 and coordination purposes.
- .5 General Contractor it to engage and hire the services of an independent third party Commissioning Provider to implement specified Cx activities including:
 - .1 Demonstrations.
 - .2 Training.
 - .3 Testing.
 - .4 Preparation, submission of test reports.
 - .5 Performing verification of performance of installed systems and equipment.
- .6 Site Facility Manager: represents lead role in Operation Phase and onwards and is responsible for:
 - .1 Receiving facility.
 - .2 Day-To-Day operation and maintenance of facility.

1.7 EXTENT OF CX

- .1 The General Contractor shall provide commissioning services for the following items .
 - .1 List of Electrical Equipment and Acceptance Tests:
 - .1 Preventable Inspections - Box, Conduit & Cable Installations

- .2 Underground Services/Manholes
- .3 Ground system inspection/report
- .4 Instrument Transformers
- .5 Meggering Report
- .6 UPS Start Up
- .7 Certificates and/or Equipment Test Report
- .8 Equipment Spare Parts Report
- .9 Generic Acceptance Report
- .10 Twelve Step Final Acceptance Report

1.8 DELIVERABLES RELATING TO O&M PERSPECTIVES

- .1 General requirements:
 - .1 Compile English documentation.
 - .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.

1.9 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 includes:
 - .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 performance verification (PV) report forms.
 - .6 Results of Performance Verification Tests and Inspections.
 - .7 Description of Cx activities and documentation.
 - .8 Description of Cx of integrated systems and documentation.

- .9 Tests witnessed by Departmental Representative.
- .10 Training Plans.
- .11 Cx Reports.
- .12 Prescribed activities during warranty period.
- .4 Cx Authority to witness and certify tests and reports of results provided to Departmental Representative.

1.10 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Items listed in this Cx Plan include the following:
 - .1 Pre-Start-Up inspections: by Cx Authority prior to permission to start up and rectification of deficiencies to Departmental Representative's satisfaction.
 - .2 Cx Authority to use approved check lists.
 - .3 Cx Authority will monitor some of these pre-start-up inspections.
 - .4 Include completed documentation with Cx report.
 - .5 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections. To be witnessed and certified by Cx Authority and does not form part of Cx specifications.
 - .6 Cx Authority will monitor some of these inspections and tests.
 - .7 Include completed documentation in Cx report.
- .2 Pre-Cx Activities - ELECTRICAL:
 - .1 Low voltage distribution systems require independent testing agency to perform pre-energization and post-energization tests.

1.11 START-UP

- .1 Start up components, equipment and systems.
- .2 Cx Authority to monitor some of these start-up activities.
 - .1 Rectify start-up deficiencies to satisfaction of Cx Authority Departmental Representative.
- .3 Performance Verification (PV):
 - .1 Approved Cx Provider to perform.
 - .1 Repeat when necessary until results are acceptable to Departmental Representative.
 - .2 Use procedures modified generic procedures to suit project requirements.
 - .3 Cx Authority to witness and certify reported results using approved PI and PV forms.
 - .4 Cx Authority to approve completed PV reports and provide to Departmental Representative.
 - .5 Cx Authority and Departmental Representative reserves the right to verify up to 30% of reported results at random.
 - .6 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

1.12 CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Perform Commissioning by specified Cx Provider using procedures developed by Cx Authority.
- .2 Cx Authority to monitor Cx activities.
- .3 Upon satisfactory completion, Cx Provider performing tests to prepare Cx Report using approved PV forms.
- .4 Cx Authority to witness, certify reported results of, Cx activities and forward to Cx Authority.
- .5 Departmental Representative reserves right to verify a percentage of reported results at no cost to contract.

1.13 MECHANICAL SYSTEMS TESTING, ADJUSTING AND BALANCING

- .1 Testing:
 - .1 Quality Assurance:
 - .1 Test equipment and material where specified or required by authority having jurisdiction to demonstrate its proper and safe operation.
 - .2 Test procedures shall be in accordance with applicable portions of NFPA, NETA, CSA and other recognized test codes as far as field conditions permit.
 - .3 Provide notice to the Cx Authority before tests.
 - .2 Liability: During tests, assume responsibility for damages in the event of injury to personnel, building or equipment and bear costs for liability, repairs and restoration.

1.14 ELECTRICAL TESTING, ADJUSTING AND BALANCING

- .1 Conduct and pay for tests of the following:
 - .1 Circuits originating from branch distribution panels.
 - .2 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
- .2 Furnish manufacturers certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer' s instructions .
- .3 Carry out tests in presence of the Cx Authority and Departmental Representative.
- .4 Give advance notice of proposed time of tests so that the Cx Authority and Departmental Representative can be represented at the tests.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit test results for review by the Cx Authority and Departmental Representative.
- .7 Test all systems in accordance with details in appropriate sections.
- .8 Testing methods and test results: in accordance with CSA, CEC, NETA MTS, and regulations of the supply authority and other authorities having jurisdiction.
- .9 Liability: During tests, assume responsibility for damages in the event of injury to personnel, building or equipment and bear costs for liability, repairs and restoration.

- .10 Remove and replace with new materials all conductors that are found to be shorted or grounded.
- .11 Conduct dielectric tests, hi-pot tests, insulation resistance tests and ground continuity tests as required by the nature of the various systems and equipment.
- .12 With the systems completely connected and lamped, conduct the following tests on the power system:
 - .1 Control and Switching: test all circuits for the correct operation of devices, switches and controls.
 - .2 Polarity Tests: test all circuits for correct operation of devices, switches and controls.
 - .3 Voltage Tests: make a voltage test at the last outlet of each circuit. Maximum drop in potential permitted will be 2% on 120V, and 208V branch circuits. 2% on 208V feeder circuits, and 5% on 600V feeder circuits. Correct any deficiency in this respect.
 - .4 Phase Balance: measure the load on each phase at each switchboard, splitter, distribution panel board and lighting and power panel board. Report results in writing to the Cx Authority and Departmental Representative. Re-arrange phase connections as necessary to balance the load on each phase as instructed by the Cx Authority and Departmental Representative with the re-arrangement being restricted to the exchanging of connections at the distribution points mentioned in this paragraph. After marking any such changes, make available to the Cx Authority and Departmental Representative, drawings or marked prints showing the modified connections.
 - .5 Supply Voltage: measure the line voltage of each phase at the load terminals of the main breakers and report the results in writing to the Cx Authority and Departmental Representative. Perform this test with the majority of electrical equipment in use.
 - .6 Motor Loading: measure the line current of each phase of each motor with the motor operating under load and report the results in writing to the Cx Authority and Departmental Representative. Upon indications of any imbalance or overload, thoroughly examine electrical connections and rectify any defective parts or wiring. If electrical connections are correct, overloads due to defects in the driven machines shall be reported in writing to the Cx Authority and Departmental Representative. Verify motor full load amps and overload
 - .7 Relays are properly sized and adjusted accordingly.
 - .8 General Operations: energize and put into operation each and every electrical circuit and item. Make repairs, alterations, replacements, tests and adjustments necessary for a complete and satisfactory operating electrical system.
- .13 Carry out tests covering "General Operation" at the time of acceptance of the work.
- .14 Test all systems and obtain written confirmation from the manufacturer of each system that all components have been installed correctly and that the system is functioning as intended. Present separate certification for all systems including: fire alarm, power distribution, to the Cx Authority and Departmental Representative.

- .15 Provide labour, instruments, apparatus and pay all expenses required for the tests. The Cx Authority and Departmental Representative reserves the right to demand proof of the accuracy of all instruments used.
- .16 When tests are performed, the Cx Authority and Departmental Representative may require that equipment be opened and removed from their housings to examine interior of equipment, terminations and connections. Provide all required labour and tools.
- .17 Co-ordinate the testing of motors with the trades providing the equipment driven by the motors so that they are carried out at the time the driven equipment is put on test. In addition to the motor loading tests, provide labour and instruments to take and record all motor load readings required to supplement the tests on the driven equipment through various load sequences, as required by the trades involved.
- .18 Insulation Resistance Testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 351-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.

1.15 INSTALLATION CHECK LISTS (ICL)

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.16 PRODUCT INFORMATION (PI) REPORT FORMS

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.17 PERFORMANCE VERIFICATION (PV) REPORT

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / 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 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 Pre-TAB review: 28 days after contract award, and before construction starts.
 - .3 Cx agents' credentials: 60 days before start of Cx.

- .4 Cx procedures: 3 months after award of contract.
- .5 Cx Report format: 3 months after contract award.
- .6 Discussion of heating/cooling loads for Cx: 3 months before start-up.
- .7 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
- .8 Notification of intention to start TAB: 21 days before start of TAB.
- .9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
- .10 Notification of intention to start Cx: 14 days before start of Cx.
- .11 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.
- .12 Identification of deferred Cx.
- .13 Implementation of training plans.
- .14 Cx reports: immediately upon successful completion of Cx.
- .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Property Manager.
- .3 Six (6) months in Cx schedule for verification of performance in all seasons and wear conditions.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Contractor, Contractor's Cx Provider, Cx Authority, and Departmental Representative will monitor progress of Cx against this schedule.

1.20 CX REPORTS

- .1 Submit reports of tests, witnessed and certified by Cx Authority and Departmental Representative to Departmental Representative who will verify reported results.
- .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 Cx Authority.

1.21 TESTS TO BE PERFORMED BY OWNER/USER

- .1 None is anticipated on this project.

1.22 TRAINING PLANS

- .1 Refer to Section 01 91 41 - Commissioning (Cx) - Training.

1.23 FINAL SETTINGS

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Commissioning forms to be completed for equipment, system and integrated system.

1.2 INSTALLATION/START-UP 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. As deemed necessary by Cx Authority and Departmental Representative supplemental additional data lists will be required for specific project conditions.
- .3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.
- .4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Cx Authority and Departmental Representative. Check lists will be required during Commissioning and will be included in Building Maintenance Manual (BMM) 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 is included in the BMM at completion of work.
- .2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Cx Authority and Departmental Representative's approval.

1.4 PERFORMANCE VERIFICATION (PV) FORMS

- .1 PV 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 Contractor records measured data and readings taken during functional testing and Performance Verification procedures.
- .3 Prior to PV of integrated system, complete PV forms of related systems and obtain Cx Authority and Departmental Representative approval.

1.5 COMMISSIONING FORMS

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
 - .1 Contractor provides project-specific Commissioning forms with Specification data included.
 - .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
 - .3 Confirm operation as per design criteria and intent.
 - .4 Identify variances between design and operation and reasons for variances.
 - .5 Verify operation in specified normal and emergency modes and under specified load conditions.
 - .6 Record analytical and substantiating data.
 - .7 Verify reported results.
 - .8 Form to bear signatures of recording technician.
 - .9 Submit immediately after tests are performed.
 - .10 Reported results in true measured SI unit values.
 - .11 Provide Cx Authority and Departmental Representative with originals of completed forms.
 - .12 Maintain copy on site during start-up, testing and commissioning period.

1.6 LANGUAGE

- .1 To suit the language profile of the awarded contract.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 This Section specifies roles and responsibilities of Commissioning Training.
- .2 Related Sections:
 - .1 General Commissioning (Cx) Requirements Section 01 91 13
 - .2 Commissioning (Cx) Plan Section 01 91 31

1.2 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.

1.3 INSTRUCTORS

- .1 Engineer will provide:
 - .1 Descriptions of systems.
 - .2 Instruction on design philosophy, design criteria, and design intent.
- .2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:
 - .1 Start-Up, operation, shut-down of equipment, components and systems.
 - .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
 - .3 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.

1.4 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 Proper preventive maintenance, diagnosis and trouble-shooting.
 - .4 Ability to update documentation.
 - .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 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, Cx Authority and Facility Manager will review training manuals.
- .4 Training materials to be in a format that permits future training procedures to same degree of
- .5 detail.
- .6 Supplement training materials:
 - .1 Transparencies for overhead projectors.
 - .2 Multimedia presentations.
 - .3 Manufacturer's training videos.
 - .4 Equipment models.

1.6 SCHEDULING

- .1 Include in Commissioning Schedule time for training.
- .2 Deliver training during regular working hours, training sessions to be 8 hours in length.
- .3 Training to be completed prior to acceptance of facility.

1.7 RESPONSIBILITIES

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

1.8 ELECTRICAL SYSTEM TRAINING

- .1 Organize and conduct training courses to instruct the Departmental Representative in the operation and preventative maintenance of equipment and systems provided at the completion of the project.
- .2 Provide services of qualified personnel, including each sub-trade, each major equipment supplier and design engineer to and instruct on their equipment or systems.
- .3 One-person day shall be eight hours including one half hour for breaks, and one person week shall be five person days.

- .4 Submit sessions schedule and list of representatives to the Departmental Representative for approval 30 days prior to course starting date. Confirm attendance of course by written notification to all participants, followed by verbal confirmation just prior to course starting date.
- .5 Submit final copies of record drawings and operating and maintenance manuals to Departmental Representative. Submit a written follow-up of all courses, complete with an attendants list to the Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 31 19 – Project Meetings.
- .2 Section 01 33 00 – Submittal Procedures.
- .3 Section 01 35 43 – Environmental Procedures.
- .4 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .5 Section 01 74 11 – Cleaning.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA S350-M1980 (R2003), Code of Practice for Safety in Demolition of Structures.
- .2 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.
- .3 Canadian Environmental Protection Act (CEPA), 1999, C.33.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section:
 - .1 01 33 00 - Submittal Procedures.
 - .2 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .3 01 35 43 - Environmental Procedures.

1.4 SITE CONDITIONS

- .1 Review "Designated Substance Report" and take precautions to protect environment.
- .2 If material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous is encountered, stop work, take preventative measures, and notify Departmental Representative immediately.
 - .1 Proceed only after receipt of written instructions have been received from Departmental Representative.
- .3 Notify Departmental Representative before disrupting building access or services.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 EXAMINATION

- .1 Inspect site with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .3 Notify and obtain approval of utility companies before starting demolition.
- .4 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.
 - .1 Immediately notify Departmental Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.
 - .2 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to: requirements of authorities having jurisdiction.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during demolition.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal after completion of demolition work.
- .2 Protection of In-Place Conditions:
 - .1 Prevent movement, settlement, or damage to adjacent structures, utilities, and landscaping features and parts of building to remain in place. Provide bracing and shoring required.
 - .2 Keep noise, dust, and inconvenience to occupants to minimum. Dust control in laboratories to be reviewed with departmental representative prior to starting work to ensure sensitive specimens are not damaged.
 - .3 Protect building systems, services and equipment.
 - .4 Provide temporary dust screens, covers, railings, supports and other protection as required.
 - .5 Do Work in accordance with Section 01 35 33 - Health and Safety Requirements.
- .3 Demolition/Removal:
 - .1 Remove items as indicated.

- .2 Removal of Pavements, Curbs and Gutters:
 - .1 Square up adjacent surfaces to remain in place by saw cutting or other method approved by Departmental Representative.
 - .2 Protect adjacent joints and load transfer devices.
 - .3 Protect underlying and adjacent granular materials.
- .3 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to suit future use.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Refer to demolition drawings and specifications for items to be salvaged for reuse.
- .4 Waste Management: separate waste materials for reuse recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 GENERAL SCOPE

- .1 'Provide' shall mean 'supply and install'.
- .2 Provide complete, fully tested, and operational systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.
- .3 Contract documents and drawings of this Division are diagrammatic and approximately, to scale unless detailed otherwise. They establish scope, material, and installation quality but are not detailed installation instructions.
- .4 Follow manufacturers' recommended installation instructions, details, and procedures for equipment, supplemented by requirements of the Contract Documents.
- .5 Clarifications or requests for alternate materials or equipment must be submitted in writing no later than seven (7) working days prior to the Mechanical trades' closing tender date. Approval of requests shall only be given by addendum.
- .6 Make reference to electrical, mechanical, structural, and architectural drawings when setting out work. Consult with respective Divisions in setting out locations for ductwork, equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained. Jointly work out all conflicts on site before fabricating or installing any materials or equipment.

1.3 CODE COMPLIANCE, PERMITS AND FEES

- .1 All work shall comply with current editions of the National, Provincial and Municipal Codes, Standards, Acts and Bylaws and will meet the requirements of the Authority having jurisdiction.
- .2 Obtain all permits and pay all fees applicable to the scope of work. Contractor shall arrange for inspections of the work by the authorities having jurisdiction and shall provide certificates indicating Final Approval.

1.4 TENDER PRICE BREAKDOWN

- .1 Submit a tender price breakdown within thirty (30) days of tender closing and before first progress claim, in a format agreed to with the departmental representative. As a minimum, include the following in the tender price breakdown:
 - .1 Mechanical: Equipment, materials, labour
 - .2 Sheet Metal: Equipment, materials, labour
 - .3 Controls: Equipment, materials, labour

1.5 SUBMITTALS

- .1 Comply with Division 01 – Submittal Procedures and Closeout Procedures.

- .2 Shop drawings: Submit shop drawings for all equipment as electronic files (file format: .dwg, .dxf, pdf, or comparable). When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Submittals shall include a complete bill of materials of equipment to be used indicating quantity, manufacturer, model number, and other relevant technical data
- .3 Closeout Submittals: Provide a minimum of four (4) mechanical operation and maintenance manuals and one digital copy, prepared by qualified and experienced personnel for use by owner..
 - .1 Operation and maintenance manual approved by, and final copies deposited with the departmental representative a minimum of 7-days before final inspection.
 - .2 Operation and maintenance manual to include but not limited to:
 - (a) Layman's description of the systems and associated controls.
 - (b) Operational instructions, servicing, maintenance, operation, and trouble-shooting instructions for each item of equipment.
 - (c) Warranties
 - (d) Equipment manufacturer's performance datasheets indicating point of operation as left after commissioning is complete.
 - (e) Testing, adjusting, and balancing reports.
 - (f) List of suppliers and contact information.
- .4 Record Drawings:
 - .1 The Owner to determine the final process and who generates the final record drawings.
 - .2 The contractor is to have 1 set of white prints at contractors cost to mark changes as work progresses and as changes occur. Use different colour waterproof ink for each service. Do not use pencil or black ink. Transfer information weekly to show work as actually installed. Drawings shall be available on a weekly basis for review by the departmental representative.
 - .3 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
 - .4 If the Contractor is tasked with generating the record drawings:
 - (a) Submit to departmental representative for approval and make corrections as directed.
 - (b) Submit completed CAD record drawings with final Operating and Maintenance Manuals within two (2) weeks of substantial completion. Failure to submit drawings will result in the work being undertaken by the Owner and deducted from the Contractor's hold back amount.

1.6 QUALITY OF WORK

- .1 All work shall be by qualified tradesmen with valid Provincial Trade Qualification Certificates. Spot checks will be made by the departmental representative. Work, which does not conform to standards accepted by the departmental representative and the trade, may be rejected by the departmental representative. The Contractor shall redo rejected work to the accepted standard at no cost to the Owner.

1.7 METRIC CONVERSION

- .1 All units in this division are expressed in SI units.
- .2 On all submittals (shop drawings etc.) use the same SI units as stated in the specification.
- .3 Equivalent Nominal Diameters of Pipes - Metric and Imperial:
 - .1 Where pipes are specified with metric dimensions and Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment, and piping.
 - .2 When CSA approved SI Metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

Equivalent Nominal Diameter of Pipes					
mm	Inches (NPS)	mm	Inches (NPS)	mm	Inches (NPS)
3	1/8	40	1-1/2	200	8
6	1/4	50	2	250	10
10	3/8	65	2-1/2	300	12
15	1/2	75	3	375	15
20	3/4	100	4	450	18
25	1	125	5	500	20
30	1-1/4	150	6	600	24

- .4 Metric Duct Sizes:
 - .1 The Metric duct sizes are expressed as 25 mm = 1 inch.

1.8 DRAWINGS AND SPECIFICATIONS

- .1 Should any discrepancy appear between drawings and specifications, which leaves the Contractor in doubt as to the true intent and meaning of the plans, and specifications, obtain written clarification from the departmental representative during the tender period. Without a written clarification, the better quality and/or greater quantity of work or materials shall be estimated, performed, and furnished within the tendered price.
- .2 Examine all contract documents, including all drawings and specifications, and work of other trades to ensure that work is satisfactorily carried out and equipment will fit within the proposed locations without changes to building.

1.9 CUTTING, PATCHING AND CORING

- .1 Provide holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves. All work shall be coordinated with other trades.
- .2 Obtain written approval from the Structural departmental representative before cutting or burning structural members.
- .3 Provide X-ray of all required penetrations of the floor. X-ray use for locating in floor rebar and conduit to be done after normal working hours. Take necessary precautions to protect computer equipment when X-raying floors. Coordinate with Owner.

1.10 COMPLIANCE WITH ENERGY BY-LAW

- .1 All equipment installed on this project shall comply with:
 - .1 ASHRAE Standard 90.1 - 2010

1.11 INSTALLATION OF EQUIPMENT

- .1 Pipe all equipment drains to building drains except systems containing glycol.
- .2 Unions and flanges shall be provided in piping or ductwork to permit easy removal of equipment.
- .3 Maintain permanent access to equipment for maintenance.

1.12 CONNECTIONS TO EXISTING SERVICES

- .1 Maintain liaison with the Owner and provide a mutually acceptable schedule to interrupt, reroute, or connect to existing building services with the minimum of interruption of those services.

1.13 SELECTIVE DEMOLITION

- .1 Remove from site all equipment, ducting or piping which is no longer required because of work under this Contract.
- .2 Cease operations and notify the departmental representative immediately for special protective and disposal instructions when any asbestos materials are uncovered during the work in this Section.
- .3 Except as otherwise stated, salvageable materials from area of demolition shall become the property of the Owner at his discretion. All material not taken over by the Owner or removed from the building under this contract shall be removed from this site and disposed of as required by any applicable disposal regulations.
- .4 Turnover to and deliver to the Owner's storage area all items which have been determined to have salvage value and has been removed due to the Work.

1.14 EQUIPMENT AND MATERIALS

- .1 Where two or more products of the same type are required, products shall be of the same manufacturer.
- .2 Notify the departmental representative in writing ten (10) days prior to the tender close, any materials or equipment specified which is not currently available or will not be available for use as called for herein. Failing this, the contract will assume that the most expensive alternate has been included in the tender price.

- .3 Approved equivalents and/or alternatives to specified products shall be equal to the specified product in every respect, operate as intended, and meet the space, capacity, and noise requirements outlined.
- .4 The Contractor shall be fully responsible for any additional labour and materials required by any trades or other Contractors to accommodate the use of other than specified materials or equipment. The Contractor shall bear any and all costs for design/system modifications to accommodate the "alternate" equipment. Extras will not be approved to cover such work.
- .5 The Owner and/or departmental representative holds the right to reject any equipment and/or materials that is different from that specified. It is the Contractor's responsibility to replace with the acceptable material or equipment as required.
- .6 All rotating equipment shall be supplied from the manufacturer with dynamically balanced shafts, wheels and any other rotating parts. Equipment supplier and manufacturer are responsible for any additional balancing, equipment, and materials replacement, and cost for addressing damages to the building, any systems, and equipment due to the supplied equipment improper balancing.
- .7 All equipment installed on this project shall comply with all applicable requirements including:
 - .1 BC Building Code and all referenced codes and standards
 - .2 BC Fire Code
 - .3 BC Plumbing Code
 - .4 CSA Standards
 - .5 Local Standards and Bylaws
 - .6 Manufacturer requirements and recommendations
 - .7 NFPA standards
 - .8 National Energy Code of Canada for Buildings (NECB)
 - .9 ASHRAE Standard 90.1
 - .10 ASHRAE Standards, Guidelines, Handbooks and Design Guides

1.15 DELIVERY, STORAGE AND HANDLING

- .1 Storage and Handling Requirements:
 - .1 Store materials and equipment in accordance with the manufacturer's recommendations; in a clean, dry, well-ventilated area. Coordinate location of storage with the Owner.
 - .2 Store and protect equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .2 Protect equipment and open end duct with polyethylene covers and maintain equipment on crates until installation.
- .3 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.16 FIRESTOPPING AND SMOKE SEALS

- .1 Provide firestopping system(s) to provide and maintain a fire resistance rating, as indicated on drawings and in accordance with UL, WH, ULC, cUL or FM design details for all mechanical work in Divisions 21, 22, 23 and 25.
- .2 For renovation projects, in addition to the necessary new penetrations, provide the firestopping for all existing mechanical assemblies where firestopping is damaged, discontinued or absent.
- .3 All firestop system installations must meet the requirements of CAN4-S115-M or ULC S-115-M Tested assemblies that provide a fire rating.
- .4 A manufacturer's direct representative (not distributor or agent) shall be on-site during the initial installation of firestop systems to train appropriate contractor personnel in correct selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

1.17 ACCESS DOORS

- .1 Provide access doors for maintenance or adjustment of all parts of the mechanical system.
- .2 Provide 300 mm x 300 mm minimum size for inspection and hand access.
- .3 600 mm x 600 mm minimum size, larger if indicated on drawings, where entry is required, and access is difficult.

1.18 ESCUTCHEONS AND PLATES

- .1 Provide escutcheons and plates on all piping and ductwork passing through finished walls, floors, and ceilings.

1.19 GUARANTEE / WARRANTY

- .1 Furnish a written guarantee stating that all work executed in this contract will be free from defective workmanship and materials for a period of one (1) year from the date of Substantial Performance.

1.20 BALANCING

- .1 The approved balancing agencies are: Blue Collar Group, Flotech Mechanical, Western Mechanical; K.D. Engineering.
- .2 Balance exhaust fans and air outlets to air quantities indicated on the drawings and in this specification. Where outlet quantities are not indicated, divide capacity equally among all outlets.
- .3 The balancer shall use appropriate air flow settings and control methods for single floor systems, accounting for the central system air volume diversity.
- .4 Submit a PDF copy of the report to the departmental representative within two (2) weeks after substantial completion. Failure to submit the report within the specified time will result in the work being done by the Owner and the costs deducted from final payment.
- .5 Balancing shall be performed to the following:
 - .1 Air-Terminal Outlets: $\pm 10\%$
 - .2 Air-Central Equipment: $\pm 5\%$

- .3 Hydronic-Pumps and Central Equipment: $\pm 5\%$
- .6 Provide a drop test of all fire dampers and a letter/certificate confirming this work.
- .7 Cooperate with the Balancing Agency as follows:
 - .1 Make any corrections as required by Balancing Agency.
 - .2 Allow Balancing Agency free access to site during construction phase. Inform Balancing Agency of any major changes made to systems during construction and provide a complete set of record drawings and specifications for their use.
 - .3 Operate automatic control system and verify set points during balancing.
 - .4 Provide and install balancing valves, dampers, and other materials requested by the Balancing Agency and/or necessary to properly adjust or correct the systems to design flows, without additional cost to Owner.
 - .5 Provide and install pulleys and sheaves for rotating equipment, as required to properly balance the systems to design flows, without additional cost to Owner.
 - .6 Allow in the contract price shaving of impellers as required to balance the pumps to design flow at operating condition.

1.21 COMMISSIONING AND DEMONSTRATION

- .1 Be responsible for the performance and commissioning of all equipment supplied and re-used under Divisions 23
- .2 Confirm operation and review condition of all existing air valves and heat pumps, and associated control devices in the renovated area. Submit report noting any remedial work required.
- .3 At the conclusion of commissioning, demonstrate the operation of the systems to the departmental representative and then to the owner's operating staff.
- .4 At the completion of the commissioning, testing, balancing and demonstration submit to the departmental representative a letter certifying that all work specified under this contract is complete, clean and operational in accordance with the specification and drawings.

1.22 FLASHING AND ROOF CURBS

- .1 Provide curbs, flash and counter flash as required where mechanical equipment passes through weather or waterproofed walls, floors and roofs.

1.23 SEISMIC CONTROL

- .1 Provide seismic restraints for all required equipment, piping, and ductwork.
- .2 The Contractor shall retain the services of a qualified professional seismic engineer (Seismic Engineer) registered in the Province British Columbia. The Seismic Engineer shall design and review the installation of all seismic restraints as well as mechanical equipment and mechanical system supports. The restraints and supports shall be specifically designed to fasten to the structure indicated in the contract documents and installed in the field. The complete design for these systems shall comply with all applicable building code requirements.

- .3 Seismic Engineer shall provide and submit to the Owner's departmental representative Assurance of Professional Design and Commitment for Field Review Schedule B and Assurance of Professional Field Review and Compliance Schedule C-B for seismic engineering.
- .4 Piping ductwork and equipment shall be restrained in accordance with the latest edition of the Seismic Restraints Manual for Mechanical Systems produced by SMACNA, and the latest edition of the ASHRAE Application Handbook Chapter 49, Seismic Restraints.
- .5 Submit shop drawings of all seismic restraint details prepared and sealed by the seismic engineer. Prior to substantial completion, the seismic engineer shall visit the site and verify the seismic restraint installation as required to satisfy the Assurance of Professional Field Review and Compliance Schedule C-B of the Building Code.
- .6 The contractor shall obtain approval for the location of all restraint fixing points from the structural engineer, on site, prior to installation.
- .7 Where equipment is mounted on spring or resilient mounts for vibration isolation, it shall be the responsibility of the manufacturer of the mount to incorporate seismic restraint. These restraints shall be multi-directional as described in the guidelines specified above. Provide steel frame bases where necessary to achieve this and also avoid overturning. The manufacturer shall supply certificates, signed by a Professional Engineer registered within the jurisdiction, verifying the design of the seismic restraints in accordance with this section.

1.24 VIBRATION ISOLATION

- .1 Provide neoprene isolators for deflections 6mm ($\frac{1}{4}$ ") and under.
- .2 Provide either neoprene or steel spring isolators for deflections between 6mm and 12mm ($\frac{1}{2}$ ").
- .3 Provide steel spring isolators for deflections of 12mm ($\frac{1}{2}$ ") and over.
- .4 Provide adjustable limit stops for spring isolation mounts on equipment with operating weights substantially different from the installed weights
- .5 All spring isolators shall be "open spring" unless otherwise stated. Seismically rated housed spring isolators may be used in lieu provided that they meet this project's requirements for seismic restraint.
- .6 Select isolators in accordance with equipment weight distribution to allow for an average deflection meeting or exceeding the specified deflection requirements and so that no isolator has a deflection less than 80% of the static deflection specified. A minimum of 4 isolators are required for each piece of equipment, unless specified otherwise. Refer to the minimum static deflection table contained in this Section.

1.25 SUBSTANTIAL AND TOTAL PERFORMANCE

- .1 Prior to requesting an inspection for Substantial Performance, provide a complete list of items, which are deficient.
- .2 A certificate of Substantial Performance will not be granted unless the following items are completed and available to the Owner's departmental representative:
 - .1 Schedule C-B for seismic engineering.
 - .2 Fire stopping and Fire Damper test letter

- .3 Draft Operating/Maintenance Manuals have been submitted for review.
- .4 All mechanical systems have been commissioned and are capable of operation with alarm controls functional and automatic controls in operation.
- .5 Air and water systems have been balanced with draft report submitted to the departmental representative.
- .6 Operating and Maintenance demonstrations have been provided to the Owner.
- .7 Record drawings have been submitted.
- .8 All previously identified deficiencies have been corrected and accepted.
- .3 Prior to a Total Performance Inspection, provide declaration in writing that deficiencies noted at time of substantial performance inspection have been corrected and the following items completed prior to the total performance inspection:
 - .1 Submit final air balance reports.
 - .2 Submit final operating and maintenance manuals.
- .4 The departmental representative shall provide one (1) visitation for the purpose of total performance inspection. Subsequent visitations if required shall be at the expense of the Contractor.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 Listed manufacturers are acceptable for their ability to meet the general design intent, quality and performance characteristics of the specified product. The list does not endorse the acceptability of all products available from the listed manufacturers/suppliers.
- .2 It remains the responsibility of the Contractor to ensure the products supplied are equal to the specified products in every respect, operate as intended, and meet the performance specifications and physical dimensions of the specified product.
- .3 The contractor shall be fully responsible for any additional work or materials, to accommodate the use of equipment from the acceptable manufacturers and suppliers listed.

2.2 DEMOLITION

- .1 All coring, patching and removal of existing equipment, pipes, and ductwork, which may affect the operation of occupied areas of the building, shall be carried out outside of regular office hours or as scheduled with the Owner.

2.3 ASBESTOS

- .1 The intent is for a Haz-Mat Contractor to remove all asbestos containing material prior to the proposed project work taking place. Notify the departmental representative if asbestos containing material is suspected to remain on site.

2.4 FIRESTOPPING AND SMOKE SEALS

- .1 Use the same manufacturer throughout the project and compatible materials for restoration work.

- .2 Provide fill material components for each firestopping system as needed. Use only components specified by the firestopping manufacturer for the designated fire-resistance-rated systems.
- .3 Acceptable manufacturers: 3M, Hilti, AD Firebarrier, Tremco

2.5 ELECTRICAL MOTORS

- .1 Supply mechanical equipment complete with electrical motors.
- .2 Provide motors designed, manufactured, and tested in accordance with the latest edition of the following codes and standards: NEMA, EEMAC, CSA, CEC Part 1, IEEE and ANSI. All motors to be CSA labelled. All motors to be approved for use in the designated area classification by the Provincial Electrical Protection Branch. All motors intended for use with a variable frequency drive (VFD) shall be inverter only rated.
- .3 Unless specified otherwise, provide motors designed for full voltage starting, EEMAC Design B. Motors driving high torque or high inertia loads may be EEMAC Design C or D.
- .4 Provide motors rated for continuous duty with 1.15 service factor unless specified otherwise in the driven equipment specifications. Provide all motors with thermal overload protection.
- .5 Motors less than 3/4 hp shall be 120 V, 60 Hz, 1 phase. Motors 3/4 hp and larger shall be 3 phase at the indicated voltage.
- .6 All motors shall be 1800 rpm unless otherwise noted.
- .7 Provide motors complete with equipment except where indicated.
- .8 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.
- .9 Provide motors designed with Class B insulation; Class F insulation for totally enclosed motors.
- .10 Refer to electrical specifications, for voltage, frequency, and phase data. This shall take precedence over any reference in mechanical specification.
- .11 Where motor power is stated in watts or kilowatts, nominal motor horsepower multiplied by 746 or 0.746 respectively, has been used as the conversion factor.
- .12 Minimum certified motor efficiency shall be as outlined in ASHRAE 90.1.

2.6 DUCTWORK AND ACCESSORIES

- .1 Provide ductwork constructed, reinforced, sealed, and installed to withstand 1-1/2 times the working static pressure.
- .2 Low Pressure Ductwork 500 Pa (2" W.G.) and under
 - .1 Supply ductwork and plenums on systems without terminal mixing boxes or air valves.
 - .2 Supply ductwork downstream from terminal mixing boxes or air valves.
 - .3 Outdoor air ductwork and plenums, unless noted otherwise.
 - .4 Return air ductwork and plenums, unless noted otherwise.
 - .5 Exhaust and relief air ductwork and plenums, unless noted otherwise.
 - .6 Low pressure insulated flexible ductwork shall be equal to Thermaflex Type M-KC.

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- .7 Connect outlet terminals to low pressure ducts with 900mm (36") maximum length of stretched flexible duct. Hold in place with strap or clamp, caulk sealed. Do not use flexible duct to change directions.
 - .8 Provide a flexible connection where low pressure ducts are connected to fan equipment, terminal boxes, or any other apparatus. Joint shall be screwed or bolted flexible gasketed joint, minimum 50mm (2") wide.
 - .3 Medium Pressure Ductwork to 1000 Pa (4"W.G.)
 - .1 Supply air ductwork downstream from supply air handling units discharge to terminal mixing boxes or air valves.
 - .2 Exhaust and return air ductwork downstream of return/exhaust air valves to the return/exhaust fans and discharge ductwork from the return/exhaust fans to the air handling units and/or relief opening.
 - .3 Outdoor intake plenums in mechanical room(s).
 - .4 Where flexible air ducts are used to connect terminal mixing boxes or air valves to metal ducts, the flexible air ducts shall be rated for 30.5 m/s (6000 fpm) velocity and 2500 Pa (10" W.G.). Maximum stretched length of flexible air duct shall be 300 mm (12"). Do not use flexible duct to change direction. Where flexible air ducts are attached to metal insulated duct, furnish flexible air ducts with fiberglass wool insulation and metalized jacket. Thermaflex M-KC or equal.
 - .4 Medium Pressure Ductwork to 1500 Pa (6"W.G.)
 - .1 Stair, vestibule and elevator pressurization ducts.
 - .2 Smoke evacuation ducts.
 - .5 Duct Hangers
 - .1 Hangers and Supports to SMACNA standards
 - .2 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .3 Maximum size duct supported by strap hanger: 500 mm.
 - .4 Hangers: Galvanized steel angle with galvanized steel rods to SMACNA.
 - .5 Toggle hangers and/or strap hangers shall not be used.
 - .6 Power actuated fasteners and "drop-in" anchors shall not be used for tension load applications such as pipe and duct hangers.
 - .6 Duct Sealing
 - .1 Low Pressure Ductwork 500 Pa (2" W.G.) and under shall be SMACNA seal class A. Seal all supply, return and exhaust duct joints, longitudinal as well as transverse joints as follows:
 - (a) Slip Joints: Apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds 1.5 mm (1/16") use heavy mastic type sealant.
 - (b) Flanged Joints: Soft elastomer butyl or extruded form of sealant between flanges followed by an application of heavy brush-on high pressure duct sealant.
 - (c) Other Joints: Heavy mastic type sealant.

- .2 Medium Pressure Ductwork to 1000 Pa (4"W.G.) shall be SMACNA seal class A. Seal all supply, return and exhaust duct joints, longitudinal as well as transverse joints as follows:
 - (a) Combination of woven fabrics and sealing compound followed by an application of high-pressure duct sealant.
- .3 Duct tapes as sealing method are not permitted, except on residential ductwork – minimum 2 wraps of 2" wide (50mm) foil duct tape is acceptable.
- .4 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding.
- .5 Do not insulate any section of the ductwork until it has been inspected and approved of duct sealant application, by the departmental representative.

2.7 ACCESS DOORS

- .1 Fire Rated Walls:
 - .1 Non-combustible construction: Uninsulated steel door (16ga) and steel frame (16ga), door flush to frame edge, 25mm mounting frame with masonry anchor straps, concealed self-closing hinge, flush key latch, prime coat grey painted finish, ULC rated 2 hour 'B' label.
 - .2 Combustible construction: Insulated steel door (20ga) for maximum 250°C rise after 30 minutes and steel frame (16ga), door flush to frame edge, 25mm mounting frame with masonry anchor straps, concealed self-closing hinge, flush key latch, prime coat grey painted finish, ULC rated 1½ hour 'B' label.
- .2 Fire Rated Ceilings: 50mm Insulated steel door (16ga) and steel frame (16ga), door flush to frame edge, 25mm mounting frame with masonry anchor straps, concealed upswing self-closing hinge, L handle latch, white baked enamel finish, size 600mm x 600mm (24" x 24") ULC rated 2 hour 'B' label.
- .3 Ductwork: Ultra low leakage type, flat oval design, galvanized steel frame (22ga), double skin galvanized steel door (22 ga) with 25mm insulation fully enclosed in panel, bulb type seal integrally fastened to door, lever cam locks. Provide stainless steel in lieu of galvanized steel in stainless steel ductwork.

2.8 IDENTIFICATION

- .1 Existing identification standard shall be used for renovation projects in existing buildings. In the case of no available standard, use the following:
- .2 Identify piping with labels and flow arrows. Provide identification at 15m (50ft) maximum intervals, before and after pipes passing through walls, at all sides of tees, behind access doors. Use Brady B-500 vinyl cloth labels for non insulated pipes and B-350 for insulated pipes.
- .3 Provide 20mm (¾") diameter brass tags, secure to valve stems with key chain. Provide a valve directory at all mechanical rooms, in the O&M manuals and a digital copy cross referenced with any associated controls nomenclature.
- .4 Each piece of equipment shall be identified with its equipment schedule identification, e.g., exhaust fan EF-1, cooling coil CC-1, pump P-1 with lamacoid plates having 6mm (¼") minimum letter size.

2.9 DUCT AND BREECHING INSULATION

- .1 Exposed Rectangular Ducts: External rigid Insulation, service temperature 5°C to 232°C (41°F to 450°F), mineral fiber board for low and medium temperature applications, all service aluminum foil-scrim kraft (FSK) vapour barrier jacket with glass fibre reinforcement, factory applied.
 - .1 Density 36kg/m³ (2.25 PCF), Minimum RSI 0.76/25mm (R 4.3/in)
- .2 Round Ducts and Concealed Rectangular Ducts: External flexible insulation, service temperature 5°C to 232°C (41°F to 450°F), glass fiber or mineral fiber flexible blanket for low and medium temperature applications, all service aluminum foil-scrim kraft (FSK) vapour barrier jacket with glass fibre reinforcement, factory applied.
 - .1 Density 12kg/m³ (0.75PCF), Minimum RSI 0.49/25mm (R 2.8/in) (installed)
- .3 Breeching Insulation: External semi-rigid insulation, service temperature up to 538°C (1000°F), glass fiber or mineral fiber flexible blanket for high temperature applications.
 - .1 Density 25kg/m³ (1.6PCF), Minimum RSI 0.25/25mm (R 1.4/in)
- .4 Finish Jackets
 - .1 Utility Finish: Over rigid insulation for rectangular ductwork and flexible insulation for round ductwork. Apply continuous metal corner bead to all corners. Adhere vapor retarder tape over all joints and breaks in vapor retarder, and at all corners.

2.10 SEISMIC CABLE RESTRAINTS

- .1 Galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint.
- .2 Cables must be pre-stretched to achieve a certified minimum modulus of elasticity. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement.

2.11 VIBRATION ISOLATION

- .1 Neoprene Washer/Bushing
 - .1 A one piece molded bridge bearing neoprene washer/bushing. The bushing shall surround the anchor bolt and have a flat washer face to avoid metal to metal contact. Use washer/bushing only on light-weight equipment.
 - (a) Mason HG hemi grommet or equal
- .2 Spring Hangers
 - .1 Hangers shall consist of rigid steel frames containing minimum 32mm (1 1/4") thick neoprene elements at the top and a steel spring seated in a steel washer reinforced neoprene cup on the bottom.
 - .2 Provide a combination rubber and steel rebound washer as the seismic upstop for suspended piping, ductwork, and equipment. Rubber thickness shall be a minimum of 6mm (1/4"). Colour coded springs, rust resistant, painted box type hangers.

- .3 To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring.
 - (a) Mason HD, HS or equal
- .3 Acceptable Manufacturers, Korfund, Vibro-Acoustics

PART 3 EXECUTION

3.1 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Division 09 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.
- .4 Clean exposed bare metal surfaces supplied under Divisions 21, 22, 23 and 25. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.

3.2 DEMONSTRATION

- .1 Supply tools, equipment, personnel to demonstrate and instruct the operating, and maintenance personnel in operating, controlling, adjusting, troubleshooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Use operation and maintenance manual, record drawings, and audio-visual aids as part of instruction materials.

3.3 FIRESTOPPING AND SMOKE SEALS

- .1 The Owner's departmental representative shall conduct mandatory destructive reviews for each type of installation. Destructive testing shall be at the discretion of the Owner's departmental representative and Authority having jurisdiction.
- .2 Allow for destructive testing of 5% of fire stopping applications. Should installations not conform to manufacturer's listed assembly, an additional 25% of installations may be destructively tested and should there be more failures, the contractor will be responsible to remove all fire stopping products and reinstall products correctly, at no additional cost to the project.
- .3 Tag all penetrations and every 3 meters of joint seal with printed tags
 - .1 Tags shall indicate:
 - (a) Product
 - (b) System #
 - (c) Date installed
 - (d) Installed by: (name and phone number of subcontractor)
 - (e) Re-penetrated by & Date
 - .2 Tags shall state:
 - (a) CAUTION! FIRESTOP - DO NOT REMOVE, PUNCTURE OR DISCONTINUE UNLESS PREPARED TO RE-SEAL IMMEDIATELY WITH SPECIFIED PRODUCT
- .4 Comply with manufacturer's instructions for installation of through-penetration joint materials.

- .5 Where possible, use metal sleeves for floor penetrations to prevent/mitigate the consequences of leakage or flooding.
- .6 Perform under this section patching and repairing of firestop caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.4 DUCTWORK AND ACCESSORIES

- .1 Fabricate ductwork in accordance with:
 - .1 SMACNA Duct Construction Standards – metal and flexible
 - .2 NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems
 - .3 NFPA 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems
 - .4 NFPA 96 – Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 Prior to fabrication of ductwork, check all ceiling spaces and heights and conflicts with other trades.
- .3 Duct sizes indicated are inside clear dimensions. For acoustically lined or internally insulated ducts allow for insulation thickness and maintain interior clear dimensions indicated.
- .4 Provide fire dampers where ducts cross fire separations. Fire dampers shall be ULC listed and “dynamic”; rated to close under airflow. Refer to architectural drawings for fire separation ratings and locations.
- .5 Provide balancing dampers were indicated on drawings and at points on low pressure supply, return and exhaust ducts where branches are taken from larger ducts.
- .6 Size round ducts, installed in place of rectangular ducts, from ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by permission from the departmental representative.
- .7 Exposed round ductwork to be spiral lock seam type only.
- .8 Provide duct hangers and supports in accordance with SMACNA manuals.
- .9 Confirm the existing base building standards prior to submitting tender.
- .10 Ductwork shall be galvanized steel unless noted otherwise.
- .11 Duct support shall be:
 - .1 Up to 750mm duct size: angle size 25x25x3 mm with 6mm rod size
 - .2 751 to 1050mm duct size: angle size 40x40x3 mm with 6mm rod size
 - .3 1051 to 1500mm duct size: angle size 40x40x3 mm with 10mm rod size
 - .4 1501 to 2100mm duct size: angle size 50x50x3 mm with 10mm rod size
 - .5 2101 to 2400mm duct size: angle size 50x50x5 mm with 10mm rod size
 - .6 2401 and over duct size: angle size 50x50x6 mm with 10mm rod size
- .12 Upper hanger attachments shall be:
 - .1 For concrete: manufactured concrete inserts.

3.5 DUCT INSULATION MINIMUM THICKNESS TABLE (CLIMATIC ZONE 5)

Rigid Exterior Duct Insulation				
Duty	Plenum(4)	Duct Location		
		Interior		Exterior
		Conditioned Space	Unconditioned Space	
Minimum Insulation Thickness in mm (in.)				
Cooling Only Air Supply	25 (1")	25 (1")	25 (1")	125 (5")
Heating or H/C Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	125 (5")
Outdoor Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	0
Combustion Air	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	0
Return Air	25 (1")	0	25 (1")	125 (5")
Exhaust Air (1)(2)	25 (1")	0	25 (1")	25 (1")
Grease Hood Exhaust (5)	N/A	38 (1-1/2")	38 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	25 (1")	125 (5")
Mixed Air (3)	20 (3/4")	20 (3/4")	20 (3/4")	125 (5")
See note (3) for internal duct liner				

Flexible Exterior Duct Insulation				
Duty	Plenum(4)	Duct Location		
		Interior		Exterior
		Conditioned Space	Unconditioned Space	
Minimum Insulation Thickness mm (in.)				
Cooling Only Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	188 (7-1/2")
Heating or H/C Air Supply	50 (2")	50 (2")	50 (2")	188 (7-1/2")
Outdoor Air Supply	50 (2")	50 (2")	50 (2")	0
Combustion Air	50 (2")	50 (2")	50 (2")	0
Return Air	38 (1-1/2")	0	38 (1-1/2")	188 (7-1/2")
Exhaust Air (1)(2)	38 (1-1/2")	0	38 (1-1/2")	38 (1-1/2")
Grease Hood Exhaust (5)	N/A	38 (1-1/2")	38 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	38 (1-1/2")	188 (7-1/2")
Mixed Air (3)	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	188 (7-1/2")
See note (3) for internal duct liner				

Note (1): Air temperatures 15°C to 49°C (60°F to 120°F)

Note (2): Provide 40mm (1-1/2") flexible insulation on all exhaust air ductwork from outside wall or roof to damper but a minimum of 1.5 m (5 ft.) inside building.

Note (3): Where an internal duct liner is used, the thickness shall be selected to match the RSI value specified for external insulation. Internal acoustic duct liner shall be a minimum 25mm (1") where external insulation is not required.

Note (4): Plenums located outside the building shall be insulated to the values listed in the exterior column.

Note (5): Provides 1 hour fire rating. Thickness shall be doubled for 2 hour applications

Note (6): Factory installed ductwork and plenums provided with equipment need not comply with this table provided they meet the requirements of the relevant CSA Standard for that equipment and is insulated to RSI 0.58 (R3.3) or greater. Refer to NECB article 5.2.12.1 for relevant CSA Standards.

3.6 DUCT FINISHES TABLE

.1 Conform to the following:

Duty	Rectangular Duct		Round Duct	
	Type	TIAC Code	Type	TIAC Code
Indoor exposed in mechanical room and elsewhere except utility areas	Canvas Jacket	CRF/1	Canvas Jacket	CRD/1
Indoor exposed in mechanical room and elsewhere except utility areas	Canvas Jacket	CRF/1	Canvas Jacket	CRD/1
Outdoor exposed to precipitation Indoor exposed in utility areas, parkade, etc.	Aluminum Jacket Utility Finish	CRF/3CRF/2	Aluminum Jacket Utility Finish	CRD/3CRD/2
Outdoor exposed to precipitation	Aluminum Jacket	CRF/3	Aluminum Jacket	CRD/3

3.7 SEISMIC CABLE RESTRAINTS

- .1 Cables must not be allowed to bend across sharp edges.
- .2 Cable assemblies shall suit installation type:
 - .1 Ceiling and at the clevis bolt
 - .2 Between the hanger rod nut and the clevis
 - .3 Clamped to a beam

3.8 VIBRATION ISOLATION

- .1 Spring Hangers
 - .1 Locate isolation hangers as near to the overhead support structure as possible.
 - .2 Installation shall permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
 - .3 All discharge ductwork runs for a distance of 15m (50') from the connected equipment shall be isolated from the building structure by means of spring hangers. Spring deflection shall be a minimum of 19mm (0.75").
- .2 Minimum Static Deflection Schedule

Equipment	Equipment Supported By:	
	Slab on Grade	Elevated Slab
Fans, Blowers & Packaged H & V Units:		
Under 0.5 HP	1mm (1/16")	1mm (1/16")
0.5 HP to 7.5 HP	25mm (1")	25mm (1")

- .3 Notes:
- .1 Table indicates required static deflection of isolators for all fans regardless of power rating and for all other motor driven equipment over 0.37kW (0.5 HP).
 - .2 Advise departmental representative of equipment not contained in this table and obtain clarification as to the isolation performance requirements.
 - .3 Steel spring isolators shall be used for all deflections 12mm ($\frac{1}{2}$ ") and over.
 - .4 Neoprene isolators shall be used for deflections 6mm ($\frac{1}{4}$ ") and under.
 - .5 Use housed spring isolators for heat pump.
- .4 Unit is to be installed as per attached detail and manufacturers recommendations.

END OF SECTION

PART 1 GENERAL

1.1 SECTION SCOPE

- .1 Provide a complete system of automatic controls to match the base building standard with regard to control devices, components, wiring and materials. All control work associated with the work of Division 23.

1.2 RELATED REQUIREMENTS

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts. For general conditions, refer to Section 23 05 02 Heating, Ventilation, and Air Conditioning.

1.3 CODE COMPLIANCE

- .1 All work shall comply with current editions of the National, Provincial and Municipal Building and Plumbing Codes, Standards, Acts and Bylaws and will meet the requirements of the Authority having jurisdiction.

1.4 ACCEPTABLE CONTRACTORS

- .1 All controls work is to be done by the base building contractor.

1.5 EXAMINATION OF EXISTING SYSTEM

- .1 This project involves renovation to an existing control system. The contractor shall inspect the system prior to tender close and include in his bid all control components required to provide a fully operational system including replacement of existing defective components where noted in the project documents.

1.6 DESIGN REQUIREMENTS

- .1 Design and provide conduit and wiring linking elements of system to the existing building Energy Monitoring and Control System (EMCS).
- .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by departmental representative prior to installation.
- .3 Provide all control system components to make a complete and operable system, except those supplied as part of packaged equipment controls, but including all auto-sequencing devices and electrical interlocks required to accomplish the sequences specified hereafter. Refer to the electrical equipment schedule, the electrical drawings, and the electrical specification, which describes the limits of the extent to the work in Division 26 serving mechanical systems. Materials, equipment, connections, and power not provided by Division 26 but required for the Control System shall be provided under this section.

PART 2 PRODUCTS

2.1 THERMOSTATS

- .1 Provide new thermostats where indicated of building standard type. Ensure operating characteristics are compatible with control components (i.e. direct/reverse acting).

- .2 All thermostats to be located in the electrical room [located per the drawings] unless specifically noted otherwise.
- .3 All thermostats, existing and new, are to be calibrated prior to air balancing. Contact building owner if an existing thermostat needs replacing.

2.2 CONTROL COMPONENTS

- .1 Provide control valves and damper actuators as required to meet the sequence of operation and meet the design intent. Valves and actuators shall match the base building standard unless noted otherwise.
- .2 Control valves for new mechanical equipment shall be provided by Controls Contractor for installation by the Mechanical Contractor.
- .3 Where existing devices are re-used, verify operation, and re-calibrate as required.
- .4 Verify correct operation of controlled devices including existing motorized damper actuators, etc. within the area of renovation.
- .5 Actuators to be compatible with base building standard unless noted otherwise. New control actuator operation to be compatible with existing.
- .6 Report any existing control device, which need replacement. Replacement will be by building management or via change order, at the discretion of the owner.

PART 3 EXECUTION

3.1 SEQUENCE OF OPERATION

- .1 Outdoor air temperature less than 24°C (77F) and Air temperature at UPS air intake greater than 21°C (70F) RH less than 75% - EF1 on minimum, Fan speed to modulate based on air temperature between 21°C and 25°C
- .2 Outdoor air temperature less than 24°C(75F) and exhaust air greater than 25°C (+/-2°) RH less than 75% EF1 100%
- .3 Air temperature at UPS air intake greater than 21°C (70F), with RH greater than 80% - AC on – EF 1 off

Outdoor air temperature greater than 24°C(75F) and Air temperature at UPS air intake greater than 21°C (+/-2°) (68F) AC on EF 1 off.

- .4 Air temperature at UPS air intake greater than 26°C (79F) AC on and EF-1 on 100% (Indicated AC cannot keep up with load alone)
- .5 Air temperature at UPS air intake less than 20°C (68F) EF-1 off AC off
- .6 Final control temperatures to be adjusted to actual site conditions and the control point temperatures specified by the vendor for the final equipment selections

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.
 - .2 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.2 DEFINITIONS

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

1.3 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for review single line electrical diagrams under plexiglass and locate as indicated.
 - .1 Electrical distribution system in Main Electrical Room.
- .3 Shop drawings:
 - .1 Submit drawings stamped and signed by professional departmental representative registered or licensed in Province of BC, Canada.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure coordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.

- .5 Submit copies of 600 x 600 mm minimum size drawings and product data to authority having jurisdiction.
- .6 If changes are required, notify Departmental representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00 - Quality Control. Provide CSA certified equipment and material.
 - .1 Where CSA certified material is not available, submit such material to authority having jurisdiction for special approval before delivery to site.
 - .2 Submit test results of installed electrical systems and instrumentation.
 - .3 Permits and fees: in accordance with General Conditions of contract.
 - .4 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental representative.
- .5 Manufacturer's Field Reports: submit to Departmental representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.5 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid "FSR-A" Contractor license or apprentices in accordance per the conditions of Provincial Act respecting manpower vocational training and qualification.
- .3 Site Meetings:
 - .1 In accordance with Section 01 32 17 - Construction Progress Schedule - Bar (GANTT) Charts.
 - .2 Site Meetings: as part of Manufacturer's Field Services described in Part 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.
- .4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental representative with schedule within 2 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.7 SYSTEM STARTUP

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

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

1.8 OPERATING INSTRUCTIONS

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

1.9 RECORD DRAWINGS

- .1 In addition to requirements for record drawings noted in Section 01 78 00 - Closeout Submittal, the following shall also be completed as per 01 78 00 - 1.4.3:
 - .1 Complete, detailed single line, three line and wiring diagrams for all new equipment installed as part of this project including: protection relays and controls; primary voltage switching devices and internal control wiring; interface to existing systems.
 - .2 Review and document existing systems providing detailed single line, three line and wiring diagrams for the following: 600V main distribution protection, metering and connections including documentation of single-phase protection scheme; metering arrangements and devices.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.

- .3 Factory assemble control panels and component assemblies. Contractor shall use products of one manufacturer to match existing, including classification, unless otherwise specified.
- .4 Unless otherwise specified, Contractor shall comply with manufacturer's latest printed instructions for materials and installation methods.
- .5 Contractor shall deliver, store and maintain materials with manufacturer's seals and labels intact.
- .6 Contractor shall not store materials on site without DFO RPSS Site Authority approval.
- .7 SSC and PWGSC accepts no responsibility for Contractor materials or equipment stored on site.
- .8 Contractor shall supply shop drawings and manufacturer's instructions and specifications on all new installations for inclusion in the building inventory.
- .9 Where the contractor supplies equipment purchased from a contractor manufacturer, the Contractor shall obtain from the Manufacturer the normal warranty period and such warranty shall be made out to Her Majesty the Queen in right of Canada.

2.2 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of inspection authorities.
- .2 Decal signs, minimum size 175 x 250 mm.

2.3 WIRING TERMINATIONS

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

2.4 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: lamicooid 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core.
 - .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters
- .2 Labels: embossed plastic labels with 6mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

2.5 WIRING IDENTIFICATION

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

2.6 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
250V regular	Yellow	
250V UPS	Yellow	Orange
250V Emergency	Yellow	Red
600V Regular	Yellow	Green
600V UPS	Yellow/Green	Orange
600V Emergency	Yellow/Green	Red
5kV	Yellow	Blue
25kV	Yellow	Black
Ground	Green	
Telephone	Green	Black
Data	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other security	Red	Black
DDC	Orange	

2.7 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment light gray to EEMAC 2Y-1.
 - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

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

3.3 CONDUIT AND CABLE INSTALLATION

- .1 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .2 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

3.5 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.6 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems.
 - .5 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental representative.

- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.7 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies materials and installation for seismic restraint systems for electrical installations.

1.2 REGULATORY REQUIREMENTS

- .1 Restraints shall meet the requirements of the latest edition of the British Columbia Building Code and amendments.
- .2 The Seismic Engineer shall be able to provide a proof of professional insurance and the related practice credentials upon request, with a commitment to notify the Engineer of Record if there is any change to insurance.
- .3 The Seismic Engineer shall be familiar with SMACNA, ECABC & NFPA guidelines as well as the BC Building Code requirements.
- .4 The Contractors Seismic Engineer shall submit original signed BC Building Code "Letters of Assurance" "Schedules S-B and S-C" to the Electrical Consultant.
- .5 The above requirements shall not restrict or supplant the requirements of any local bylaws, codes, or other certified agencies which may have jurisdiction over all or part of the installation.

1.3 SCOPE

- .1 It is the responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
- .2 Manufacturer's shop drawings to be submitted with seismic information on equipment structure, bracing and internal components and as required by Division 01.
- .3 Provide restraint on all equipment and machinery, which is part of the building electrical services and systems, to prevent injury or hazard to persons and equipment in and around the structure. Restrain all such equipment in its normal position in the event of an earthquake.
- .4 The total electrical seismic restraint design and field review and inspection will be by a B.C. registered professional structural engineer who specializes in the restraint of building elements. Contractor to allow for coordination, provision of seismic restraints, as well as all costs for the services of the Seismic Restraint Engineer. This Engineer, herein referred to as the Seismic Engineer, will provide normal engineering functions as they pertain to seismic restraint of electrical installations.
- .5 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the project. Make proper allowance for such conditions in the tender.
- .6 The Seismic Engineer shall provide detailed seismic restraint installation shop drawings to the Contractor. Copies of the shop drawings to be included in the final project manual.

- .7 Provide seismic restraints on all equipment, and/or installations or assemblies, which are suspended, pendant, shelf mounted, freestanding and/or bolted to the building structure or support slabs.
- .8 The Seismic Engineer shall provide inspections during and after installation. The Contractor shall correct any deficiencies noted without additional cost to the contract.
- .9 Include all costs associated with the Seismic installation and certification in the base tender.

1.4 SHOP DRAWINGS & SUBMITTALS

- .1 Submit shop drawings of all seismic restraint systems including details of attachment to the structure, either tested in an independent testing laboratory or approved by the seismic Engineer.
- .2 Submit all the proposed types and locations of inserts or connection points to the building structure or support slabs. Follow the directions and recommendations of the Seismic Engineer.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 GENERAL

- .1 All seismic restraints systems shall conform to local authority having jurisdiction and all applicable code requirements.

3.2 CONDUITS

- .1 Provide restraint installation information and details on conduit and equipment as indicated below:
- .2 Vertical Conduit:
 - .1 Attachment - Secure vertical conduit at sufficiently close intervals to keep the conduit in alignment and carry the weight of the conduits and wiring. Stacks shall be supported at their bases and, if over 2 stories in height, at each floor by approved metal floor clamps.
 - .2 At vertical conduit risers, wherever possible, support the weight of the riser, at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2 m [30 ft] o.c.
 - .3 Riser joints shall be braced or stabilized between floors.
- .3 Horizontal Conduits:
 - .1 Supports - Horizontal conduit shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
 - .2 EMT tubing - tubing shall be supported at approximately 1.2 m [4 ft] intervals for tubing.

- .4 Provide transverse bracing at 12.2 m [40 ft] intervals maximum unless otherwise noted. Provide bracing at all 90° bend assemblies, and pull box locations.
- .5 Provide longitudinal bracing at 24.4 m [80 ft] intervals maximum unless otherwise noted.
- .6 Do not brace conduit runs against each other. Use separate support and restraint system.
- .7 Support all conduits in accordance with the capability of the pipe to resist seismic load requirements indicated.
- .8 Trapeze hangers may be used. Provide flexible conduit connections where conduits pass through building seismic or expansion joints, or where rigidly supported conduits connect to equipment with vibration or seismic isolators.
- .9 A conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
- .10 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with firestopping where required.
- .11 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings. Review with seismic Engineer and submit shop drawings to Departmental Consultants for their reference.

3.3 FLOOR MOUNTED EQUIPMENT

- .1 Bolt all equipment, e.g. modular UPS and battery cabinets to the structure. Design anchors and bolts for seismic force applied horizontally through the center of gravity to a seismic force of 0.5g. For equipment which may be subject to resonances, use a nominal 1.0 g seismic force.
- .2 Provide flexible conduit connections between floor mounted equipment to be restrained and its adjacent associated electrical equipment.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section includes materials and installation for tested firestopping systems as follows:
 - .1 Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated separations.

1.2 REFERENCES

- .1 Test Requirements: CAN/ULC-S115-05, "Fire Tests of Fire Stop Systems"

1.3 QUALITY ASSURANCE

- .1 Contractor's certified installer, or manufacturer's direct installation trainer to assist with initial installation of firestop systems to ensure appropriate contractor system selection and installation procedures.
- .2 Firestop System application, products and installation must meet requirements of a listed system in accordance with CAN/ULC-S115, tested to provide the appropriate fire (and temperature if applicable) rating for the penetrated assembly. Systems may be approved by any Standards Council of Canada approved testing agency.

1.4 SUBMITTALS

- .1 Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of ULC or cUL firestop systems to be used and manufacturer's installation instructions to comply with Section 01 33 00.
- .2 Submit material safety data sheets provided with product delivered to job-site.

1.5 INSTALLER QUALIFICATIONS

- .1 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary training to select and install manufacture's products per applicable requirements. A supplier's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer. Qualification should consist of training, successful completion of testing based on the Firestopping Contractors International Association Manual of Practice, and continuing education.
- .2 The work is to be installed by a contractor with at least one of the following qualifications:
 - .1 ULC Qualified Firestop Contractor
 - .2 Hilti Accredited Fire Stop Specialty Contractor
 - .3 Nuco Accredited Fire Stop Installer
 - .4 Other approved manufacturer qualification program

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and ULC or cUL label where applicable.
- .2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- .3 Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- .4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- .5 Do not use damaged or expired materials.

1.7 PROJECT CONDITIONS

- .1 Do not use materials that contain flammable solvents.
- .2 Scheduling
 - .1 Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
 - .2 Schedule installation of Drop-In firestop devices after placement of concrete but before installation of the pipe penetration. Diameter of sleeved or cored hole to match the listed system for the device
 - .3 Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- .3 Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- .4 Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- .5 During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

Part 2 Products

2.1 FIRESTOPPING, GENERAL

- .1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- .2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

- .3 For penetrations that are anticipated to be re-used (communication cable-trays, riser shaft sleeves, etc.), use a firestopping system that is re-enterable without the use of additional materials or detailed knowledge of the system (EZ-Path, Flamestopper, Speedsleeve or equivalent).

2.2 MATERIALS

- .1 Use only firestop products that have been tested and approved for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- .2 Provide Departmental Representative with ULC listed system approved for fire stopping prior to fire stopping penetrations.

Part 3 Execution

3.1 PREPARATION

- .1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - .1 Verify penetrations are properly sized and in suitable condition for application of materials.
 - .2 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
 - .3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
 - .4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
 - .5 Do not proceed until unsatisfactory conditions have been corrected.

3.2 COORDINATION

- .1 Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
- .2 Responsible trade is to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interference.

3.3 INSTALLATION

- .1 Regulatory Requirements: Install firestop materials in accordance with ULC Fire Resistance Directory or equivalent.
- .2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.
 - .1 Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
 - .2 Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of ULC firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 - .3 Protect materials from damage on surfaces subjected to traffic.

3.4 FIELD QUALITY CONTROL

- .1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- .2 Keep areas of work accessible until inspection by authority having jurisdiction.
- .3 Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" or other recognized standard.
- .4 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.5 IDENTIFICATION

- .1 Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
 - .1 The words: "Warning -Through Penetration Firestop System-Do Not Disturb. Notify Building Management of Any Damage."
 - .2 Contractor's Name, address, and phone number.
 - .3 Through-Penetration firestop system designation of applicable testing and inspecting agency.
 - .4 Date of Installation.
 - .5 Through-Penetration firestop system manufacturer's name.
 - .6 Installer's Name.

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

- .1 Remove all redundant or abandoned electrical equipment, devices, wiring, cabling, raceways, wireways at associated devices serving the existing UPS system as noted on drawings. This shall include all wiring outside the area of work that serves the UPS room, except breakers that become surplus in existing panels. These breakers shall be labeled as spares, unless specifically stated to be reused.
- .2 The Electrical Division shall take note that the demolition will be done in an occupied building that is normally occupied during the day. Maintain electrical and as required to minimize services disruption.
- .3 The Electrical Division shall also take note of the dust containment requirements as outlined in the front end specification.
- .4 Any discrepancies appearing on the drawings or in this specification are to be brought to the attention of the Departmental Representative who will provide instruction.
- .5 Where devices are not shown on the new plans in walls that are not being removed, such devices are to be reinstated and remain.
- .6 **All** existing branch circuits for **existing panelboards** designated “**existing circuit**” as noted in Panelboard Schedules in specifications are to be tested and traced to source/termination point to confirm circuit is currently in use and in operation. **All existing unused redundant branch circuits wiring shall be completely removed and the related breakers labelled as “spare”**. Provide upgraded typed panel directories to the satisfaction of the Departmental Representative.
- .7 **All** existing branch circuits re-connected to **new panelboards** designated “**Reconnected Exist. Re-Used Circuit**”, as noted in panelboard schedules in specifications, are to be tested and traced to source/termination point to confirm circuit is currently in use and in operation. **All** existing unused redundant or abandoned branch circuits wiring, outlets, and devices shall be completely removed, and the associated breakers are to be re-labelled as “**spares**”.
- .8 All surplus electrical equipment, devices, and luminaires shall be considered Owner’s property. Determine from the Departmental Representative which materials are required to be retained, and transport and store such items at a location as directed by the Departmental Representative. All other surplus materials such as conduit, wiring, devices, etc. shall be removed from the site. Request a signed receipt for surplus material turned over to the Owner and provide a copy of same to Departmental Representative.
- .9 Continuity of power and communication shall be maintained or restored promptly where services to other portions of a site are affected by renovation or demolition that is outlined on the architectural, structural, mechanical or electrical plans or specifications.

- .10 Test all concrete slabs requiring cutting or coring by **x-ray testing** and opening a small sample area to obtain the depth of conduit runs. Avoid excessive cutting of slabs to depths that may interfere with existing conduits that are to be retained. Repair all damaged conduits and wiring that are to be retained. Allow for such repair in tender sum. The Departmental Representative may consider an extra if an unexpected large number of conduits are unavoidably damaged.
- .11 When any cutting of walls, ceiling, or floor in electrical rooms is part of the contract **all** electrical equipment shall be sealed from dust. At completion of work the room and all electrical components shall be fully vacuumed out, except primary voltage gear (exceeding 750 volts). Primary gear shall be cleaned out if the project requires that the gear be de-energized. At time of cleaning, a visual check shall be made of all terminations, and any discoloring brought to the attention of the Departmental Representative.

1.2 RELATED SECTIONS

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

1.3 SUSTAINABLE REQUIREMENTS

- .1 Materials and products in accordance with Division 01 Sustainable Requirements: Construction.
- .2 Do verification requirements in accordance with Division 01 Sustainable Requirements: Contractor's Verification.

1.4 COMPLETENESS

- .1 The electrical installation and reinstallation shall be carried out to present codes and to at least as good a workmanship level as the original.
- .2 Test the completed installation to ensure all aspects are fully functional. Unless noted in writing to the Departmental Representative before the work is commenced, all systems are assumed to function fully and correctly and must do so at completion of contract.

1.5 ASBESTOS

- .1 It is understood that this site is asbestos free. If during renovations / demolition, asbestos is discovered (or material suspected to be asbestos), all work in that area shall immediately cease and the General Contractor advised. The General Contractor shall take appropriate action without delay to verify presence of friable asbestos and shall be responsible for the removal of all friable asbestos.

Part 2 Products

2.1 STANDARDS

- .1 Refer to applicable material standards in other specification sections and/or as detailed on drawings.

Part 3 Execution

3.1 DEMOLITION

- .1 Demolition shall be carried out in strict conformance to provincial, local and municipal authorities and Part 8 of the BC Building Code current edition.
- .2 All redundant electrical components in the areas of demolition excluding those specifically identified in the following clauses shall become the property of the Electrical Division and shall be removed from site.

3.2 DISRUPTION TO OPERATIONS

- .1 Contractor to issue a scheduled shutdown time and coordinate installation of the new equipment as appropriate. All equipment installed and modified requires testing before startup.
- .2 Contractor to provide temporary connections to all required equipment for temporary power during the installation of any new equipment.

3.3 INTERRUPTION TO EXISTING SERVICES

- .1 Circuit: power, voice/data, fire alarm, control etc. which are disrupted during demolition and are essential, shall be made good immediately. All such activities shall be coordinated with Department Representative prior to commencing work. The Electrical Contractor shall identify these circuits to the Departmental Representative. Specific tasks involving the demolition of essential circuits will require that the contractor obtain permission from the Departmental Representative before proceeding.
- .2 Circuits disrupted by floor cutting or drilling (ie. buried cables) to be brought to the attention of the Departmental Representative. Obvious systems disturbed because due care and attention was not followed, shall be repaired immediately at no additional cost to owner.
- .3 Where interruption of existing services is necessary as a part of the renovation, contractor must coordinate timing with base building maintenance 10 working days prior to interruption.

3.4 ABANDONED SERVICES

- .1 All abandoned conduit and wire shall be removed and disposed of by the Electrical Contractor.
- .2 Remove all accessible (eg. Surface) wiring and cables back to source.
- .3 All remaining circuits to be rerouted as required and suitably secured to the building structure.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies the materials and installation for wire and box connectors, rated to 1000V.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2No.18 latest edition, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .2 CSA C22.2No.65 latest edition, Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2, latest edition, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper alloy sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper alloy sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for stranded copper conductors.
 - .2 Clamp for stranded copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, flexible conduit as required to: CAN/CSA-C22.2No.18.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws [with appropriate compression tool recommended by manufacturer]. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
 - .3 Install fixture type connectors and tighten. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies copper, ACM alloy and aluminum conductors rated 0-1000 Volts and the most common electrical insulation and covering materials.
- .2 This section does not include fire rated building wire to ULC S139 and CSA C83, marine, hazardous, mining, instrumentation, communication and fire alarm wiring.

1.2 REFERENCES

- .1 CSA C22.2 No .0.3 latest edition, Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 131 latest edition, Type TECK 90 Cable.

1.3 GENERAL REQUIREMENTS

- .1 Typically use insulated 98% conductivity copper conductor wiring enclosed in EMT (steel) conduit for the general wiring systems unless otherwise indicated.
- .2 Aluminium conductors NOT permitted.
- .3 Teck cable may only be used where specifically indicated on the drawings or in the specifications. Where permitted, Teck wiring up to 750 system volts to be PVC jacketed armoured cable, multi-copper conductor type Teck90 1000 volt having a PVC jacket with FT-4 flame spread rating.
- .4 Flexible AC90 armoured cabling (BX) shall not be used.
- .5 Non-metallic sheathed wiring is not to be used on this project.
- .6 All wiring supplying power to the emergency power distribution system (including generator feeder to ATS, normal feeder to ATS and all downstream feeders) must be minimum 1hr rated in all buildings and 2hr rated when classified as High Building under VBBL, BCBC or the code consultant report.

Part 2 Products

2.1 WIRE AND CABLE GENERAL

- .1 Conductors: stranded for 10 AWG and larger. Minimum size #12 AWG.
- .2 Insulation to be 600 volt RW90XLPE (X link) for the general building wiring in conduit.
- .3 Main feeders to be conduit and copper insulated wiring unless otherwise noted on drawings. Provide ground wiring for all conduits. Increase conduit size as required.
- .4 Conductors to be colour-coded. Conductors No.10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No.8 gauge and larger may be colour-coded with adhesive colour coding tape, but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible. Where colour-coding tape is utilized, it shall be applied for a minimum of 50 mm at terminations, junctions and pullboxes and conduit fittings. Conductors not to be painted.

2.2 TECK CABLE

- .1 Teck cable shall be used only when specifically noted on drawings.
- .2 Cable: to CAN/CSA-C22.2 No. 131 (latest edition).
- .3 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .4 Insulation:
 - .1 Type: ethylene propylene rubber.
 - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.
- .5 Inner jacket: polyvinyl chloride material.
- .6 Armour: interlocking galvanized steel or aluminum.
- .7 Overall covering: thermoplastic polyvinyl chloride material.
- .8 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 1000 mm centers.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .9 Connectors:
 - .1 Approved for TECK cable.

2.3 CONTROL CABLES

- .1 Type LVT: 2 soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket.
- .2 Low energy 300 V control cable: solid annealed copper conductors sized as indicated, with TWH over each conductor and overall covering of PVC jacket.

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34.
 - .2 In wireways and auxiliary gutters in accordance with Section 26 05 37.
 - .3 All wires are to be pulled in together in a common raceway, using liberal amounts of Compound 77 lubricant.
 - .4 No combining of circuits onto common neutral will be permitted. Use 2 pole or 3 pole breakers for combined circuits, no connector clips will be allowed.

3.2 INSTALLATION OF TECK CABLE 0 -1000 V

- .1 Install cables.
 - .1 Group cables wherever possible on channels.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

3.3 INSTALLATION OF CONTROL CABLES

- .1 Control cable and conduit will be supplied and installed by the Electrical Contractor in per with the UPS supplier requirements.
- .2 Ground control cable shield.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies the materials and installation for grounding electrical systems rated 750V or less.

1.2 REFERENCES

- .1 ANSI/IEEE 837- 2004 – Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA C22.2 No. 41 - 2007 – Grounding and Bonding Equipment.

Part 2 Products

2.1 EQUIPMENT

- .1 Insulated grounding conductors: green, copper conductors, sized as per C.E.C.
- .2 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 Bonding jumpers, straps.
 - .5 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install connectors in accordance with manufacturer's instructions.
- .2 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .3 Soldered joints not permitted.
- .4 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .5 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .6 Bond single conductor, metallic armoured cables to cabinet at supply end and load end.

3.2 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of secondary system.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections from service entrance ground bus to equipment ground bus in all equipment including but not limited to the: modular UPS, UPS battery cabinet and bypass cabinet.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies U shape support channels either surface mounted or suspended.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41mm, 2.5mm thick, surface mounted or suspended.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to surfaces with lead anchors or nylon shields as required.
- .2 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .3 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 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.
- .6 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface mounting of two or more conduits use channels at 1.5m on centre spacing.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

- .11 Do not use supports or equipment installed for other trades for conduit or cable support except.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies rigid and flexible fasteners, fittings and installation.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES – GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped. Do not use sectional boxes.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi-gang device boxes for flush installation, minimum size 76 x 51 x 38 mm or as indicated.
- .2 Larger 102 mm square x 54mm deep outlet boxes to be used for single gang when more than one conduit enters one side, for telecommunication outlets (for slack storage), or for flush mounting devices in finished plaster and/or tile walls. Provide raised device covers as required.

2.3 SURFACE CONDUIT BOXES

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

2.4 FITTINGS – GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of foreign materials.
- .3 Conduit outlet bodies for conduit up to 35 mm. Use pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

- .1 Typical outlet box mounting heights are indicated in Section 26 05 00 or refer to wiring device and communication specification sections and to architectural layouts for particular mounting heights of outlet boxes where indicated.
- .2 Support boxes independently of connecting conduits.
- .3 Ceiling outlet boxes to be provided for each surface mounted fixture or row of fixtures installed in other than T bar ceilings with removable tiles.
- .4 Fill open boxes with paper, sponges, foam or similar approved material to prevent entry of construction material. Remove upon completion of work.

- .5 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .6 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not to be used.
- .7 All outlet boxes to be flush mounted in all areas, excluding mechanical rooms, electrical rooms, and above removable ceilings.
- .8 Adjust position of outlets in finished masonry walls to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes. All cutting of masonry work for installation of electrical fittings to be done using rotary cutting equipment.
- .9 No sectional or handy boxes to be installed.
- .10 Provide vapour barrier wrap or boots behind outlets mounted in exterior walls. Maintain integrity of the vapour barrier and insulation to prevent condensation through boxes.
- .11 Coordinate location and mounting heights of outlets above counters, benches, splash-backs and with respect to heating units and plumbing fixtures. Coordinate with architectural details.
- .12 Outlets installed back to back in party stud walls to be off-set by one stud space.
- .13 Back-boxes for all communications systems equipment to be provided in accordance with specific manufacturer's recommendations and as specified in the communications sections of these specifications.
- .14 Separate outlets located immediately alongside one another to be mounted at exactly the same height above finished floor. Similarly, outlets mounted on a wall in the same general location at varying heights to be on the same vertical centre-line unless otherwise noted.
- .15 Where outlet boxes penetrate an assembly with a fire-resistance rating (fire separation), ensure that the boxes are externally tightly fitted with an approved non-combustible material to prevent passage of smoke or flame in the event of a fire. Such boxes may not exceed 0.016 mm² per NBCC 3.1.9.2.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies rigid and flexible conduits, fasteners, fittings and installation.

1.2 REFERENCES

- .1 Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware: to CSA C22.2 No. 18.
- .2 Rigid metal conduit (RMC): to CSA C22.2 No. 45.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83.

1.3 BASIC WIRING METHODS

- .1 Partition walls and ceilings:
 - .1 All wiring to be run in EMT conduit for:
 - .1 Branch circuits.
 - .2 Distribution feeders and sub-feeders.
 - .3 Surface wiring in electrical and mechanical rooms.
- .2 Surface raceways - interior:
 - .1 All surface raceways shall be EMT, except if located without protection in areas susceptible to damage, which shall be rigid steel conduit.

1.4 LOCATION

- .1 Electrical drawings are diagrammatic and do not show all conduits, wire, cable, etc. Electrical contractor to provide conduit, wire cable, etc., for a complete operating job to meet in all respects the intent of the drawings and specifications.
- .2 Review the exact location criteria of each electrical outlet and device with the Departmental Representative prior to rough-in. Relocate any item installed without confirmation as required by departmental representative at no cost to the Owner as long as the relocation is within 3m of the location originally shown on the electrical drawings.
- .3 All outlets located on exterior walls to be complete with moulded plastic vapour barriers to maintain integrity of wall vapour barrier system.
- .4 All raceways and wiring shall be installed concealed in building fabric, except for mechanical and electrical rooms where they shall be installed on the surface.
- .5 All outlet boxes, junction boxes, and cabinets to hold electrical devices shall be mounted so the equipment can be flush mounted unless indicated otherwise.
- .6 All junction boxes mounted, out of necessity, on surface of solid walls shall be painted to match adjacent surface, with junction boxes painted to match designated systems.

Part 2 Products

2.1 EMT RACEWAY

- .1 Electrical Metallic Tubing (EMT) shall be galvanized steel of sufficient quality and thickness to allow smooth field formed bends.
- .2 EMT couplings, connectors and fittings shall be steel. Cast type units shall not be used on this installation.

2.2 OUTLET BOXES AND JUNCTION BOXES

- .1 Except as noted for rigid PVC raceways, all outlet boxes and junction boxes shall be one piece formed or welded.
- .2 Outlet boxes to be galvanized steel.
- .3 Junction boxes to be galvanized steel or aluminum.

2.3 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1500mm oc.
- .4 Threaded rods, 6 mm dia., to support suspended channels.

2.4 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT in all exterior applications. Set-screws are not acceptable.

2.5 FISH CORD

- .1 Polypropylene.

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 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .3 Use rigid galvanized steel threaded conduit where specified.
- .4 Use epoxy coated conduit underground corrosive areas.
- .5 Use electrical metallic tubing (EMT) except in cast concrete and above 2.4 m not subject to mechanical injury.
- .6 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .7 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

- .8 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .9 Install fish cord in empty conduits.
- .10 Dry conduits out before installing wire.
- .11 Conduit bends shall be made with no more than 10% flattening of the conduit. Bends shall be smooth throughout deformations.
- .12 On surface wall runs, all conduit shall be installed in true vertical or horizontal direction and on ceilings in true 90 degree angles or parallel to the walls. Crossings of conduits shall also be made at 90 degree angles. Parallel running conduit shall be kept on equal spacing on the entire length of run including bends.
- .13 All conduits shall be fastened to structure with steel straps.
- .14 Where more than three conduits are run parallel in ceiling cavity, they shall be installed on cantruss type channel, complete with all manufacturers fittings to secure channel to structure and to conduit.
- .15 Raceways extending out concrete slabs shall be securely protected using rebar stubs or similar material. All duct stubs are to be kept sealed during construction

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 CONCEALED CONDUITS

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

3.4 FIRESTOPPING

- .1 Apply ULC approved fire stopping assembly to all conduit penetrations passing through fire rated walls and floors.
- .2 Provide shop drawings showing details for each type of application on the project. Shop drawings shall include catalogue data and installation details.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies the installation of direct buried cables and cables in ducts including protection, markers and testing.

1.2 REFERENCES

- .1 Canadian Standards Association, (CSA International)
- .2 Insulated Cable Engineers Association, Inc. (ICEA)

Part 2 Products

- .1 Plastic burial marker tape. 150mm wide, yellow in color indicating "Electrical Line Buried Below – High Voltage".

Part 3 Execution

3.1 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
 - .1 Do not pull spliced cables inside ducts.
- .2 Install multiple cables in duct simultaneously.
- .3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .4 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .5 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.
- .6 After installation of cables, seal duct ends with duct sealing compound.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Perform tests using qualified personnel. Provide 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. Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance tests.
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .6 Acceptance Tests
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .1 Megger test all cables to ensure integrity of the insulation system.

- .7 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This Section specifies standard and custom panelboards and their installation.

1.2 SCOPE OF WORK

- .1 Provide and install new breakers in existing panelboards as indicated on the drawings, single line diagram, panel schedules and these specifications.

- .2 Types of panelboards in this section include the following:

- .1 CDP type Power distribution panelboards.

1.3 PRODUCT INFORMATION

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and cover dimensions.
- .3 Shop drawings to include custom cover to match new breaker assembly and existing enclosure.

1.4 PLANT ASSEMBLY

- .1 In addition to CSA requirements, manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 All new breakers to be of a common manufacturer.
- .3 Panel retrofits shall come complete with CSA (or equivalent accepted mark) to be applied on retrofitted assembly.

1.5 FINISH

- .1 Apply finishes in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Panel finish in electrical and equipment rooms and closets to be standard ASA Grey baked enamel. Confirm with Departmental Representative prior to shop finishing panels.
- .3 Panels in finished and/or public areas to be either as clause .2 above or prepared to accept painting to closely match surroundings as directed by the Architect. In the later instance, the final paint coat to be done by Division 09 but coordinated by the Electrical Division, in particular for protection and masking of locks and sensitive parts. Confirm with Departmental Representative prior to paint finishing panels.

Part 2 Products

2.1 PANELBOARDS, DOORS AND TRIMS

- .1 Panelboards: to CSA C22.2 No. 29 and product of one manufacturer.
- .2 Bus and breakers **unless otherwise indicated on the drawings** and in the specifications, shall be rated for:
 - .1 Minimum 10 kA at 208Y/120V.
 - .2 Minimum 22 kA at 600Y/347V.

- .3 Tin plated copper bus with full size neutral.
- .4 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.
- .5 Mains capacity, number of circuits and number and size of branch circuit breakers as indicated.
- .6 Provide all necessary connectors and mounting hardware in every space to facilitate installation of future breakers. Provide blank fillers for all spaces.
- .7 Concealed hinges and concealed trim mounting screws, hinged locking door with flush catch.
- .8 Panelboards to have flush, locking doors. (Gasketed where required for damp locations).
- .9 Provide two keys for each panelboard and key similar voltage and system panelboards alike.
- .10 Panel tubs to be typically 450 to 600mm wide but suiting existing panels.
- .11 Provide "sprinkler-proof" design in areas where sprinkler fire protection is installed. In any event, all surface mounted enclosures to be complete with sprinkler drip cover.
- .12 Provide door within door trims where indicated to facilitate ease of service maintenance Each tub trim cover to be hinged and self supporting and to swing out to expose breaker cable terminations and wireways. Hinged trim shall be secured with cover screws on opening side by concealed machine screws. Hinged breaker cover shall be recessed into the hinged overall tub cover. Breaker cover shall have latch type closures. Submit details on shop drawings prior to manufacturing.
- .13 CDP type panels or panels with 100 amp or larger breakers shall be complete with integral locking devices on each circuit breaker.

2.2 BREAKERS

- .1 All breakers to be:
 - .1 For Power Distribution Panelboards: Bolt on type molded case, adjustable and interchangeable trip, single, two and three pole, 120/208V or 347/600V and with trip free position separate from "On" or "Off" positions.
- .2 Two and three pole breakers to have common simultaneous trip and able to be located in any circuit position within the panelboard.
- .3 Main breaker (where required) to be separately mounted at top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Provide circuit breakers with indicated trip ratings as shown in the panelboard schedules or the Single Line Diagram.
- .5 Provide spare circuit breakers as indicated on panel schedules or single line diagram as applicable.
- .6 Provide breaker type Ground Fault Interrupter(s) (GFI) as indicated.
- .7 Provide Lock-on devices as indicated and for Fire Alarm circuits, Security Equipment circuits, Exit sign circuits and Emergency Battery Equipment circuits.

2.3 PANELBOARD IDENTIFICATION

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

Part 3 Execution

3.1 INSTALLATION

- .1 Replace breakers as indicated and mount securely, plumb true and square, to existing enclosure.
- .2 Replace feeder conductors as noted in drawings.
- .3 Connect new and existing loads to circuits as indicated. Do not splice conductors in panelboard. Ensure breaker and neutral bus locations suit existing panel and conductor arrangements.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This specification describes the operation and functionality of a continuous duty, three-phase, solid-state, static Uninterruptible Power Supply (UPS) hereafter referred to as the UPS.
- .2 Each UPS system will consist of a series of modules that are assembled in a common frame to provide a total power rating as noted.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI S1.13-1995(R1999) Measurement of Sound Pressure Levels in Air.
 - .2 ANSI S1.4-1983(R2001) with Amd. S1.4A-1995, Specification for Sound Level Meters.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA C813.1-01, Performance Test Method for Uninterruptible Power Supplies.
- .3 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - .1 ANSI/IEEE 519, "Guide for Harmonic Control and Reactive Compensation of Static Power Converters" (copyrighted by IEEE, ANSI-approved).

1.3 GENERAL DESCRIPTION

- .1 Included Features of the UPS:
 - .1 The UPS utilizes double conversion online topology.
 - .2 The UPS features internal static bypass, external maintenance bypass and input power factor correction.
 - .3 The UPS system shall consist of a series of identical, hot swappable UPS modules that sum to the total power rating noted in these documents. These modules will act to provide internal redundancy such that the failure of one UPS module does not compromise the operation of the UPS within the remaining load capability.
 - .4 The system also includes the following features.
 - .1 Field-replaceable battery modules
 - .2 Removable input/output wiring trays
 - .3 Battery disconnects
 - .4 Emergency Power Off (EPO)
 - .5 An integrated UPS Network Management Card 2 with Environmental
- .2 **Performance, Design, and Configurations:** The UPS and associated equipment operates in conjunction with a primary power supply and an output distribution system to provide quality uninterrupted power for electronic equipment load.
 - .1 This specification describes the performance, functionality, and design of the UPS, the external Battery Systems, and connectivity solutions.

- .2 All programming and miscellaneous components for a fully operational system as described in this section are available as part of the UPS.
- .3 This UPS must fit into specific spatial requirements as noted within the contract drawings. Refer to these drawings and site conditions to ensure that the UPS System will fit within the space noted, with all required clearances maintained.

1.4 SYSTEM DESCRIPTION

- .1 Mechanical Design
 - .1 The UPS is to be of a modular, scalable design and N+1 capable.
- .2 System Characteristics
 - .1 System Capacity:
 - .1 120kVA (160kVA) unity power factor 120/208V three phase output.
 - .2 UPS to be modular with 120kVA supplied capacity, upgradable to 160kVA in future by installation of additional modules.
 - .3 Batteries to be supplied for full 160kVA capacity.
 - .2 **Efficiency:** The UPS efficiency shall meet or exceed 94%.
 - .3 Input:
 - .1 AC Input Nominal Voltage:
 - .1 120/208 VAC, three phase, hardwired.
 - .2 AC Input Voltage Window:
 - .1 160 – 280 Vac (any line to line) at full load.
 - .2 100 – 280 Vac (any line to line) at 50% load.
 - .3 **Input Frequency Range:** 45-65 Hz, auto-selecting.
 - .4 **Input Power Factor:** >0.98 lagging @ 100% load
 - .5 Input Current Distortion:
 - .1 Less than 4% at 100% load at nominal voltage.
 - .4 UPS Output:
 - .1 AC Output Nominal Voltage:
 - .2 120/208 V three phase with neutral.
 - .3 Output Connectors:
 - .1 Hardwire: 4-wire (3Ph + N + G)
 - .4 AC output static voltage regulation:
 - .1 +/-1%.
 - .5 AC output dynamic voltage regulation:
 - .1 +/-5%, for 10 to 90% load step at <50 ms recovery time:
 - .6 Output Voltage Harmonic Distortion:
 - .1 <2% THD maximum for a 100% linear load
 - .2 <5% THD maximum for a 100% non-linear load
 - .7 Overload Rating:
 - .1 Normal Operation (Online):
 - .1 150% for 30 seconds

- .2 125% for 1 minute
- .3 105% continuous
- .2 Bypass Operation: Overload is limited by the external input circuit breaker feeding the UPS:
- .8 Output Power Factor Rating:
 - .1 0.8 lagging to 0.8 leading at rated load.
- .9 Output Frequency:
 - .1 50/60 +/- 3Hz (Tracking) or 50/60 +/- 0.1 Hz (free-running) or 50/60 +/- 1 Hz (free-running), user-selectable.

1.5 MODES OF OPERATION

- .1 **Normal:** The UPS output power stage (inverter) constantly recreates the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT switches. In both online operation and battery operation, the output power stage (inverter) creates an output voltage waveform independent of the mains input voltage waveform. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages do not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave of the output power stage (inverter). The input Power Factor Correction (PFC) power stage and the output power stage (inverter) operate in an on-line manner to continuously regulate power to the critical load. The input PFC stage is capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.
 - .1 **Overload Capability:** The output power stage (inverter) is capable of withstanding 150% overload for 30 seconds or 125% overload for 1 minute or 105% overload for an indefinite length of time.
 - .2 **Output Contactor:** The output power stage (inverter) is equipped with an output mechanical relay to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter will be removed from the critical bus.
 - .3 **Battery Protection:** The inverter is provided with monitoring and control circuits to limit the level of discharge on the battery system.
- .2 **Battery:** Upon failure of the AC input source, the critical load continues being supplied by the output inverter, which derives its power from the battery system. There is no interruption in power to the critical load during both transfers to battery operation and retransfers from battery to normal operation. The UPS system consists of user-replaceable, cartridges within each hot-swappable UPS module.
 - .1 The batteries of the UPS models in this specification are maintenance-free, lithium ion type batteries.
 - .2 The batteries shall be flame retardant as per UL 94V2.
 - .3 The UPS shall incorporate a battery monitor system to continuously monitor the health of each battery module. This system shall notify the user in the event that a failed or weak battery module is found.
 - .4 UPS shall be expandable for additional runtime with additional UPS modules. These modules are hot-pluggable, allowing for easy and quick installation or replacement without the need for electrical wiring, electrician services or powering down of the UPS system.

- .5 Batteries shall consist of a minimum of two DC strings.
- .3 **Charging:** Upon restoration of the AC input source, the UPS simultaneously recharges the battery and provides regulated power to the critical load.
 - .1 The intelligent battery management system contains a temperature monitoring circuit and compensation algorithm that regulates the battery charging voltage and current so as to optimize battery life. The UPS shall monitor the temperature of all battery packs and use the highest one as a reference to adjust the battery float voltage.
 - .2 The battery charging circuit remains active when in bypass or online states.
- .4 **Bypass:** During bypass operation the utility power is connected to the load, bypassing the internal converters. The system automatic bypass provides a transfer of the critical load from the Inverter output to the automatic bypass input source during times when the inverter cannot support the load. The UPS constantly monitors the output current, as well as the bypass source voltage, and inhibits potentially unsuccessful transfers to automatic bypass from taking place. The design of the automatic bypass switch power path consists of a heavy-duty electromechanical bypass relay or contactor.
 - .1 **Automatic Transfers:** An automatic transfer of load to bypass takes place if the load on the critical bus exceeds the overload rating of the UPS, if both normal and battery operation modes are unavailable, if the UPS has an internal fault, or if for any reason the UPS cannot support the critical bus. Automatic transfers of the critical load from bypass back to normal operation takes place when the overload condition is removed from the critical bus output of the system or when other causes are corrected. If the bypass mode becomes unavailable, the UPS will automatically switch to mains power. In the event that mains power is unavailable the system will switch to battery power.
 - .2 **Manual Transfers:** Manually initiated transfers to and from bypass may be initiated through the UPS computer interface (via serial or USB communications) or by engaging the bypass switch on the unit.

1.6 INPUT PFC POWER STAGE

- .1 **General:** The input Power Factor Correction (PFC) power stage of the UPS constantly rectifies the power imported from the mains input of the system, converting input mains AC power to DC power for precise regulation of the DC bus voltage, battery charging, and output power stage (inverter) regulated output power
- .2 Input Current Limit:
 - .1 The input converter shall control and limit the input current drawn from the utility supply to 150% of the UPS output.
 - .2 During conditions where input current limit is active, the UPS shall be able to support 100% load, charge batteries at 10% of the UPS output rating, and provide voltage regulation with mains deviation of up to +/-20% of the nominal input voltage.
 - .3 In cases where the source voltage to the UPS is nominal and the applied UPS load is equal to or less than 100% of UPS capacity, input current shall not exceed 130% of UPS output current, while providing full battery recharge power and importing necessary power for system losses.

- .3 Charging:
 - .1 The battery charging circuit contains a temperature monitoring circuit, which regulates the battery charging current to optimize battery life.
 - .2 The battery charging circuit remains active when the UPS is in automatic bypass and in normal operation.

1.7 OUTPUT POWER STAGE (INVERTER)

- .1 **General:** The UPS output power stage (inverter) constantly recreates the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT-driven power converters. In both normal operation and battery operation, the output power stage (inverter) creates an output voltage independent of the mains input voltage. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages, shall not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave of the output power stage (inverter).
- .2 **Overload Capability:** The output power stage (inverter) is capable of withstanding 150% overload for 30 seconds or 125% overload for 1 minute or 105% overload for indefinite length of time.
- .3 **Output Contactor:** The output power stage (inverter) is equipped with an output mechanical contactor to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter will be removed from the critical bus.
- .4 **Battery Protection:** The inverter is provided with monitoring and control circuits to limit the level of discharge on the battery system.

1.8 DISPLAY AND CONTROLS

- .1 **Control Logic:** The UPS is controlled by an embedded microcontroller which performs the following functions:
 - .1 Monitoring the quality of the output voltage
 - .2 Monitoring vital parameters of the UPS
 - .3 Intelligent battery management
 - .4 Controlling the input and output power stage
 - .5 Remaining runtime calculation
 - .6 Self-diagnostics, self-test, and proactive fault detection
 - .7 Communication to the host server via a serial port
 - .8 Communication to the Network Management Card
- .2 **Display/Control Unit:** Located on the front of the UPS is a display/control unit.
 - .1 **Control Functions** The following controls functions can be accomplished by use of the pushbutton switches or LCD display:
 - .1 Turn the UPS on
 - .2 Turn the UPS off
 - .3 Initiate a self-test to test the battery condition
 - .4 Silence an audible alarm
 - .5 Cold-start the UPS
 - .6 Display the input RMS voltage
 - .7 **Display Data:** The following indicators are available on the Display/Control Unit:

- .8 The UPS load LED bar
- .9 The UPS is online
- .10 The UPS is on battery
- .11 The UPS is in bypass
- .12 The UPS is overloaded
- .13 The UPS is in fault state
- .14 The battery needs to be replaced
- .15 The battery capacity/utility voltage LED bar
- .3 **Communication Interface:** The following are contained within the UPS for remote communications with a network via web browser or SNMP.
 - .1 An RJ-45 serial interface port.
 - .2 Provide 10m CAT6 armored cable for connection of UPS to nearby data port for remote monitoring.
- .4 **Bypass switch:** On the panel of the UPS there shall be a switch that when engaged forces the UPS into bypass state provided the input voltage and frequency are within acceptable limits.
- .5 **Maintenance Bypass:** Externally mounted, fully rated bypass switch interlocked with UPS for correct operation.
- .6 **EPO switch:** UPS shall be equipped with an Emergency Power Off (EPO) terminal that can be wired so as to provide the means to instantaneously de-energize the UPS and its load from a remote location in case of emergency.
- .7 **Audible Alarms:** Using audio signal, the UPS will notify the user about important events. The following is the list of distinct audio alarms:
 - .1 The UPS is on battery
 - .2 The UPS is on battery and the remaining battery capacity is low
 - .3 The UPS has shut down due to low battery capacity
 - .4 The battery needs to be replaced
 - .5 The UPS is overloaded
 - .6 The UPS is in fault state
- .8 **Potential Free (Dry) Contacts:** The following dry alarm contacts shall be available on the UPS:
 - .1 The UPS is on battery
 - .2 The UPS is on battery and the remaining battery capacity is low
 - .3 The UPS is off
 - .4 The battery needs to be replaced
 - .5 The UPS is in bypass
 - .6 The UPS is overloaded;
 - .7 The UPS is in fault state.

1.9 Battery

- .1 The UPS battery is of modular construction made up of owner-replaceable, fused units. Each battery module is monitored to determine the highest battery unit temperature for use by the UPS battery diagnostic, and temperature compensated charger circuitry.

- .2 The batteries are to be lithium ion type.

1.10 ACCESSORIES

- .1 Software and Connectivity:
 - .1 **Network Management Card:** The Network Management Card allows one or more network management systems (NMSs) to monitor and manage the UPS in TCP/IP network environments.
 - .2 **Unattended Shutdown:** The UPS, in conjunction with a network interface card, is capable of gracefully shutting down one or more operating systems during the time when the UPS is on battery mode.
- .2 **Remote UPS Monitoring:** The following methods of remote UPS monitoring shall be available:
 - .1 **Web Monitoring:** Remote monitoring is available via a web browser such as Internet Explorer. Connect to building ethernet network and integrate for local network access.
 - .2 **Dry Contact Monitoring and Control:** The UPS must be equipped dry contact monitoring. Extend contact to local junction box for future use.

1.11 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include:
 - .1 Outline sketch showing arrangement of meters, controls, recommended aisle spaces, battery rack, battery arrangement and dimensions.
 - .2 Dimensioned layout of actual UPS system assemblies and bypass switches situated in the prescribed location showing all clearances and access spaces.
 - .3 Shipping weight
 - .4 Schematic diagram showing interconnection of rectifier, inverter, battery, bypass switch, meters, controls and indicating lamps.
 - .5 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;
 - .6 System performance and reliability:
 - .1 Consider any deviation from the required output power waveform as failure in UPS and include estimate, with supporting calculations, of the Mean Time Between Failures (MTBF) expressed in hours.
 - .2 Provide estimate with supporting data for Mean Time To Repair factor (MTTR).
 - .7 Full load kVA output at unity power factor.
 - .8 Efficiency of system at 25%, 50%, 75% and 100% rated load.
 - .9 Type of ventilation: natural or forced.

- .10 Battery:
 - .1 Number of cells;
 - .2 Maximum and minimum voltages;
 - .3 Type of battery;
 - .4 Type of plates;
 - .5 Catalogue data with cell trade name and type;
 - .6 Size and weight of each cell;
 - .7 Cell charge and discharge curves of voltage, current, time and capacity;
 - .8 Derating factor for specified temperature range;
 - .9 Nominal ampere hour capacity of each cell;
 - .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.
- .11 Heat losses at no load, 25%, 50%, 75% and 100% of rated output, in kW.
- .12 Cooling air required in m³/s.
- .13 List of recommended spare parts, tools and instruments with catalogue numbers and current prices.
- .14 Typical operation and maintenance manual.
- .15 Description of factory test facilities.
- .16 Manufacturer's maintenance capabilities including:
 - .1 Willingness to undertake maintenance contract;
 - .2 Number of trained personnel available;
 - .3 Location of trained personnel and repair facilities.

1.12 QUALITY ASSURANCE & SUPPORT

- .1 Submit for approval to Departmental Representative, indicating and recording instruments calibration certificates, including meters installed as part of system, in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Supplier of the UPS shall have local licenced maintenance personnel based within 100km of site to provide regular maintenance and on-call services and provide for proof of such representation as part of shop drawing submittal.
- .3 UPS supplier to include a letter to guarantee response time to site within one business day and include that in shop drawing submittal.
- .4 UPS to be guaranteed by the system supplier for a period of 3 years from the date of site acceptance. Warranty to include costs of labour and material for any warranty work during that time.
 - .1 Warranty to start at the date of substantial completion, not product delivery, first power, or any other milestone.

1.13 CLOSEOUT SUBMITTALS

- .1 Provide data for incorporation into operation and maintenance manual specified in Section 26 05 00 – Common Work Results - Electrical.

- .2 Submit interim, draft final, and final Operation and Maintenance (OM) Manual. Final manual approved by Departmental Representative. Submit interim copies to Departmental Representative prior to notification of factory test date.
- .3 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.

1.14 DELIVERY, STORAGE AND HANDLING

- .1 Crating:
 - .1 Adequately enclosed and protected from weather and shipping damage by use of minimum 12 mm plywood with vapour barrier inside.
 - .2 For tractor train or sea shipment use double layer of vapour barrier and 19 mm plywood covering.
 - .3 Subassemblies may be packed separately.
 - .4 Label crates:
 - .1 Shipping address.
 - .2 Weight and dimensions
 - .3 Serial number of unit and brief description of contents.
 - .4 Stencilled with durable paint on at least two sides of each crate.
 - .5 List of contents:
 - .1 In weatherproof envelope stapled on outside of each crate;
 - .2 Copy placed inside each crate.

1.15 SYSTEM START-UP

- .1 Provide for:
 - .1 For factory service engineer to supervise start-up of system, checking, adjusting and testing on site;
 - .2 For instruction of Departmental personnel on theory, construction, installation, operation and maintenance of system:
 - .1 After installation and during site testing;
- .2 Advise on:
 - .1 Expected failure rate of equipment;
 - .2 Type of expected failures;
 - .3 Estimated time between major overhauls based on 20 year equipment life;
 - .4 Estimated cost of major overhaul based on current costs and excluding travelling expenses;

- .5 Type and cost of test equipment needed for fault isolating and performing preventive maintenance.
- .6 UPS manufacturer to have a minimum of two factory employed, factory trained field technicians, who reside in the province of British Columbia and can offer a 24-hour, on-site response time.
- .7 Third party technicians, not employed, by the UPS manufacturer are not permitted.

Part 2 Products

2.1 UNINTERRUPTIBLE POWER SYSTEM

- .1 Input power:
 - .1 120/208 V, three phase, 3 wire with ground, 60 Hz.
 - .2 Normal supply from AC mains.
 - .3 Emergency supply from existing standby automatic diesel-electric unit connected to the main distribution via an automatic transfer switch.
- .2 Output power:
 - .1 120/208 V, three phase, 4 wire, grounded neutral, 60 Hz.
 - .2 Full load output at 1.0, Unity power factor.
 - .3 Overload capability: 125% of rated full load current at 1.0 power factor and rated voltage for 7 min.
 - .4 Frequency - nominal 60 Hz:
 - .5 Duration of 100% load output after mains failure not less than 9 min.
 - .6 Efficiency: Overall system efficiency not less than 94%.

2.2 ELECTRICAL REQUIREMENTS

- .1 In accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Wires number tagged or colour coded with same designation on drawings. Tags: non deteriorating type.
- .3 Components and sub-assemblies accurately made for interchangeability.

2.3 ENCLOSURE

- .1 Dead front free rack mounting minimum 2.5 mm thick, CSA Enclosure 1.
- .2 Service Access from **front** only.
- .3 Meters, indicating lamps and controls group mounted in panel front.
- .4 Panel front enclosed by hinged doors to prevent tampering and to protect instruments and controls during shipping. Doors formed wrap-around type, rigid, to open and close smoothly, locking type handle with 2 keys. Hinges to permit doors to be lifted off cubicle.
- .5 Module sizes not to exceed number of rack units indicated in drawings for main module and battery modules.
- .6 External cable connections at top or side of cubicle through bolted plate for drilling at site to suit.

- .7 Ambient temperature range during operation -20 degrees C to +40 degrees C. Natural or forced ventilation as required. For forced ventilation power from inverter output and fan directly driven by motor mounted on vibration isolators. Each enclosure to have redundant fans, with fan failures alarmed. Air inlet and outlet openings protected with screens and metal guards.
- .8 Disposable air filters on fan cooled enclosures. Method of attachment and opening locations to make removal convenient and safe.
- .9 Maximum operating sound level not to exceed 73 dbA as measured on sound level meter with A weighting and slow response, at distance of 1 meter.
- .10 Enclosure frames interconnected by ground bus with ground lug for connection to ground.

2.4 RECTIFIER

- .1 Input disconnect: bolt-on moulded case three pole air circuit breaker, quick make, quick break type for manual or automatic operation, temperature compensated for 40 degrees C ambient, magnetic instantaneous trip element.
- .2 Surge suppressor: to protect equipment from supply voltage switching transients.
- .3 Rectifier:
 - .1 Solid-state Pulse Width Modulation (PWM) rectifier utilizing Insulated Gate Bipolar Transistor (IGBT)
- .4 Filter: for rectifier DC output.
- .5 Fuse: to protect DC output.
- .6 Performance of rectifier:
 - .1 Automatically maintain battery in fully charged state while mains power available, and maintain DC float voltage within +/-1% of setting, no load to full load, during mains voltage variations up to +15% to -20%.
 - .2 Battery charging rate such that after battery has provided full load power output for specified duration, charger returns battery to 95% of fully charged state in 4 hours.
 - .3 Programmable Automatic equalize charging circuit to initiate equalize charging of battery.

2.5 INVERTER

- .1 Input power supply from:
 - .1 Rectifier DC output;
 - .2 Battery DC output.
- .2 Input disconnect: bolt-on moulded case, single pole, circuit breaker, quick make, quick break type, for manual or automatic operation, temperature compensated for 40 degrees C ambient, magnetic instantaneous trip element.
- .3 Input filter: with separately fused computer grade capacitor banks and indicator lights, to eliminate inverter source noise and restrictions on input cable length.
- .4 Power stage: High efficiency Solid-state Pulse Width Modulation (PWM) rectifier utilizing Insulated Gate Bipolar Transistor (IGBT). Components, solid state devices capable of satisfactory operation under ambient conditions of -20 degrees C to +40 degrees C.

- .5 Output filter: output of high frequency switching stage contains elements of carrier frequency which are filtered to low harmonic sine wave.
- .6 Output disconnect: bolt-on, moulded case, three pole circuit breaker or magnetic contactor, quick make, quick break type, for manual or automatic operation, temperature compensated for 40 degrees C ambient, magnetic instantaneous trip element.

2.6 BATTERY

- .1 Battery to be Lithium Ion.
- .2 Batteries to consist of minimum two strings.
 - .1 Discharge current to supply inverter at full load output, for 9 min.
 - .2 Battery are replaceable without shutting down UPS or going into bypass.
 - .3 Battery modules are connected via an internal battery breakers.

2.7 STATIC BYPASS SWITCH

- .1 Solid state closed circuit automatic transfer switch.
- .2 Logic unit with three normal source voltage sensors, which monitor overvoltage undervoltage and loss of voltage.
- .3 High speed automatic transfer from normal voltage to alternate source when:
 - .1 Normal source voltage lost: transfer time and sensing 1/4 cycle;
 - .2 Normal source: undervoltage at 80% of nominal value; adjustable.
 - .3 Normal source: over voltage at 115% of nominal value.
 - .4 Loss of normal source static switch continuity.
 - .5 Short circuit on normal source trips normal source breaker.
- .4 Return to normal source:
 - .1 When normal source remains within return voltage limits of 95% to 110% of nominal value (adjustable) for approximately 1 s timing interval, circuit checks voltage balance and phase synchronization, then initiates return with zero switching time.
- .5 Accessories:
 - .1 Manual bypass switch for maintenance and testing without load disturbance.
 - .2 Continuity monitor: automatic transfer to alternate source in event of static switch discontinuity.
 - .3 Alternate power source loss alarm contacts.

2.8 OPERATING DEVICES

- .1 Mode lights mounted on front panel to indicate:
 - .1 Ac output on inverter - green;
 - .2 Ac input available - green;
 - .3 Static bypass switch in bypass position - red;
 - .4 Overtemperature alarms – red;
 - .5 UPS on battery operation - red;
 - .6 Rectifier in equalize mode - amber;

- .7 Battery discharging indicator - red, to change from steady to flashing during final 5 to 10 min of battery duration.
- .2 Alarms: audible alarm when any mode light shows red. Silence pushbutton not to extinguish trouble light.

2.9 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Cubicles:
 - .1 Inside finish: To match exterior
 - .2 Exterior finish: black or manufacturer's standard color;
 - .3 Exterior hardware and trim: corrosion resistant and not requiring painting such as stainless steel or aluminum.

2.10 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 For major components such as AC input breaker, inverter breakers, bypass switch: size 5 nameplates.
- .3 For mode lights, alarms, meters: size 3 nameplates.

2.11 SOURCE QUALITY CONTROL

- .1 Complete system component test, including rectifier, inverter, bypass switch, remote annunciator panel, controls and battery factory test report is to be provided to Department Representative.
- .2 Notify Departmental Representative:
 - .1 One week in advance of date of factory test;
 - .2 That system has had preliminary testing and has met design requirements satisfactorily.
 - .3 Test procedures:
 - .4 Prepare blank forms and check sheet with spaces for recording data.
 - .5 Mark check sheet and record test data on forms in duplicate as test proceeds. Attach meter recordings.
 - .6 Provide Departmental Representative's signature on form to indicate concurrence in results reported.
 - .7 Duplicate given to Departmental Representative at end of test.
 - .8 Information from original presented as part of O&M Manual.
- .3 Test equipment:
 - .1 Instruments used during test, including indicating meters installed as part of system to have recent calibration certificate.
 - .2 Dummy load for testing, adjustable to 150% of system rated output at 0.8 power factor lagging. Load on each phase adjustable from zero to 100 % so that unbalanced output maybe tested for 3 phase systems.

- .4 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 Each battery cell polarity and polarity of connections to inverter are correct;
 - .5 Proper size fuses are installed;
 - .6 Accessories are present;
 - .7 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. Repeat several times;
 - .3 Adjustable settings;
 - .4 Record values measured at test points using oscilloscope, digital multimeter, and camera attachment;
 - .5 Bypass switch automatic operations. Record absence of load disturbance during automatic bypass switching.
 - .3 Operating sound level:
 - .1 Measure sound level according to ANSI S1.13 using sound level meter with A weighting and slow response, conforming to ANSI S1.4.
 - .2 Operator to take reading by placing meter in front of him with microphone pointed at right angles to path of travel of generated sound, positioned at height of 1.5 m and distance of 1 m from equipment to be tested.
 - .3 Measure sound level during low ambient sound level.

Part 3 Execution

3.1 INSTALLATION

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

3.2 TESTING

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical and CSA-C813.1.

- .2 Provide:
 - .1 Competent field personnel to perform test, adjustments and instruction on UPS equipment.
- .3 Notify 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 remote mode 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.
 - .8 Coordinate an offhours outage to simulate a BC Hydro failure to ensure that the existing 300kw generator can properly synchronize and support the new UPS. There are often issues with generators and UPS units where the generator protection system will detect UPS injected harmonics as a fault condition and shut down the generator. Contractor is to ensure this has been checked and appropriately mitigated.
 - .9 Run generator for 1-hours on UPS normal operating loads to ensure stability in the system.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies the materials and installation for communication cables inside buildings.

1.2 SCOPE

- .1 Supply and installation of a communication cabling system complete with provision of cables and connectors, as per the drawings and as required for the monitoring of the new UPS system.
- .2 All materials and installation shall meet the requirements of these specifications.
- .3 The complete data/communications system installation is to be in accordance with EIA/TIA-568 Standards.
- .4 All cables made redundant by new installation are to be removed. All existing abandoned cables are also to be removed back to the source.

1.3 REFERENCES

- .1 Canadian Standards Association, (CSA International)
 - .1 CSA-T529-latest edition, Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/EIA TIA 568a with modifications).
 - .2 CSA-C22.2 No. 214-latest edition, Communications Cables (Bi-national Standard, with UL 444).
 - .3 CAN/CSA-C22.2 No. 182.4-latest edition, Plugs, Receptacles, and Connectors for Communication Systems.
- .2 Telecommunications Industry Association (TIA)
 - .1 TIA/EIA-568-latest edition, Commercial Building Telecommunications Cabling Standards Set.

1.4 SYSTEM DESCRIPTION

- .1 Structured system of telecommunications cables (copper) installed within buildings for distributing data.

Part 2 Products

2.1 CABLES AND CONNECTORS

- .1 Each UTP cable shall meet the requirements of will consist of four unshielded twisted pairs of 24 AWG (0.5mm) 100-ohm nominal characteristic impedance, solid round annealed copper conductors insulated with flame retardant polymer.
- .2 All cables will be certified/approved by CSA Standard PCC FT4 flammability test and UL CMR.

- .3 UTP cables will meet or exceed the requirements in the proposed National Electrical Manufacturers Association (NEMA) Standard for Low-Loss Extended Frequency Premises Telecommunication Cable. The cable will meet the performance requirements of Category cable of the Underwriters Laboratories Inc. specifications and cable surface markings shall indicate this classification.

2.2 COMMUNICATION OUTLETS AND TERMINAL CONNECTIONS

- .1 Cable runs will have 1000mm length of cable left coiled up inside UPS cabinet for termination of RS232C connection. Confirm termination requirements with manufacturer.

2.3 LABELLING

- .1 Labels on wall plates and patch panels to be Brother P-Type or equivalent, black lettering on white tape. Labelling identification numbering to be as directed by Owner's representative.
- .2 All raceways shall be clearly and permanently marked at both ends to indicate destination and function. The markings shall be clearly visible after construction is completed.
- .3 Each cable shall be clearly marked with a permanent sequential identifier at each end of the cable. All horizontal cable terminations will be labelled at patch panels and at data/comm. outlets. Label of wiring to be the same identifier as the label at the termination point.

2.4 PERFORMANCE REQUIREMENTS

- .1 The complete end-to-end installation, including jacks, cables, patch panels, and patch cords shall meet the industry standard performance parameters for enhanced Category 6 as recommended by CAN/CSA-T529, latest revision. Test parameters shall include: Attenuation, Return Loss, NEXT, Power Sum NEXT, ELNEXT, Power Sum NEXT, ELFEXT, ACR, Power Sum ACR, Propagation Delay, and Delay Skew.

Part 3 Execution

3.1 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

- .1 Communications raceway shall be minimum 20mm EMT conduit stubbed into accessible ceiling space. All cables in ceiling space shall be installed in conduit and cable support system and cable tray and as indicated on the drawings.
- .2 Wires and cable shall be as short as practical except that sufficient slack shall be provided to:
- .3 Prevent undue stress on cable forms, wires, and connections.
- .4 Enable network components to be removed and replaced during servicing without disconnecting other parts.
- .5 Facilitate movement of equipment for maintenance purposes.
- .6 Wires and cables shall be placed and protected to avoid contact with rough surfaces or sharp edges. Where wires or cables run through holes in metal, they shall be protected by suitable grommets or bushings.

- .7 Clearance between cables and heat emitting or interference generating devices shall be such as to avoid deterioration of these wires and cables due to heat dissipation from these devices, and to comply with industry standards. In particular cables shall have a minimum separation of 150mm from unshielded power lines and 600mm from fluorescent lighting.
- .8 The horizontal wiring shall be continuous with no splice points. Bridged taps are not permitted and there will be no cross-connects between the outlet and the patch panel.
- .9 The maximum cable length for each run is 90 metres and will allow for 3 extra metres at the UPS end and 7 extra metres for the patch cord end.
- .10 Each cable shall be clearly marked with a permanent sequential identifier at each end of the cable. All horizontal cable terminations will be labelled at cross-connects and at telecommunications outlets. Labelling will include room number or patch panel as per labelling requirements reference.
- .11 Horizontal conduit fill must comply with the Canadian Electrical Code requirements.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Test intra-building telephone cable for continuity.
- .3 All data/communications cables shall be tested using testing equipment approved for Category 5e installations.
- .4 Testing shall be conducted by authorized representative of cable and hardware manufacturer.
- .5 Tests shall be performed from termination block to wall outlet jack on horizontal cables.
- .6 Testing set-up shall be for a channel test, maximum length of 95m.
- .7 Testing shall include verification of labelling integrity.
- .8 Test results shall be documented and shall include the following information in addition to the cable parameters:
 - .1 Cable ID
 - .2 Transmit and Receive locations
 - .3 Test Equipment used to complete the test
 - .4 Contractor's name
 - .5 Technician's name and signature
 - .6 Date test was performed
 - .7 Relevant additional comments
- .9 The complete end-to-end installation, including jacks, cables and patch panels shall meet or exceed industry standard performance requirements for Category 6. Cable test parameters are to include: Attenuation, Return Loss, NEXT, Power Sum NEXT, ELFEXT, Power Sum ELFEXT, ACR, Power Sum ACR, Propagation Delay, and Delay Skew. Permanent Link Test is required.

- .10 Test results must include the Telecommunication Room number from which the cables terminate and indicate the following information:
 - .1 Telecommunication Room
 - .2 Room number of outlet box location
 - .3 Communication jack number.

END OF SECTION