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Services gouvernementaux
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Public Works and
Government Services
Canada

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA INSTALLATION OF TRANSPORT CANADA CHARGING TERMINALS

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PURPOSES.***

ELECTRICAL TECHNICAL SPECIFICATIONS ISSUED FOR FINAL VERSION 100%

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PART 1. GENERAL**1.1 RELATED SECTIONS**

- .1 This section is general in nature and provides information that can be linked to all sections of the tender document.

1.2 WORKS COVERED BY DOCUMENTS TENDER

- .1 Work under this Contract covers:
 - .1 Electrical distribution, 347/600 V and 120/208 V.
 - .2 New 600 V circuit breaker in an existing panel.
 - .3 Low voltage power transformer.
 - .4 120/208V distribution panels.
 - .5 Network of electric charging point.
 - .6 Installation of charging point.
 - .7 Coordination of electrical and civil works.
 - .8 Any other work described in the plans and specifications.

1.3 RESTRICTIONS ABOUT WORKS

- .1 Co-ordinate Progress Schedule in function of the airport operations and coordinate with the departmental representative.
- .2 Construct Work in stages to provide for continuous daily normal airport operations usage as per planned schedule. The progress of works must also allow outside of the period of operation, the restore of air traffic in the case of emergency and medical evacuation.
- .3 Maintain fire access/control.

1.4 CONTRACTOR USE OF PREMISES

- .1 Limit use of premises to necessary areas for works execution.
- .2 Co-ordinate use of premises under direction of Departmental Representative.
- .3 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.5 EXISTING UTILITY 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 48 hours notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to airports activity.
- .3 Provide alternative routes for pedestrian and vehicular traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .5 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .6 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .7 Record locations of maintained, re-routed and abandoned service lines.

1.6 REQUIRED DOCUMENTS

- .1 Maintain at job site, one copy each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and Other Safety Related Documents.
 - .11 Other documents as specified.

1.7 TYPE OF CONTRACT

- .1 Tenders will be made on a unit and/or a lump sum price.
- .2 All expenses incurred to meet the requirements of the present contract and non covered by item of payment of the unit price table will have to be included in the overheads of the contractor and distributed proportionally on the different items of tender.
- .3 The Contractor when submitting his tender agrees that he is fully informed regarding all the conditions affecting the work to be done, the labour, materials, equipment plant he is to supply and the means of access to the site and that his information was obtained by personal investigation on the site by himself or his authorized representative and not from verbal information given to him by representatives of this Department.
- .4 While the drawings and specifications indicate the general nature of the work to be performed, it must be distinctly understood that the Department reserves the right to alter the alignment grades or the extent of the work as may be found desirable without in any way invalidating the conditions of the contract.
- .5 All expenses incurred to meet the requirements of the present contract and non-covered by item of payment of the unit price table will have to be included in the overheads of the contractor and distributed proportionally on the different items of tender.

1.8 INITIAL TERRAIN MODEL

- .1 Initial terrain model supplied by the departmental representative :
 - .1 The Contractor will be required to validate and approve for the purpose of calculating volumes the field model provided from the survey carried out by the Departmental Representative in the summer of 2018 using a scanning method.
 - .2 In the event of a dispute over the initial survey data provided, the resumption of the survey shall be done jointly between the Departmental Representative and the Contractor.

1.9 CODES

- .1 The works must be executed in a manner to satisfy at all exigency:
 - .1 Of contractual documents.
 - .2 Regulations and specified Codes and all other document referred to.
 - .3 Local authority.
- .2 In any case of conflict or discrepancy, the more stringent requirements shall apply.

1.10 WORK SCHEDULE

- .1 Provide within 5 working days after Contract award, a schedule showing anticipated progress stages and final completion of work within time period required by Contract documents as describe in 1.15 of this section.
- .2 Interim reviews of real work progress based on work schedule will be done as required by the departmental representative. Schedule updates will be carried out by the Contractor with the collaboration and approval of the Departmental representative.
- .3 The approval of the revised schedule by the Departmental representative does not free the Contractor from his responsibility relative to all consequences resulting from a non-respect of the original calendar requirements.

1.11 ADDITIONAL DRAWINGS

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

1.12 SCHEDULE TO COMPLETE ALL WORKS

- .1 All the Works including mobilisation and demobilisation shall be completed at least 60 days following the reception of the official awarding notice and shall begin in the 5 days following reception of that notice. The granular recharging works on manoeuver area and graded area shall be executed inside a delay of 30 calendar days comprise in the 60 days previously mentioned.

PART 2. PRODUCTS**2.1 NOT USED****PART 3. EXECUTION****3.1 NOT USED**

END OF SECTION

PARTIE 1. GENERAL**1.1 RELATED SECTIONS**

- .1 Section 03 30 00 – Cast-in-place concrete.
- .2 Section 32 11 16.01 – Aggregate base courses.

1.2 ADMINISTRATIVE

- .1 Submit to the Departmental Representative submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Work affected by submittal shall not proceed until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to the Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be considered rejected.
- .6 Notify the Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are coordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by the Departmental Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by the Departmental Representative review.
- .10 Keep one reviewed copy of each submission on site.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in Province or Territory of Canada.

- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow 10 days for the Departmental Representative's review of each submission.
- .5 Adjustments made on shop drawings by the Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to the Departmental Representative prior to proceeding with Work.
- .6 Make changes in shop drawings as the Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify the Departmental Representative in writing of any revisions other than those requested.
- .7 Accompany submissions with transmittal letter, in [duplicate], containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .8 Submissions shall include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.

-
- .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .9 After the Departmental Representative's review, distribute copies.
- .10 Submit 1 electronic copy or 3 copies of shop drawings and product data sheets or brochures for requirements requested in specification Sections and as requested by the Departmental Representative.
- .11 Submit 1 electronic copy or 3 copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .12 Submit 1 electronic copy or 3 copies of test reports for requirements requested in specification Sections and as requested by [Departmental Representative
- .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of contract award for project.
- .13 Submit 1 electronic copy or 3 copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
- .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.

- .14 Submit 1 electronic copy or 3 copies of manufacturer's instructions for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions
- .15 Submit 1 electronic copy or 3 copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .17 Submit 1 electronic copies or 3 copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .18 Delete information not applicable to project.
- .19 Supplement standard information to provide details applicable to project.
- .20 If upon review by the Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, a copy will be returned, and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .21 The review of shop drawings by Public Works and Government Services Canada (PWGSC) is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that PWGSC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of construction and Contract Documents.
 - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of all sub-trades.

1.4 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to the Departmental Representative's business address.
- .3 Notify the Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.

- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by the Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to the Departmental Representative prior to proceeding with Work.
- .6 Make changes in samples which the Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.5 MOCK-UPS – REST BOARD

- .1 Test board shall be realised of works as per section 32 11 16.01 - Aggregate base courses.

1.6 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic copy of color digital photography in JPG format, high resolution presented on an external hard drive.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Frequency of photographic documentation:
 - .1 Photos must be taken for every construction stage and activity. Take care to capture all works or all situations from the point of view of environmental protection was an issue.
 - .2 Upon completion of utility canalization and services but before concealment and as directed by Departmental Representative.

1.7 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after Awards of Contract, submit the pertinent documents as per the "Commission de la santé et de la sécurité au travail" requirements.
- .2 Submit transcription of insurance immediately after award of Contract.

PARTIE 2. PRODUCTS

- .1 Not Used.

PARTIE 3. EXECUTION

.1 Not Used.

END OF SECTION

PART 1. GENERAL**1.1 REFERENCES**

- .1 Canada Labour Code - Part II, Canadian Occupational Safety and Health Regulations.
- .2 Canadian Standards Association (CSA)
- .3 Workplace Hazardous Materials Information System (WHMIS)/ Health Canada
 - .1 Signalitic sheet (MSDS).
- .4 Act Respecting Occupational Health and Safety, R.S.Q. Chapter S-2.1.
- .5 Safety Code for the construction industry, S-2.1, r. 4.

1.2 DOCUMENTS AND SAMPLES TO BE SUBMITTED

- .1 Submit the documents required according to section 01 33 00 –Documents and samples to be submitted.
- .2 Submit to Departmental Representative, the CSST and at the Association paritaire en santé et sécurité du secteur de la construction (ASP Construction) the site-specific safety program, as outlined in 1.8 at least 10 days prior to start of work. The Contractor must review his program during the course of the project if any change occurs in work methods or site conditions. The Departmental Representative may, after receiving the program or at any time during the project, ask the Contractor to update or modify the program in order to better reflect the reality of the construction site and activities. The Contractor must make the required changes before work begins.
- .3 Submit to Departmental Representative the site inspection sheet, duly completed, at the intervals indicated in 1.13.1.
- .4 Submit to Departmental Representative within 24 hours a copy of any inspection report, correction notice or recommendation issued by federal or provincial inspectors.
- .5 Submit to Departmental Representative within 24 hours an investigation report for any accident involving injury and any incident exposing a potential hazard.
- .6 Submit to Departmental Representative all safety data sheets for hazardous material to be used at the site at least three days before they are to be used.
- .7 Submit to Departmental Representative copies of all training certificates required for application of the safety program, in particular:
 - .1 General construction site safety and health courses;
 - .2 Safety officer attestations;
 - .3 First aid in the workplace and cardiopulmonary resuscitation;
 - .4 Work likely to release asbestos dust;

- .5 Work in confined spaces;
 - .6 Lockout procedures;
 - .7 Wearing and fitting of individual protective gear;
 - .8 Forklift truck;
 - .9 Positioning platform;
 - .10 Any other requirement of Regulations or the safety program.
- .8 Medical examinations: Wherever legislation, regulations, directives, specification or a safety program require medical examinations, Contractor must:
- .1 Prior to start-up, submit to Departmental Representative certificates of medical examination for all concerned supervisory staff and employees who will be on duty when the site opens.
 - .2 Thereafter, submit without delay certificates of medical examination for any newly hired concerned personnel as and when they start work at the site.
- .9 Emergency plan: The emergency plan, as defined in 1.8.3, shall be submitted to Departmental Representative at the same time as the site-specific safety program.
- .10 Notice of site opening: Notice of site opening shall be submitted to the Commission *de la santé et de la sécurité du travail* before work begins. A copy of such notice shall be submitted to Departmental Representative at the same time and another posted in full view at the site. During demobilization, a notice of site closing shall be submitted to the CSST, with copy to Departmental Representative.
- .11 Plans and certificates of compliance: Submit to the CSST and to Departmental Representative a copy signed and sealed by engineer of all plans and certificates of compliance required pursuant to the Construction Safety Code (S-2.1, r. 6), or by any other legislation or regulation or by any other clause in the specifications or in this contract. Copies of these documents must be always on hand at the site.
- .12 Certificate of compliance delivered by the CSST: The certificate of compliance is a document delivered by the CSST confirming that the contractor is in rule with the CSST, i.e., that he had pay out all the benefits concerning this contract. This document must be delivered to Departmental Representative at the end of the work.

1.3 HAZARDS ASSESSMENT

- .1 The contractor must identify all hazards inherent in each task to be carried out at the site.
- .2 The contractor must plan and organize work so as to eliminate hazards at source or promote mutual protection so that reliance on individual protective gear can be kept to a minimum. Where individual protection against falling is required, workers shall use safety harness that meets standard Can - CSA- Z-259.10 - M90. Safety belts shall not be used as protection against falling.

- .3 Equipment, tools and protective gear which cannot be installed, fitted or used without compromising the health or safety of workers or the public shall be deemed inadequate for the work to be executed.
- .4 All mechanical equipment shall be inspected before delivery to the site. Before using any mechanical equipment, submit to Departmental Representative a certificate of compliance signed by a qualified mechanic. Whenever he suspects a defect or accident risk, Departmental Representative may at any time order the immediate shut-down of equipment and require a new inspection by a specialist of his own choosing.

1.4 LEGAL AND REGULATORY REQUIREMENTS

- .1 Comply with all legislation, regulations and standards applicable to the site and its related activities.
- .2 Comply with specified standards and regulations to ensure safe operations at site containing hazardous or toxic materials.
- .3 Regardless of the publication date shown in the construction safety code, always use the most recent version.

1.5 SITE-SPECIFIC CONDITIONS

- .1 At the site, the contractor must take account of the following specific conditions:
 - .1 Evening and night works.

1.6 SAFETY AND HEALTH MANAGEMENT

- .1 Acknowledge and assume all the tasks and obligations which customarily devolve upon a principal Contractor under the terms of the Act Respecting Occupational Health and Safety (R.S.Q., chapter S-2.1) and the Construction Safety Code (S-2.1, r.4).
- .2 Develop a site-specific safety program based on the hazards identified and apply it from the start of project work until close-out is completed. The safety program must take account of all information appearing in 1.7 and must be submitted to all parties concerned, in accordance with the provisions set forth in 1.3. At a minimum, the site-specific safety program must include:
 - .1 Company safety and health policy.
 - .2 A description of the work, total costs, schedule and projected workforce curve.
 - .3 Flow chart of safety and health responsibility.
 - .4 The physical and material layout of the site.
 - .5 First-aid and first-line treatment standards.
 - .6 Identification of site-specific hazards.

- .7 Risk assessment for the tasks to be carried out, including preventive measures and the procedures for applying them.
 - .8 Training requirements.
 - .9 Procedures in case of accident/injury
 - .10 Written commitment from all parties to comply with the prevention program.
 - .11 A site inspection schedule based on the preventive measures.
- .3 The contractor must draw up an effective emergency plan based on the characteristics and constraints of the site and its surroundings. Submit the emergency plan to all parties concerned, pursuant to the provisions of 1.3. The emergency plan must include:
- .1 Evacuation procedure;
 - .2 Identification of resources (police, firefighters, ambulance services, etc.);
 - .3 Identification of persons in charge at the site;
 - .4 Identification of those with first-aid training;
 - .5 Training required for those responsible for applying the plan;
 - .6 Any other information needed, in the light of the site characteristics.

1.7 RESPONSIBILITIES

- .1 No matter the size of the construction site or how many workers are present at the workplace, designate a competent person to supervise and take responsibility for health and safety. Take all necessary measures to ensure the health and safety of persons and property at or in the immediate vicinity of the site and likely to be affected by any of the work.
- .2 Take all necessary measures to ensure application of and compliance with the safety and health requirements of the contract documents, applicable federal and provincial regulations and standards as well as the site-specific safety program, complying without delay with any order or correction notice issued by the Commission de la santé et de la sécurité du travail.
- .3 Take all necessary measures to keep the site clean and in good order throughout the course of the work

1.8 COMMUNICATIONS AND POSTING

- .1 Make all necessary arrangements to ensure effective communication of safety and health information at the site. As they arrive on site, all workers must be informed of their rights and obligations pertaining to the site specific safety program. The Contractor must insist on their right to refuse to perform work which they feel may threaten their own health, safety or physical integrity or that of other persons at the site. The Contractor must keep and update a written record of all information transmitted with signatures of all affected workers.

- .2 The following information and documents must be posted in a location readily accessible to all workers:
 - .1 Notice of site opening;
 - .2 Identification of principal Contractor;
 - .3 Company OSH policy;
 - .4 Site-specific safety program;
 - .5 Emergency plan;
 - .6 Data sheets for all hazardous material used at the site;
 - .7 Minutes of site committee meetings;
 - .8 Names of site committee representatives;
 - .9 Names of those with first-aid training;
 - .10 Action reports and correction notices issued by the CSST.

1.9 UNFORESEEN CIRCUMSTANCES

- .1 Whenever a source of danger not defined in the specifications or identified in the preliminary site inspection arises as a result of or in the course of the work, immediately suspend work, take appropriate temporary measures to protect the workers and the public and notify Departmental Representative, both verbally and in writing. Then the Contractor must modify or update the site specific safety program in order to resume work in safe conditions.

1.10 INSPECTION OF SITE AND CORRECTION OF HAZARDOUS SITUATIONS

- .1 Inspect the work site and complete the site inspection sheet at least once a week.
- .2 Immediately take all necessary measures to correct any lapses from legislative or regulatory requirements and any hazards identified by a government inspector, by the Departmental Representative, by the site safety and health coordinator or during routine inspections.
- .3 Submit to Departmental Representative written confirmation of all measures taken to correct lapses and hazardous situations.
- .4 Give the safety officer or, where there is no safety officer, the person assigned to safety and health responsibilities, full authority to order interruption and resuming of work as and when deemed necessary or desirable in the interests of safety and health. This person should always act so that the safety and health of the public and site workers and environmental protection take precedence over cost and scheduling considerations.
- .5 Without limiting the scope of sections 1.8 and 1.9, Departmental Representative may order cessation of work if, in his/her view, there is any hazard or threat to the safety or health of site personnel or the public or to the environment.

END OF SECTION

PART 1. GENERAL**1.1 PROJECT CLEANLINESS**

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by Owner or other Contractors.
- .2 Remove waste material and debris from site at end of each working day. Waste materials should not be burned on the job site.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris.
- .5 Provide and use marked separate bins for recycling.
- .6 Store volatile waste in covered metal containers and remove from premises at end of each working day.
- .7 Runway and taxiway used by Contractor must be cleaned. Cleaning operations must be done in continuous for areas used by aircrafts and once a day for other areas.

1.2 FINAL CLEANING

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste materials from site. Do not burn waste materials on site.
- .5 Take necessary disposition and obtain permit from competent authority about the elimination of debris and garbage materials.
- .6 If construction vehicles are allowed to use movement area, Contractor will keep on site all cleaning equipments needed to maintain movement area cleaned to the departmental representative's satisfaction.
- .7 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .8 Daily and before re opening movement areas, an inspection will be done with Transport Canada escort .If needed, Contractor will do more cleaning to Transport Canada satisfaction.

1.3 CONSTRUCTION-DEMOLITION WASTE MANAGEMENT

- .1 Separate waste materials for reuse / re-use and recycling.

1.4 MEASUREMENT FOR PAYMENT

- .1 All costs for this section will be included in different tender items.

PART 2. PRODUCTS

- .1 Not Used.

PART 3. EXECUTION

- .1 Not Used.

END OF SECTION

PART 1. GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-06, Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations.
 - .2 National Building Code of Canada (NBC) 2010, Quebec amendments.
 - .3 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC).
 - .1 IEEE SP1122, 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 EQUIPMENT AND MATERIAL CERTIFICATIONS

- .1 Ensure that the equipment and material are CSA approved. Where there is no alternative to supplying equipment, which is not CSA certified, obtain approval by the Electrical Inspection Department prior to the installation of the equipment and material. Pay all associated fees for approval process.

1.4 DESIGN REQUIREMENTS

- .1 Operating voltages to CAN3-C235.
- .2 Control/safety devices able to operate sufficiently at 60 Hz and within the limits established in the above-mentioned standard.
 - .1 Devices able to withstand operation under extreme conditions without damage as defined in this standard.
- .3 Operating and display language: for identification and display purposes, control devices to include nameplates in French and English.
- .4 Use one (1) nameplate for both languages.

1.5 SUBMITTALS

- .1 Shop drawings and data sheets
 - .1 Submit required data sheets as well as manufacturer's documentation regarding electrical equipment. Data sheets must indicate products, performance criteria, dimensions, limits and finishes.

- .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 on drawings clearances for operation, maintenance, and replacement of equipment devices.
 - .5 If changes are required, notify the Departmental Representative of these changes before they are made.
 - .6 Submit one (1) copy of drawings and data sheets in PDF format to the Departmental Representative.
 - .7 Do not undertake work until the documents and/or samples submitted have been reviewed by the Departmental Representative. These requirements are complementary to the Departmental Representative's specifications regarding shop drawings.
- .2 Certificates:
- .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment is not available, submit such proposed equipment to inspection authorities for approval before delivery to the site.
 - .3 Once work is complete, submit load balancing report.
 - .4 Submit test results of installed electrical systems and instrumentation.
 - .5 Submit to the Departmental Representative the acceptance certification delivered by the competent authority.
 - .6 Permits and fees: in accordance with General Conditions of contract.
- .3 Manufacturer field test reports: submit to the Departmental Representative at the very latest three (3) days after testing and verifying electrical instruments, a written report from the manufacturing stating that the work is in compliance with the criteria set out.

1.6 CLOSEOUT SUBMITTALS

- .1 O&M sheets: provide instructions with regard to operating and maintenance.

1.7 OPERATING INSTRUCTIONS

- .1 Provide operating instructions for each main system and item of equipment as specified in technical sections for use by Operation & Maintenance personnel.
- .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each main 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.

1.8 GENERAL REQUIREMENTS

- .1 Unless otherwise indicated, all work shown on drawings and described in specifications is an integral part of the contract and at the General Contractor's cost. The General Contractor is responsible for performing all work, including that which he entrusts to his subcontractors.
- .2 Addenda
 - .1 If addenda have been issued, the Contractor is responsible for verifying with the Departmental Representative to ensure that his tender is complete, prior to completing his tender. Any omission to add addenda to the tender will result in automatic rejection of the tender.
- .3 The present section covers common requirements in multiple specification sections and serves as a complement to the Tender General Conditions for overall project installation. The complementary general conditions apply to the work described in this division.
- .4 The drawings and specifications from other engineering and architectural divisions are an integral part of the electrical specifications as if mentioned in both.
- .5 Perform work according to phasing indicated on architectural specifications and drawings (Division 01).
- .6 All work must be perfectly executed and the installation of all elements must be done taking into consideration ease of reading, calibration, access, inspection and repair. The Departmental Representative will require any element that is installed without regard to the present clause to be relocated, and to the exclusive cost of the Contractor.
- .7 The electrical drawings are complementary to architectural, structural and mechanical drawings and specifications. Verify on site all dimensions and consult mechanical drawings to ensure exact location of equipment before installation of such.

- .8 All systems must be complete, perfectly operational and must include all equipment and accessories to obtain, upon work completion, fumehoods, motor control centres (MCC) and entirely functional rooms that are compliant to codes and standards in effect.
- .9 The present specifications do not necessarily specify in detail the design, construction or all parts/components of equipment, or their installation. Where appropriate, the Contractor must observe generally-accepted techniques and manufacturers' recommendations

1.9 QUALITY ASSURANCE

- .1 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the province in which work is to be executed.
 - .1 Employees registered in provincial apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

1.10 START-UP

- .1 Instruct the Departmental Representative and O&M personnel on operating mode and maintenance methods with regard to facility, equipment and components.

1.11 EQUIPMENT AND MATERIALS LIST

- .1 Submit a list identifying the names of manufacturers and details of proposed equipment and materials. It is strictly forbidden to order equipment and materials before the list and shop drawings have been reviewed by the Departmental Representative.

1.12 ELECTRICAL SYMBOLS

- .1 When the general cabling method and material requirements for the overall installation are mentioned in the specifications or noted on drawings, a special notation will not be shown close to symbols on drawings (ex. if the overall installation as required by the specifications and general note on the drawings must be weatherproof, the symbols will not have any special identification).
- .2 When particular cabling methods or special material are required for various parts of the building or outlets, such requirements are clearly identified on the drawing by individual outlet symbol notation.

1.13 ELECTRICAL DRAWINGS AND SPECIFICATIONS

- .1 Electrical drawings and specifications are complementary. Everything including on drawings and in specifications is considered as being included in the electrical drawings and specifications.

- .2 Drawings illustrate approximate location of equipment, materials and conduits; their exact location must be determined by the Contractor from mechanical drawings. Furthermore, the Contractor must verify available space on site before installing equipment, material or conduits, and must perform coordination of work and available space with the other divisions.
- .3 Any discrepancy between the general drawings and specifications, or other specialities, and the electrical drawings and specifications, must be brought to the attention of the Departmental Representative prior to submitting tenders. The Departmental Representative will provide supplemental information in the form of addenda.

1.14 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and acceptance requirements deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and handling requirements:
 - .1 Store materials off ground in clean, dry, well-ventilated area and in accordance with manufacturer's recommendations.
 - .2 Replace defective or damaged materials with new.
 - .3 Store and protect from nicks, scratches and blemishes.

1.15 SEISMIC MOUNTING

- .1 Each subcontractor in each specialty trade is responsible for the compliance of seismic restraint systems.
- .2 Refer to Section 23 05 29 – Hangers and Supports for Electrical Systems.

1.16 MATERIAL OR PRODUCTS OF ACCEPTANCE

- .1 When materials or products are specified by trademark, consult the Tenderer Instructions for procedure to follow with regard to request for approval of replacement materials or products.

PART 2. PRODUCTS

2.1 MATERIALS/EQUIPMENT

- .1 All materials and electrical equipment to be CSA certified. Where CSA certified material and equipment are not available, submit such equipment to inspection authorities for approval before delivery to site and submit such approval as described in PART 1 – SUBMITTALS.
- .2 Factory assemble control panels and component assemblies.
- .3 The new circuit breaker and combination magnetic starter drawers must be compatible with existing MCCs and certified by Siemens.

2.2 WIRING TERMINATIONS

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

2.3 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235.
- .2 Make sure all motors, electric heating components, control devices and electric equipment operate satisfactorily at 60 Hz and within the operating limits established by above standard. They must be able operate in extreme conditions established in above standard without damage to equipment.

2.4 ROOF CROSSINGS

- .1 When a cable or conduit passes through the roof, the Contractor shall take all necessary means to ensure that expansion and contraction do not deteriorate the roof structure. Refer to Division 01 drawings and specifications for instructions.

2.5 EQUIPMENT SUPPORTING STRUCTURES

- .1 All suspended equipment must be secured to the building frame or envelope.
- .2 Provide and install a freestanding wall on channels, secured to the wall and slab for the installation of variable frequency drives (VFDs), filter, disconnect switches as indicated on drawings.
- .3 Install disconnect switches on U-shape channels.

2.6 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 The respective responsibilities of the Supplier and Installer are indicated on motor, equipment and control tables on mechanical drawings and the related responsibilities with regard to mechanical installations are indicated on the mechanical equipment table on the mechanical and electrical drawings.
- .2 Review responsibilities with regard to installation and coordination of motors and control devices, as indicated.
- .3 Control wiring and related conduits must be provided under the Electrical Division, with the exception of conduits, wiring and connections operating at lower than 50 V and with regard to the control systems specified in the Mechanical Division and on mechanical installation drawings.

2.7 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.

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

2.8 CABLE IDENTIFICATION

- .1 Identify wiring with permanent, indelible markings using plastic numbered tape on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase order and same colour scheme throughout and for entire length.
- .3 Identify all neutrals with suitable numbered circuit(s) at all connections and pull boxes.
- .4 Colour code must be to CSA C22.10 (*Code de construction du Québec*, Chapter V – Electricity, 2010 Edition).
- .5 Identify conductors according to the following colour code:

- .1 Control wiring (up to 120 V):

Colour	Utility
Red	Control (min. AWG 16)
White	Neutral
Black	Power
Blue	DC
Green	Ground

- .6 Power wiring (120 V to 750 V):

- .1 3-phase:

Colour	Utility
Red	Phase A
Black	Phase B
Blue	Phase C
White	Neutral
Green	Ground
Green Yellow (line)	Insulated ground

.2 Single phase:

Colour	Utility
Black	L1
Red	L2
White	Neutral
Green	Ground
Green Yellow (line)	Insulated ground

.7 Use colour coded wires in communication cables, matched throughout network.

.8 Paint the following red: junction boxes, pull boxes, splitter boxes, fittings and connections for the fire alarm network.

2.9 RECEPTACLE AND SWITCH IDENTIFICATION

.1 Receptacles and switches must be identified with a self-adhering plastic tag (P-Touch), 12.7 mm by 12.7 mm with panel and circuit number.

.2 Outlet and receptacle location

.1 Locate outlets and receptacles in accordance with Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change location of outlets and receptacles at no extra cost or credit, providing distance does not exceed 3,000 mm, and information is given before installation.

2.10 LABELLING SYSTEM

.1 Labelling

.1 All labels are to be machine fabricated and of professional quality; labels are to be either transparent heat-shrinkable film or stickers.

.2 Stickers may be used for patch cords.

.3 Ink is to be indelible.

.4 No handwritten labels will be accepted.

2.11 EQUIPMENT, CONDUIT AND CABLE IDENTIFICATION

- .1 Identify equipment with nameplates and labels in accordance with the following specifications:
 - .1 Nameplates for components and equipment: plastic laminate or Lamicoid 3 mm minimum thick engraving sheet, black matt face, white core, lettering accurately aligned and engraved into core, mechanically attached with self tapping screws.
 - .2 Nameplates for components and equipment on emergency distribution network: plastic laminate or Lamicoid 3 mm minimum thick engraving sheet, red matt face, white core, lettering accurately aligned and engraved into core, mechanically attached with self tapping screws.
 - .3 Format in accordance with table below:

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

- .4 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .5 Wording on nameplates and labels to be approved by the Departmental Representative prior to manufacture.
- .6 Allow for at least twenty-five (25) letters per nameplate and label.
- .7 Terminal cabinets and pull boxes: indicate system and voltage on nameplates.
- .8 Wording on nameplates and terms to be reviewed and approved by Departmental Representative prior to manufacture.
- .9 Transformers: indicate capacity, primary and secondary voltages.
- .10 Identify each panel, transformer, disconnect, splitter box, starter, VFD, heating coil, etc.
- .11 Nameplates for terminal cabinets and junction boxes to indicate network and/or voltage characteristics.
- .12 Wording must be in French and English.

.2 Colour code conduits, boxes and metallic sheathed cables.

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

	Prime Colour	Auxiliary Colour
Up to 250 V	Yellow	
Up to 600 V	Yellow	Green
Up to 5 kV	Yellow	Blue
Up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	
Fire Alarm EMT conduit	Red	
Other Security Systems	Red	Yellow
Emergency Voice	Red	Blue

- .3 Identify wiring with permanent indelible identifying markings, using numbered plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .4 Maintain phase sequence and colour coding throughout.
- .5 Colour coding: to CSA C22.1.
- .6 Use colour coded wires in communication cables.
- .7 Update typewritten card inside modified panels and add the new panels identifying power circuits.
- .8 Identify power outlets with a self-adhesive plastic label indicating the panel number and power circuit. Labels must be white with black lettering.
- .9 For identification inside junction boxes, paint entire edge of junction boxes as per colour code, but not the cover. Using a thick indelible marker, identify the source (panel) and circuit numbers on the cover for all wiring penetrating junction and pull boxes when located in an unfinished or ceiling space.

PART 3. EXECUTION

3.1 EXAMINATION

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

3.2 RESPONSIBILITIES

- .1 Note that the present article specifies some of the Contractor's requirements, obligations and responsibilities during work execution:
 - .1 The Contractor must indicate, in a timely manner, all spaces to be left in walls, ceilings, roofs, floors and partitions for the installation of equipment, materials and conduits.
 - .2 For this purpose, the Contractor must coordinate his work in order to locate all necessary sleeves and openings in a timely manner. Execute all cutting and patching required for conduit and cable crossing, their costs being the responsibility of the present Contractor.
 - .3 Remove, when work is completed, all tools, waste, surplus of material and waste material resulting from work executed. Ensure that equipment and material installed are not damaged; if they are, repair them or replace them.
 - .4 Carefully store all equipment, material, accessories and conduits in selected locations, not to interfere with traffic.

3.3 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 All free-standing electrical equipment must be installed on housekeeping pads 100 mm high and dimensions as per equipment.

3.4 PROTECTION OF WORK

- .1 Protect electrical installations against all damage until the complete work has been accepted by the concerned authority.

- .2 Protect floors against all deposits or waste that can damage it when work benches are installed inside the building.

3.5 SCHEMATICS, DIAGRAMS AND PLAN VIEWS

- .1 All schematics, diagrams, typical details, plan views and cuts shown on electrical drawings, as well as included in specifications, are complementary. The Contractor must provide and install all equipment, materials and electrical accessories shown on schematics, diagrams, typical details, plan views, cuts and/or in specifications without additional remuneration.

3.6 OPERATING INSTRUCTIONS

- .1 Provide operating instructions for each main system and 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 main 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.

3.7 MANUFACTURER'S INSTRUCTIONS

- .1 All devices, accessories and equipment, etc., must be installed, connected and made operational in strict conformity with the most recent instructions and recommendations from the equipment manufacturers. When the drawings and specifications do not show required accessory details or connections in the installation of equipment, the manufacturer's recommendations apply to the installation in question and these accessories and connections are part of the drawings and specifications as if specifically mentioned within. If the Contractor is in doubt, he will present a case to the Departmental Representative, whose decision will be final.

- .2 Fittings, flexible joints, shock absorbers, supports, thermal insulation, sound attenuating insulation, valves, in addition to all accessories necessary according to the instructions and recommendations of the equipment manufacturer, even if not mentioned on drawings, in specifications or addenda, must be furnished and correctly installed as per the most recent standard in effect and requirements with respect to these standards.

3.8 NAMEPLATES AND LABELS

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

3.9 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify with Departmental Representative before proceeding with installation.
- .3 Install electrical equipment at following heights, unless indicated otherwise.
 - .1 Distribution panels: to Code requirements or as indicated.
 - .2 Disconnect switch, starter and contactor: 1,250 mm.
 - .3 Electric panels (top of panel): 1,800 mm.
 - .4 Equipment must be installed at height indicated on drawings, but never less than 102 mm from the floor.

3.10 PROTECTION OF WORK

- .1 During construction work, protect exposed and live equipment to ensure personnel safety.
- .2 Close off and identify rooms with live equipment with the warning sign "DANGER – LIVE VOLTAGE – 600 V OR 120 V".
- .3 Provide temporary doors to close off rooms with electrical distribution equipment. Padlock these doors unless when an electrician provides direct supervision of such.
- .4 Utility interruptions
 - .1 If electrical utilities are to be interrupted, this must take place outside of normal work hours. Normal work hours are defined in the tender documents. Following a written agreement with the Departmental Representative, this work may be conducted outside of the normal work hours.
 - .2 The Departmental Representative must be notified in writing of any interruptions to the electrical utilities a minimum of seven (7) working days prior to the said interruption.

- .3 Building utilities must not be interrupted without the Departmental Representative's written approval.
 - .4 The Contractor must obtain a utility interruption permit from the Departmental Representative before interrupting any utility.
 - .5 The written request from the Contractor must include the zones affected and length of utility interruption.
 - .6 Submit work calendar to the Departmental Representative and obtain approval from Departmental Representative with regard to temporary interruption of existing utilities or networks. Perform utility interruptions according to approved calendar and provide prior notification of such to persons affected.
 - .7 Take all necessary precautions to avoid disturbing building operations. Perform connection work to existing networks at times set out by the Departmental Representative while being as unobtrusive as possible to pedestrian and vehicle traffic.
 - .8 If work or testing must be conducted in occupied rooms, the Contractor must obtain permission from the Departmental Representative and coordinate his work as a result, for any utility interruption, if necessary.
 - .9 When required, the Contractor must ensure continuous existing utilities in the sectors concerned. The provision, installation and connection of all equipment to this effect must be included in the present contract.
- .5 Lock-out procedure
- .1 Lock-out procedure request (complements the prevention program under the Loi sur la santé et la sécurité au travail). Among other things, the Contractor must use the Departmental Representative's approval and follow-up procedure and forms.
 - .2 The Contractor is responsible for coordinating required shutdown and lock-out between the various technical personnel of the Departmental Representative and the Contractor. No live work is to take place without prior agreement. Verbal agreements will not be accepted.
 - .3 The Departmental Representative must be informed of any lock-out procedure request from the Contractor.
 - .4 The written request must include the date, time, Contractor's delegated persons, description and length of work. **This memo must be transmitted to the Departmental Representative 72 hours prior to the set date.**
 - .5 Obtain the Departmental Representative's approval before shutting down existing services. The Site Superintendent must be present during these procedures.

- .6 The Contractor must take into consideration the following principles in work planning:
 - .1 At any time work is performed on an electrical panel, this panel's supply will be locked out. The policy promulgated by the Ministry is to work at all times in **Zero Energy** mode.
 - .2 In general, lock-out procedures will not take place before 7:30 a.m. Anticipate a period of approximately 30 minutes for lock-out procedures for which the Contractor's superintendent must be present.

3.11 OPENINGS IN FIRE-STOP WALLS AND FLOORS

- .1 Seal all existing and new openings in fire-stop walls and floors once piping or ducts have been passed to restore the resistance of fire-stop walls and floors.
- .2 Seal all openings around crossing into walls and screens that are not fire rated, and on visible surfaces of dry wall and concrete or masonry barriers using sealing product made of modified latex acrylic elastomer and fire-resistant caulking 3M Fire Barrier CP-25WB+ or Hilti FS-One. On concealed dry wall, use rubber base synthetic Acoustical Sealant from Tremco.
- .3 ULC and/or FM approved products.
- .4 Consult architectural drawings for the location of seal-tight, acoustic and masonry walls.
- .5 The Contractor of the present section is responsible for all openings 154 mm and smaller while openings of 154 mm and larger will be made by the General Contractor. An X-ray of the slab is mandatory before any openings are made due to the presence of existing conduits in the slab.
 - .1 Prior to making any openings in a critical sector the Electrical Contractor must use all technical means possible to detect the presence of an existing conduit:
 - .1 Thermographic survey.
 - .2 Metal detector to detect metal conduits.
 - .3 Radar.
 - .4 X-ray.

3.12 SLEEVE INSTALLATION

- .1 General: use sleeves for all wall, floor and slab crossings.
- .2 Install conduits and sleeves before pouring concrete. Install sleeves passing through concrete and concrete block walls, use steel pipe, series 40, diameter to allow conduit clearance and extending concrete by 2 in. on either side of a wall or floor.

- .3 For conduits that pass through fire-rated walls and floors, fill interstitial space between the sleeve and conduit with a flame-retardant compound.

3.13 CONCEALED CABLES AND CONDUITS

- .1 Install cables and conduits to be concealed neatly and closely to building structure to minimize furring.

3.14 AS-BUILT DRAWINGS

- .1 As-built drawings provided by the Contractor
 - .1 As-built drawings:
 - .1 Prior to commencing testing and balancing of circuits, complete as-built drawings.
 - .2 Identify each drawing in the lower right-hand corner, in minimum height letter of ½ in., as follows: AS-BUILT DRAWINGS: THE FOLLOWING DRAWING HAS BEEN REVISED AND ILLUSTRATES ELECTRICAL EQUIPMENT/MATERIAL AS THEY HAVE BEEN INSTALLED. (Contractor's signature) (Date)
 - .3 Submit as-built drawings to the Departmental Representative for verification purposes. Make necessary corrections following comments from the Departmental Representative.
 - .4 Perform tests, start-up and circuit balancing of equipment, material and networks keeping in mind the as-built drawing mark-ups.
 - .5 Submit reproducible copies of completed as-built drawings with the O&M manuals.

3.15 START-UP

- .1 Start up all equipment. Ensure proper functioning and demonstrate that the equipment and materials correspond to the requirements of drawings and specifications.

3.16 TESTING

- .1 Once the Contractor has completed his work or a portion of his work, the Contractor will, at his own expense, and in the presence of the Departmental Representative, conduct testing to prove that his installation fulfills all of the required conditions. If the installation appears to be defective in any manner, the Contractor is responsible to remedy such and redo testing at his own expense until test results are satisfactory.
- .2 All motors shown on Division 23 drawings must be verified as per the requirements of testing sheets, whether provided or not by Divisions 23 and 26.

- .3 Assist the Contractor of Divisions 21, 22, 23 and 25 in conducting testing on Division 26 electrical equipment.
- .4 Submit test results to the Departmental Representative.

3.17 FIELD QUALITY CONTROL

- .1 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.
- .2 Carry out tests in presence of the Departmental Representative.
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of work.
- .4 Manufacturer's field services. Obtain written report from manufacturer verifying compliance of work, in handling, installing, applying, protecting and cleaning of product.
 - .1 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.

3.18 OPERATING, MAINTENANCE AND PERFORMANCE SHEETS

- .1 Include on operating sheets:
 - .1 Description of measures to take in case of equipment failure.
 - .2 Copy of all shop drawings.
- .2 Include on maintenance sheets:
 - .1 Instructions with regard to maintenance, operating and correction of failures for each piece of equipment.
 - .2 List of periodical maintenance recommended by manufacturers, frequency and required tools.
- .3 Include on performance sheets:
 - .1 Performance sheets provided by the equipment manufacturer with "as-built" set points.
 - .2 Performance testing results for equipment.
 - .3 Results of special performance testing, as set out in the various specifications sections.

- .4 Compile and present operating and maintenance sheets and performance data in an “Operation and Maintenance Manual”.

3.19 O&M MANUAL

- .1 Manual:
 - .1 An organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual products or systems as specified in individual sections of the specifications.
- .2 General:
 - .1 Assemble, coordinate, bind and index required data into “Operation and Maintenance Manual”.
 - .2 Submit complete “Operation and Maintenance Manual” to Departmental Representative two (2) weeks prior to substantial work completion. Make necessary changes to manual as per instructions and resubmit.
 - .3 Submit two (2) paper copies of the manual in French and English.
 - .4 Submit two (2) CDs of the O&M Manual in French and English.
 - .5 Organize data into same numerical order as specifications sections.
 - .6 Label each section with tabs protected with celluloid covers fastened to hard paper dividing sheets.
 - .7 Type lists and notes.
 - .8 Drawings, diagrams and manufacturers’ literature must be legible.
 - .9 Incorporate a colour single-line schematic into each manual.
- .3 Shop drawings:
 - .1 Bind separately one complete set of revised shop drawings and product descriptions as indicated in “Shop Drawings and Product Data”.

3.20 WARRANTY AND RESPONSIBILITY

- .1 Before requesting a final inspection, the Contractor must guarantee in writing, in duplicate, that all the systems, devices, accessories, material and work are in compliance with the drawings and specifications, that they are free from all mechanical and/or electrical defects, and they are guaranteed for one (1) year from the beginning of the guarantee against all defects resulting from normal usage. Each contractor must send a letter to the Departmental Representative in which they agree to respect the guarantee.

- .2 Should a defect be discovered within the guarantee period, the Contractor must immediately replace and/or repair all defective parts of the systems or work, with no charge to Departmental Representative. He is also exclusively responsible for all repairs and/or replacement caused by the defective equipment.
- .3 In addition, the Contractor must consider that, should a device, accessory, etc., be defective, the Departmental Representative has the right, in the Departmental Representative's interest, to require an extension of the guarantee for a period equal to the elapsed time between the discovery of the defect and the beginning of the guarantee.
- .4 The pre-written requirements apply, whatever the agreement or arrangement between the Contractor and his providers. The Contractor must therefore protect himself when placing orders.
- .5 At no additional cost and at any time following the date of the beginning of the guarantee, the Contractor must also supply and install any article required by the drawings and/or specifications that could have been omitted by a specific written authorization. He must also replace any article that has not been approved and that is not in compliance with the drawings and specifications. The Contractor is the only one responsible for all the direct and indirect costs caused by this necessity to make corrections.
- .6 The present article does not diminish in any way the Contractor's responsibility concerning construction defects as stated in the law.
- .7 The Contractor must not make any excuses, nor claim a defect in the original material or in the work of another contractor with whom he must work or continue or complete work to justify a defect in a finished product for which he is responsible.
- .8 The fact that the Contractor begins work signifies that he approves the materials and preliminary work and renders himself the only person responsible for the finished product.

3.21 SYSTEM START-UP

- .1 Provide these services for a sufficient period of time, anticipating the number of visits necessary to start up the equipment and installations and ensure that the operating personnel is familiar with all aspects of equipment and installations start-up.
- .2 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.

3.22 CLEANING

- .1 Clean, to the satisfaction of the Departmental Representative, all areas affected by work.

END OF SECTION

PART 1. GENERAL**1.1 RELATED SECTIONS**

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 05 21 – Wires and Cables (1–1,000 V).

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2 No.18-[98], Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .2 CSA C22.2 No. 18.4-04 (R2009) – Hardware for the Support of Conduit, Tubing and Cable.
 - .3 CSA C22.2 No.65-[93(R1999)], Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA).

1.3 SUBMITTALS

- .1 Submit documents and samples in accordance with Section 01 33 00 - Submittal Procedures with regard to shop drawings, data sheets and samples.

PART 2. PRODUCTS**2.1 EQUIPMENT**

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

- .5 Connections and joints for conductors 8 AWG or larger with non-insulated, seamless compression connectors.
- .6 Clamps for stranded aluminum conductor.
- .7 Stud clamp bolts.
- .8 Clamps or connectors for armoured cables, TECK cables and flexible conduits, as required to: CAN/CSA-C22.2 No.18.4.

PART 3. EXECUTION

3.1 VERIFICATION

- .1 Verification of conditions: before commencing installation of wire and box connectors, verify that conditions of substrate previously installed under other sections or contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 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 to CAN/CSA-C22.2 No.65.
 - .4 Install bushing stud connectors in accordance with related NEMA standards.

END OF SECTION

PART 1. GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 05 20 – Wire and Box Connectors (0–1,000 V.
- .3 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)/CSA International
 - .1 CSA C22.2 No.0.3-09 Test Methods for Electrical Wires And Cables.
 - .2 CAN/CSA C22.2 No. 131 – 07 (R2012) Type TECK 90 Cable.
 - .3 C22.2 No. 51-95 (R1999), Armoured Cables.
 - .4 C22.2 No. 35-M1987 (R2004), Extra-Low-Voltage Control Circuit Cable, Low-Energy Control Cable, and Extra-Low-Voltage Control Cable.

1.3 INFORMATION SUBMITTALS

- .1 Submit documents and samples in accordance with Section 01 33 00 - Submittal Procedures with regard to shop drawings, data sheets and samples.

1.4 MATERIAL OR PRODUCTS OF ACCEPTANCE

- .1 When materials or products are specified by trademark, consult the Tenderer Instructions for procedure to follow with regard to request for approval of replacement materials or products.

PART 2. PRODUCTS

2.1 BUILDING WIRING

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with insulation of cross-linked thermosetting polyethylene material rated 600 V and RW90XLPE and/or RWU90XLPE, for equipment at 120/208 V and 347 V in the overall secondary distribution.
- .3 Copper conductors: size as indicated, with insulation of cross-linked thermosetting polyethylene material rated 1,000 V and RW90XLPE and/or RWU90XLPE, for equipment at 600 V in the overall secondary distribution.
- .4 Branch circuit wiring power supply cables for receptacles, lighting fixtures, or by direct connection must be minimum 10 AWG. Connection may be made using 12 AWG rated conductors from the last junction box.

- .5 The following data must be indicated at regular intervals on cables and conductors:
 - .1 Gauge.
 - .2 Conductor and insulation type.
 - .3 Manufacturer's name.
 - .4 Type FT4 flame retardant for conduit sheath or jacket.

2.2 TECK90 CABLES

- .1 No TECK cables allowed on this project.

2.3 ARMoured CABLES

- .1 No armoured cables allowed on this project.

2.4 CONDUCTOR COLOUR CODING

- .1 Within the system circuits, the phase colours will be black, red, blue, etc., and neutrals will be white.
- .2 Bonding conductors will be installed in all conduits. Conductors that are used in bonding will be insulated, green and of the capacity as per the Electrical Code.
- .3 Conductors that are used in grounding equipment, special outputs, special receptacles and insulated receptacles will be insulated, green and of the capacity as per the Electrical Code.

2.5 NEUTRAL CONDUCTORS

- .1 There will be a neutral conductor for each breaker pole to protect single-phased loads when there is a two- or three-pole breaker.
- .2 All circuits protected by a single-pole breaker must have its own neutral conductor.

2.6 CONDUCTOR GAUGE

- .1 Conductor gauge, the dimensions of which are indicated on drawings, is the minimum size. When conductors are not indicated on drawings, provide and install type and gauge that meets Canadian Electrical Code, latest edition.
- .2 Wiring to connect CSA 5-20R receptacles must be #10 AWG.

PART 3. EXECUTION

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical.

- .2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors (0–1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 – Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Concealed wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend.
- .8 Install a green bonding conductor in each rated conduit as defined by the requirements of the *Code de l'électricité du Québec*, table 16.

3.3 BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 Cable terminations in accordance with Section 26 05 20 – Wire and Box Connectors (0 – 1,000V).
 - .3 In conduits, as per the requirements of Section 26 05 34. Provide distinct conduits for each type of system or load, for example: do not install lighting fixture conductors with those of receptacles in the same conduit; or alarm intrusion conductors with access control or camera surveillance conductors; or mechanical system motor conductors with those of process system motors; and so on.

- .4 In raceways or conduits having at least four (4) conductors or more, increase conductor gauge based on the following correction factors:

<u>Conductors</u>	<u>Correction Factor</u>
4 to 6	80%
7 to 24	70%
25 to 42	60%
43 and more	50%

- .5 Install a green bonding conductor in each gauge conduit defined in the requirements of the Quebec Electrical Code, Table 16, 2010 Edition.
- .2 Install, as needed, connection adaptors when equipment is not designed to receive aluminum cables or when lugs are of insufficient gauge for aluminum conductors.
- .3 Each circuit must be equipped with a **separate neutral**.

END OF SECTION

PART 1. GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 20 – Wire and Box Connectors (0–1,000 V).
- .2 Section 26 05 21 – Wires and Cables (0–1,000 V).

1.2 REFERENCES

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 MATERIAL OR PRODUCTS OF ACCEPTANCE

- .1 When materials or products are specified by trademark, consult the Tenderer Instructions for procedure to follow with regard to request for approval of replacement materials or products.

PART 2. PRODUCTS**2.1 CONNECTORS AND TERMINATIONS**

- .1 Copper long barrel compression connectors to CSA C22.2 No.65 as required sized for conductors.
- .2 Contact aid for aluminum cables where applicable.
- .3 2-way joint boxes, dry location type.

- .4 Junction boxes with respective pothead for conductor cables with allowance for stress (within and beyond), for X-linked polyethylene, polyethylene cables with or without copper or aluminum sheath and overall jacket as indicated.

2.2 PRODUCTS OF ACCEPTANCE

- .1 Products from the following companies: Leviton, Hubbel and Legrand.
- .2 Replacement products must be approved by addenda in compliance with Tenderer Instructions.

PART 3. EXECUTION

3.1 INSTALLATION

- .1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2 No.41.
- .3 Install connectors for lighting fixtures and tighten. Replace insulating cap.

END OF SECTION

PART 1. GENERAL**1.1 RELATED SECTIONS**

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

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE 837-[1989(R1996)], Qualifying Permanent Connections Used in Substation Grounding.
 - .2 Canadian Standards Association (CSA International).

PART 2. PRODUCTS**2.1 EQUIPMENT**

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Insulated grounding conductors: green, type RW90 for indoor use or RWU90 for exterior use.
- .3 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

PART 3. EXECUTION**3.1 INSTALLATION – GENERAL**

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT or flexible conduits are used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from damage.

- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 Ground secondary service pedestals.

3.2 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to the following list: service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, , distribution panels and lighting network.

3.3 FIELD QUALITY CONTROL

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

END OF SECTION

PART 1. GENERAL

1.1 RELATED SECTIONS

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

1.2 REFERENCES

- .1 National Building Code 2010 (NBC).
- .2 User's Guide – Structural Commentaries on the National Building Code 2010 (Part 4).
- .3 SMACNA – Seismic Restraint Manual Guideline for Mechanical Systems.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit documents and samples in accordance with Section 01 33 00 - Submittal Procedures with regard to shop drawings, data sheets and samples.
- .2 Identify specified elements on the manufacturer's documentation:
 - .1 Anchoring.
 - .2 Supports.
 - .3 Bracing.
 - .4 Seismic protection.
- .3 Submit shop drawings and calculations for seismic restraint systems for approval. These documents must be stamped by a member of the *Ordre des ingénieurs du Québec*.
- .4 Upon completion of work the Contractor must submit a signed and stamped certificate from a standing member of the *Ordre* who specializes in seismic controls confirming that the work has been carried out in accordance with standards in effect.
- .5 Provide separate shop drawings for each system, shop drawings of the overall system, complete with performance and product data.
- .6 Provide separate shop drawings and performance data for each seismic restraint system and devices used for equipment.
- .7 The Contractor must hire an experienced manufacturer to design, supply and supervise installation of all seismic control measures.
- .8 All manufacturers of seismic control measures are responsible for designing, supplying and supervising installation of seismic control measures. The manufacturer remains responsible for the structural integrity of seismic control measures.

1.4 SEISMIC CONTROL MEASURES

- .1 Seismic restraints must meet the requirements in the standards and guides listed in section 1.2.
- .2 Design, supply and install a complete seismic restraint system for electrical equipment, both vibration isolated and statically supported against vibrations and related systems.
- .3 The seismic restraint system is to be fully integrated, and compatible with noise and vibration controls of electrical equipment and related systems as specified on the drawings and elsewhere.
- .4 The seismic restraint system is to be fully compatible with the mechanical, electrical and structural design of the building.

1.5 SEISMIC CONTROL WORK

- .1 The Contractor must, without being limited to, supply and install all materials necessary to seismically restrain electrical equipment.
- .2 The Contractor shall supply and install two (2) suspension cables (without obligatory lateral crossbracing) able to resist seismic loads for the following equipment:
 - .1 Recessed, inverted T lighting fixtures or another type of suspended ceiling.
 - .2 Lighting fixtures (less than 10 kg) suspended more than 50 mm above the fixture up to the structural support.
 - .3 Any other equipment that is recessed and inverted T equipment or any other type of suspended ceiling.
 - .4 Any other equipment that is suspended more than 305 mm above the fixture up to the structural support.
- .3 The Contractor shall supply and install seismic restraints for the following equipment:
 - .1 Freestanding electrical equipment such as:
 - .1 Electrical sub-station.
 - .2 Switchgear centres.
 - .3 Inverter.
 - .4 Motor control centres.
 - .5 Transformers.
 - .6 Generator set.

- .2 Suspended electrical equipment (with mandatory lateral bracing) such as:
 - .1 Lighting fixtures (10 kg and heavier) suspended more than 305 mm from the structure.
 - .2 Transformers.
 - .3 Emergency power conduits suspended more than 305 mm from the structure.
 - .4 Electrical conduits 100 mm and larger.
 - .5 Cabletrays.
 - .6 Shielded bus ducts.
- .3 Electrical equipment secured to wall consoles such as:
 - .1 Transformers.
 - .2 Back-up batteries.

PART 2. PRODUCTS

2.1 GENERAL

- .1 The dimensions and shape of pads, as well as performance characteristics on vibration isolation devices must be in accordance with indications.
- .2 The seismic restraint systems must be able to sustain forces in all directions.
- .3 Fasteners and attachments to structure must be able to resist the same loads as the seismic restraint materials.
- .4 High resistance chemical anchoring must be used to fasten seismic protection holes to the concrete structure. Drilled or power driven anchors and fasteners are not permitted.
- .5 Unless otherwise indicated, the seismic control measures must be designed and chosen to meet the requirements of the latest edition of the National Building Code 2015 and its supplement.
- .6 The anchorings must be designed to respect a Risk Coefficient (IE) of 1.0 (medium risk category), for buildings other than High Risk and Civil Protection, taking into account the ground characteristics and the seismic spectral response acceleration applicable to the region of the project.
- .7 The seismic restraint system shall prevent the mechanical and electrical systems and equipment and related systems from causing personal injury and moving from their normal position during a seismic event. The anchored equipment must remain in operation as if in normal conditions during a seismic event.

- .8 The manufacturer of the seismic restraint systems must obtain all information relating to the equipment and electrical conduits necessary for seismic restraint system design calculations (weight, number, thermal insulation, run, spacing between supports, and grouping on supports).
- .9 The manufacturer of the seismic restraint systems must obtain the information listed below from the equipment manufacturers:
 - .1 Weight, location of centre of gravity, number of fastening points, location of fastening points' centre of gravity, rotation speed, seismic sensitivity of internal components and so on.
- .10 The design calculations and installation details with regard to anchoring bolts and seismic restraint systems must be verified by a professional engineer specializing in seismic design.
- .11 Provide seismic restraint systems shop drawings and calculations.
 - .1 Provide for each piece of equipment:
 - .1 Identification.
 - .2 Manufacturer's name and model.
 - .3 Physical dimensions.
 - .4 Weight.
 - .5 Location of centre of gravity (indicate if location was obtained by equipment manufacturer or speculated).
 - .6 Location and number of fastening points.
 - .7 Location of fastening points' centre of gravity (if centre of gravity is different than the equipment's centre of gravity).
 - .8 Rotation speed (if necessary).
 - .9 Seismic sensitivity of equipment's internal components.
 - .2 Anchoring bolt calculations indicating:
 - .1 Type of bolts, manufacturer and model.
 - .2 Diameter.
 - .3 Embedment in concrete.
 - .4 Concrete compression force.
 - .5 Minimum spacing between bolts and concrete edges or joints.

- .6 Applied and allowable loads in shear and tension.
- .3 Types of seismic restraint systems for each piece of equipment and indicate characteristics of cables and rigid members.
- .12 The seismic restraint systems manufacturer must provide written proof confirming that the drawings, specifications, shop drawings, as well as the installation, were verified by a professional engineer specializing in seismic design and are adequate and compatible with the overall building and meet seismic standards.
- .13 All seismic control measures must be entirely integrated and compatible with sound attenuating standards, vibration isolation systems for electrical equipment and related systems, as specified on drawings and elsewhere.
- .14 All seismic control measures must be compatible with the electrical and structural design of the building. Seismic control measures must not impede on the normal functioning of electrical systems.
- .15 Do not add seismic control measures to existing electrical conduit supports without verifying the capacity of these supports to resist any additional forces.
- .16 Seismic restraint measures must not interfere with functioning or integrity of firestopping equipment.
- .17 When required to prevent buckling, stiffeners must be added to suspension rods.

2.2 FASTENERS AND EQUIPMENT SUPPORTS

- .1 Expansion anchors to be recessed in order to secure equipment to the surfaces of poured concrete.
- .2 Toggle bolts to secure equipment to hollow masonry walls or suspended ceilings.
- .3 Protection against mechanical damage of all instruments, ducts, etc., that are prone to breakage.
- .4 Components of the seismic restraint systems are to be manufactured in accordance with the following standards:
 - .1 Cold formed angles must be in accordance with standards CSA S136-M89 and CSA S136.1-M91 for a minimum F_y equal to 230 MPa and a maximum F_y equal to 260 MPa. The following thicknesses must be respected.

Gauge	Minimum Thickness before Painting (mm)	Minimum Thickness after Galvanisation (mm)
12	2.66	2.75
14	1.90	1.99
16	1.52	1.61

- .2 Steel structural members: standard channels and plates must be in accordance with standard CSA G40.21, latest edition, grade 350W.
- .3 Steel tubing used as bracing must be in accordance with standard ASTM A53.
- .4 Bolts for assembly must be in accordance with standard ASTM A325. Anticipate an opening 2 mm larger than bolt diameter.
- .5 Provide technical data sheets and resistance of bolts to be secured to concrete.
- .6 Welding must be in accordance with standard CSA W59, latest edition and carried out by experienced welders according to standard CSA W47.1, latest edition.
- .7 Oblong openings for adjusting bolts are not permitted.

2.3 CONDUITS AND CABLE FASTENERS AND SUPPORTS

- .1 Flanges to fasten exposed cables or conduits to the building structure or support system.
 - .1 One-hole malleable iron or steel flanges for surface fastening of conduits and cables 50 mm diameter or less.
 - .2 Two-hole steel flanges to fasten conduits and cables of more than 50 mm diameter.
 - .3 Steel frames to fasten conduits to exposed structural steel work.
- .2 Suspended support systems:
 - .1 Support each cable or conduit with threaded rods and spring clips.
 - .2 Support at least two (2) cables or conduits on suspended U channels to threaded suspended rods, when impractical to fasten them to the building structure.
 - .3 Surface-mounted supports to stabilize two (2) or more conduits to the U channels. Use surface-mounted or suspended U channel supports of 41 mm x 41 mm x 2.5 mm thick. Acceptable products: Burndy, Unistrut, or Canstrut.
 - .4 Provide metallic brackets, mounting, hooks, clamps and other types of supports in locations indicated or as needed to support the conduits and cables.
 - .5 Do not use tie wires or perforated iron hangers to support or fasten conduits or cables.
 - .6 Ensure adequate support for equipment with vertical-installed conduits when there is no wall support.

- .7 Do not use other trades' supports or installed equipment as conduit supports, unless otherwise permitted by other trades and with the Departmental Representative's approval.
- .8 Use of Ramset nails is not permitted.

2.4 SEISMIC RESTRAINT SYSTEMS FOR STATIC EQUIPMENT (WITHOUT NEED FOR VIBRATION ISOLATED EQUIPMENT)

- .1 Floor-mounted equipment:
 - .1 Anchor equipment to supports, which must be anchored to structure by using bolt sizes as indicated on shop drawings.
- .2 Suspended equipment:
 - .1 Use one or a combination of the following methods as per site conditions:
 - .1 Anchor equipment tightly to structure.
 - .2 Cross-brace equipment in all directions.
 - .3 Brace back to structure.
 - .4 Anchor equipment with slack cables.
 - .2 Seismic restraint system to allow for cushioning action to be gentle and steady by utilizing elastomeric material or other means to avoid high impact loads.
- .3 Supports must be able to resist all static and dynamic conditions, including the following:
 - .1 Their weight, plus accessories, insulation and internal fluids.
 - .2 Forces imposed by thermal effect of expansion and contraction.
 - .3 Reactions as a result of start-ups and stops.
 - .4 Vibrations.
 - .5 Other occasional loads such as ice, wind and seismic forces.

2.5 SEISMIC RESTRAINT SYSTEMS FOR VIBRATION ISOLATED EQUIPMENT WITH SPRINGS

- .1 Floor-mounted equipment:
 - .1 Apply one or more of the following methods according to the site conditions:
 - .1 Use vibration isolation devices with integrated shock absorbing system.

- .2 Use independent shock absorbers in addition to the vibration isolation devices.
- .3 Use a manufactured shock absorbing system composed of structural elements and an elastomeric layer, with the Departmental Representative's approval.
- .4 Reinforce equipment in all directions.
- .2 Seismic restraint system must not hinder performance of sound attenuating and vibration isolation systems. Anticipate a clearance of 4 mm to 8 mm—under normal operating conditions of equipment and systems—between the seismic restraint system's shock absorbers and equipment.
- .3 Incorporate seismic restraints into vibration isolation systems to resist complete isolator unloading.
- .4 Cushioning action, by utilizing elastomeric material or other means, must be gentle and steady to avoid high impact loads.
- .2 Suspended equipment:
 - .1 Use one or a combination of the following methods as per site conditions:
 - .1 Anchor equipment with slack cables.
 - .2 Reinforce equipment fastening points to the structure via vibration isolation devices with integrated shock absorbers or additional independent shock absorbers.
 - .3 Supports must be able to resist all static and dynamic conditions, including the following:
 - .1 Their weight, plus accessories, insulation and internal fluids.
 - .2 Forces imposed by thermal effect of expansion and contraction.
 - .3 Reaction as a result of start-ups and stops.
 - .4 Vibrations.
 - .5 Other occasional loads such as ice, wind and seismic forces.
 - .4 Seismic restraint system must provide gentle and steady cushioning action to avoid high impact loads.

PART 3. EXECUTION

3.1 INSTALLATION

- .1 Install vibration isolation equipment in accordance with the manufacturer's instructions and adjust mountings to level equipment.

- .2 Ensure conduit and cable connections to vibration isolation equipment and instruments do not reduce vibration isolation system flexibility and that conduits and cables passing through walls or floors do not transmit vibrations.
- .3 When vibration isolation equipment is bolted to floor, use vibration isolation rubber washers.
- .4 Block and shim level bases so that conduits and cables can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no contact between the isolated equipment and building structure.
- .5 All fastening and attachment points to resist same maximum load as seismic restraint in accordance with the most recent edition of the National Building Code 2010 and its supplement.
- .6 Connect cable protection devices to suspended equipment so that axial projection of wires passes through centre of gravity of equipment.
- .7 Install cables using grommets, assembly lugs and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.
- .8 Orient restraint cables on ceiling-hung equipment at approximately 90° to each other (on drawing), tie back to structure at maximum 45° to structure.
- .9 Clearance of at least 25 mm is to be anticipated between seismic restraint equipment and any other equipment or service element.
- .10 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.
- .11 Bolt all equipment that is not isolated to the structure.
- .12 Install fasteners and supports according to each type of equipment, conduit or cable, while following the manufacturer's guidelines.
- .13 Brace all conduits and cables as follows:
 - .1 All conduits and cables 32 mm and larger nominal diameter in corridors, boiler rooms, mechanical, electrical and telecommunication rooms and generator set rooms.
 - .2 All conduits and cables 64 mm and larger nominal diameter.
 - .3 However, the conduits or cables fastened by a suspension rod 300 mm long and smaller do not require bracing. The rod length is taken above the conduit or cable up to the structural fastener.
- .14 Use a flexible joint when conduits pass through a building expansion joint, or when conduits are securely fastened to equipment resting on vibration isolation systems.

- .15 Rigid conduits and cables must not be cross-braced to another cross-brace system within the same building because the systems will react differently during an earthquake.
- .16 Riser pipes must be laterally supported at each floor.
- .17 Conduit supports must be equipped with longitudinal and transverse cross-bracing. They may be rigid or cable supports. Always use identical crossbeams within the same bracing (never use a rigid crossbeam with a cable).

END OF SECTION

PART 1. GENERAL**1.1 RELATED SECTIONS**

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Quebec Construction Code, 2010 Edition.
 - .2 CSA C22.2 No. 40-M 1989 (C2009) – Cutout, Junction and Pull Boxes.
 - .3 CSA C22.2 No. 76-M92 (C2012) – Splitters.

1.3 SUBMITTALS

- .1 Submit documents and samples in accordance with Section 01 33 00 - Submittal Procedures with regard to shop drawings, data sheets and samples...
- .2 Product data
 - .1 Provide manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, physical size, finish and limitations.

PART 2. PRODUCTS**2.1 SPLITTERS**

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: connection blocks to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare terminals: minimum three (3) spare terminals on each connection or lug block sized less than 400 A.
- .4 Grey steel box, minimum 14 Ga, continuous copper buses, including seamless lug.

2.2 JUNCTION AND PULL BOXES

- .1 Minimum 16 Ga steel boxes, electrostatically applied finish coat, welded steel construction with screw-on flat covers for surface mounting.
- .2 When exposed, TC type boxes with frame, concealed hinge doors, lock and hidden screws.

- .3 Larger boxes equipped with steel corner frame to create a rigid assembly, sectional and easy-to-remove covers.

2.3 CABINETS

- .1 Construction: welded sheet steel aluminum as indicated, hinged door, handle, latch, lock two (2) keys and catch.
- .2 Type E Empty: surface return flange flush overlapping sides mounting with handle, latch, lock.
- .3 Type T Terminal: surface return flange with flush overlapping sides mounting, hinged door, handle, latch, lock, containing 20 mm ($\frac{3}{4}$ in.) thick fire-resistant plywood backboard.

PART 3. EXECUTION

3.1 SPLITTER INSTALLATION

- .1 Mount plumb, true and square to building lines on fire-resistant plywood sheets 20 mm ($\frac{3}{4}$ in.) thick.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOX AND CABINET INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1 so that the conduits in each box are maximum 30 m long.
- .4 Install access panels when boxes are inaccessible.
- .5 Install terminal block as indicated in Type T cabinets.

3.3 IDENTIFICATION

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

END OF SECTION

PART 1. GENERAL**1.1 RELATED SECTIONS**

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-06, Canadian Electrical Code, Part 1, 2010 Edition.
 - .2 CSA C22.2 No. 18.1-13 Metallic Outlet Boxes.
 - .3 CSA C22.2 No. 18.2-06 (R2011) Non-metallic Outlet Boxes.

1.3 SUBMITTALS

- .1 Submit documents and samples in accordance with Section 01 33 00 - Submittal Procedures with regard to shop drawings, data sheets and samples.
- .2 Product data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for products specified and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 MATERIAL OR PRODUCTS OF ACCEPTANCE

- .1 When materials or products are specified by trademark, consult the Tenderer Instructions for procedure to follow with regard to request for approval of replacement materials or products.

PART 2. PRODUCTS**2.1 OUTLET AND CONDUIT BOXES – GENERAL**

- .1 Size boxes in accordance with CSA C22.10.
- .2 102 mm square or larger outlet boxes as required for specific components.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.
- .7 Boxes in suspended tile ceilings must be securely fixed using Caddy-Erico type supports.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 Extension and plaster rings for flush mounting devices in finished tile walls.
- .5 Electro-galvanized construction conduit boxes for outlets connected to surface-mounted EMT conduits, minimum size 102 x 63 x 48 mm.
- .6 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished tile walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 CONDUIT BOXES

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

2.6 FLOOR BOXES

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brushed aluminum faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 73 mm for receptacles and communication outlets.
- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 21 mm and 27 mm conduit. Minimum size: 73 mm deep.

2.7 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

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

2.8 FITTINGS – GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.

- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.
- .5 Knock-out fillers to prevent entry of debris.

2.9 PLATES

- .1 Provide and install blank stainless steel plates on unused outlet boxes on finished walls.

2.10 PRODUCTS OF ACCEPTANCE

- .1 Products from the following companies: Leviton, Hubbel and Legrand.
- .2 Replacement products must be approved by addenda in compliance with Tenderer Instructions.

PART 3. EXECUTION

3.1 INSTALLATION

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

END OF SECTION

PART 1. GENERAL**1.1 RELATED SECTIONS**

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 05 21 – Wires and Cables (0–1,000 V).

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18-[98(R2003)], Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45-[M1981(R2003)], Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56-[04], Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83-[M1985(R2003)], Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2-[M1984(R2003)], Rigid PVC (Unplasticized) Conduit.

1.3 SUBMITTALS

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

1.4 GENERAL

- .1 Conduit routing is not entirely illustrated on drawings; it is represented schematically.

PART 2. PRODUCTS**2.1 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings, with expanded ends. EMT to be equipped with green insulated grounding conductors without splices, one conductor per bypass circuit for entire EMT routing..
- .3 Rigid PVC conduit: underground installation to CSA C22.2 No. 211.2.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, liquid tight.

- .5 Empty liquid-tight flexible metal conduits (LFMC) with aluminum shielding. They will be equipped with green insulated grounding conductors without splices, one conductor per bypass circuit for entire EMT routing.
- .6 Use minimum 21 in. dia. or larger conduits only.

2.2 CONDUIT FASTENINGS

- .1 One-hole steel straps to secure surface conduits 50 mm and smaller.
 - .1 Two-hole steel straps for conduits larger than 50 mm.
 - .2 Beam clamps to secure conduits to exposed steel work.
 - .3 Channel type supports for two or more conduits at 1.5 m on centre.
 - .4 Threaded rods, 6 mm diameter, to support suspended channels.
 - .5 Maximum spacing of conduit supports:
 - .6 All rigid metal conduits of the same size shall be securely attached to hangers or to a solid surface with the maximum spacing of the points of support not greater than:
 - .1 1.5 m for 21 mm conduits.
 - .2 2 m for 27 mm and 35 mm conduits.
 - .3 3 m for 41 mm and greater conduits.
 - .7 Where rigid metal conduits of mixed sizes are run in a group, the conduit supports shall be so arranged that the maximum support spacing will be that shown in subrule (1) for the smallest conduit.
 - .8 When flexible metal conduit is installed, it shall be secured at intervals not exceeding 1.5 m. and within 300 mm on each side of every outlet box or fitting except where flexible metal conduit is fished and except for lengths of not over 900 mm at terminals where flexibility is necessary.

2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, specially manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90-degree bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

- .4 Watertight connectors must be used for outdoor installation in humid locations with variable temperatures, those exposed to water spray, and dusty locations such as service roads and workshops.
- .5 Unless otherwise indicated, EMT screw-type fittings and sleeves.
- .6 Fittings equipped with seals for NEMA 2 or 12 equipment.

2.4 FISH CORD

- .1 Polypropylene, ¼ in. dia.

PART 3. EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 GENERAL

- .1 When conduits are illustrated on drawings, they are represented in schematic form only. Install conduits to conserve headroom in exposed locations. Before beginning work, verify location of all conduits with the Departmental Representative.
- .2 Daisy chain connections are not permitted.
- .3 Parallel running conduit runs must be the same length.
- .4 Take necessary measures for cutting holes and making openings and other structural works necessary for the installation of electrical conduits, cables, fish cords, pull boxes and outlet boxes.
- .5 Openings made in concrete beams, walls and floors must be approved by the Departmental Representative.

3.3 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 electrical metallic tubing (EMT) except in cast concrete and when conduits are located more than 2.4 m above ground and not subject to mechanical damage.
- .4 Use rigid PVC conduit underground.

- .5 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without prewired outlet box, connection to surface or recessed fluorescent fixtures and work in movable metal partitions.
- .6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .7 Use explosion-proof flexible connection for connection to explosion-proof motors.
- .8 Install conduit sealing fittings in hazardous areas.
 - .1 Fill with compound.
- .9 Minimum conduit size for all applications: 21 mm.
- .10 Bend conduit cold.
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .11 Mechanically bend steel conduit over 21 mm diameter.
- .12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .13 Install fish cord in empty conduits.
- .14 Dry conduits out before installing wire.

3.4 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 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.

3.5 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.

3.6 CONDUITS IN CAST-IN-PLACE CONCRETE

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

3.7 UNDERGROUND CONDUITS

- .1 Slope conduits to provide drainage.
- .2 Conduits are to be aluminum when partially visible down to 650mm underground. Complete with PVC conduit.
- .3 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

END OF SECTION

PART 1. GENERAL**1.1 RELATED SECTIONS**

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .1 Section 31 23 33.01 - Excavating, trenching and backfilling.

1.2 REFERENCES

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

PART 2. PRODUCTS

Not Applicable.

PART 3. EXECUTION**3.1 EXAMINATION**

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

3.2 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.
- .2 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .3 To facilitate matching of colour coded multiconductor control cables, reel off in same direction during installation.
- .4 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.

- .5 After installation of cables, seal duct ends with duct sealing compound.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results for 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.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
- .7 Provide the Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.4 CLEANING

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

3.5 PROTECTION

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

END OF SECTION

PART 1. GENERAL**1.1 RELATED SECTIONS**

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CAN/CSA-C22.2 No. 47 – Air-Cooled Transformers (Dry Type).
 - .2 CSA C9 – Dry-Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA).

1.3 PRODUCT DATA

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

PART 2. PRODUCTS**2.1 TRANSFORMERS**

- .1 Use transformers of one manufacturer throughout project.
 - .1 Type: ANN.
 - .2 3-phase, 4 wires as indicated on drawings, primary input voltage 600 V, secondary output voltage 120/208 V, 4 wires, 60 Hz.
 - .3 Voltage taps: four (4) at 2½%, 2 ANFC and 2BNFC.
 - .4 Winding: copper, one winding per phase on the primary and secondary side
 - .5 Insulation: Class 220, 150°C temperature rise.
 - .6 Basic Impulse Level (BIL): standard.
 - .7 Hipot: standard.
 - .8 Average sound level: standard.
 - .9 Impedance at 17°C: standard.
 - .10 Enclosure: AMEEC 2, removable metal front panel.
 - .11 Mounting: floor.
 - .12 Finish: in accordance with Section 26 05 00 – Common Work Results for Electrical.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Nameplate wording: as required in Section 26 05 00.

PART 3. EXECUTION

3.1 INSTALLATION

- .1 Mount dry type transformers on wall.
- .2 Ensure adequate clearance around transformer for ventilation as required by manufacturer.
- .3 Install transformers in level upright position.
- .4 Remove shipping supports only after transformer is installed and just before putting into service.
- .5 Use neoprene pads to isolate vibrations to the floor.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 If possible, energize transformers immediately after installation is complete.

3.2 CONNECTION

- .1 Make primary and secondary connections in accordance with wiring diagram.

3.3 FIELD QUALITY CONTROL

- .1 Perform testing in accordance with specifications.
- .2 Perform the following tests:
 - .1 Verify insulation resistance.
 - .2 Verify grounding of exposed conductive part at a single point only.
 - .3 Verify transformation ratio for all transformer taps.
- .3 Submit the testing reports and integrate them into the Operating and Maintenance Manual.

END OF SECTION

PART 1. GENERAL**1.1 RELATED SECTIONS**

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 28 16.02 – Moulded Case Circuit Breakers.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2No.29-[M1989(R2000)], Panelboards and Enclosed Panelboards.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Existing electrical panel
 - .1 Submit technical data sheets for new breakers compatible with existing panels. Technical data sheets are to indicate product characteristics and performance criteria.
- .3 Shop drawings
 - .1 Electrical details of breakers, branch breaker type, quantity, ampacity and enclosure dimensions.

1.4 MATERIAL OR PRODUCTS OF ACCEPTANCE

- .1 When materials or products are specified by trademark, consult the Tenderer Instructions for procedure to follow with regard to request for approval of replacement materials or products.

PART 2. PRODUCTS**2.1 PANELBOARDS**

- .1 Panelboards: to CSA C22.2No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 120/208 V panelboards: busses rated for 10 kA symmetrical; breakers must have an interrupting capacity of 10 kA symmetrical or as indicated.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

- .4 Existing panelboards: nominal current and number and size of branch circuit breakers as indicated.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02 – Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards and/or according to manufacturer's recommendations except as indicated otherwise.
- .3 Main circuit breaker as indicated, installed separately at the lower or upper part of the panel, depending on the location of the cable entry. When the circuit breaker is mounted vertically, the circuit must be opened by lowering the handle.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Complete circuit directory with typewritten legend showing location and load of each circuit for new panels and existing modified panels.

2.4 PRODUCTS OF ACCEPTANCE

- .1 Products from the following companies: Cutler Hammer, Siemens or Square-D

2.5 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on a flame retardant treated plywood backboard. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 – Common Work Results for Electrical or as indicated.
- .4 Connect neutral conductors to common neutral bus.
- .5 Connect loads to circuits as indicated on drawings.
- .6 Connect neutral conductors to existing common neutral bus.

2.6 BALANCING

- .1 Circuits must be distributed in the panels for the best balance between the phases. During commissioning, tests and measurements will be performed and any significant deviations are to be corrected without additional costs.

2.7 PROTECTION

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

END OF SECTION

PART 1. GENERAL**1.1 RELATED SECTIONS**

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 24 16.01 – Panelboards Breaker Type.

1.2 REFERENCES

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

1.3 SUBMITTALS

- .1 Submit documents and samples in accordance with Section 01 33 00 - Submittal Procedures with regard to shop drawings, data sheets and samples.
- .2 Product data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for moulded case circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 MATERIAL OR PRODUCTS OF ACCEPTANCE

- .1 When materials or products are specified by trademark, consult the Tenderer Instructions for procedure to follow with regard to request for approval of replacement materials or products.

PART 2. PRODUCTS**2.1 AUTHENTICATION**

- .1 Prior to installing circuit breakers in a new or existing installation, the Electrical Contractor must submit three (3) copies of an original certificate from the manufacturer in French duly signed by the manufacturing plant and local representative of the said manufacturer attesting that all circuit breakers from this manufacturer are new and meet standards and regulations in effect. These certificates must be submitted to the Departmental Representative for acceptance purposes.
- .2 A delay in producing the authentication certificate will not justify extension of contract or additional compensation.

- .3 Manufacturing, assembly and installation must not begin until the authentication certificate has been accepted by the Departmental Representative. Upon refusal to comply with the requirements, the Departmental Representative reserves the right to mandate the manufacturer indicated on the circuit breakers to authenticate all new circuit breakers set out in the contract, to the expense of the Electrical Contractor.
- .4 In general, the certificate of authentication must indicate:
 - .1 Name and contact information of manufacturer and the person in charge of authentication who must date and sign the certificate.
 - .2 Name and contact information of authorized distributor and person in charge of handling the Contractor's account.
 - .3 Name and contact information of Contractor and person in charge of the project.
 - .4 Name and address of building where circuit breakers will be installed.
 - .5 Project title (title on specifications or drawings).
 - .6 Departmental Representative's reference number.

2.2 GENERAL REQUIREMENTS

- .1 Moulded-case circuit breakers: to CSA C22.2 No. 5.
- .2 Provide original certificate with proof of purchase for all new 600 V circuit breakers. Used and refurbished circuit breakers will not be accepted for this project.
- .3 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation.
- .4 Common-trip breakers: with single handle for multi-pole applications.
- .5 Circuit breakers to have interrupting capacity rating as indicated.
- .6 Circuit breakers dedicated to fire alarm services are to be red in colour.

2.3 THERMAL MAGNETIC BREAKERS

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

2.4 CURRENT LIMITING THERMAL MAGNETIC BREAKERS

- .1 Thermal magnetic breakers with current limiters.
 - .1 Time current limiting characteristics with time current tripping characteristics of circuit breaker.

.2 Coordination to result in interruption by breaker of fault-level currents up to interrupting capacity of breaker.

.2 Series rated breakers will not be accepted.

2.5 PRODUCTS OF ACCEPTANCE

.1 Products from the following companies: Siemens, Eaton and Schneider.

.2 Replacement products must be approved by addenda in compliance with Tenderer Instructions.

PART 3. EXECUTION

3.1 INSTALLATION

.1 Provide and install a breaker for each outlet shown on drawings.

.2 Install circuit breakers as indicated by the Manufacturer.

END OF SECTION

PART 1. GENERAL**1.1 RELATED SECTIONS**

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.2 No.4-[M89 (R2000)], Enclosed Switches.
 - .2 CSA C22.2 No.39-[M89 (R2003)], Fuseholder Assemblies.

1.3 SUBMITTALS

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

1.4 MATERIAL OR PRODUCTS OF ACCEPTANCE

- .1 When materials or products are specified by trademark, consult the Tenderer Instructions for procedure to follow with regard to request for approval of replacement materials or products.

PART 2. PRODUCTS**2.1 DISCONNECT SWITCHES**

- .1 Heavy duty fusible, non-fusible, disconnect switch in CSA Enclosure, to CAN/CSA C22.2 No.4, size as indicated.
- .2 Provision for padlocking in off switch position by three (3) locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Quick-make, quick-break action.
- .5 ON-OFF switch position indication on switch enclosure cover.
- .6 Provide an auxiliary SPDT when the disconnect switch is installed between a VFD starter and a motor to stop the starter before power is cut to the motor.
- .7 Terminals for aluminum or copper cables.

- .8 NEMA-12 housing for indoor use, sprinklerproof, and NEMA-4X or NEMA-3R for outdoor use, as indicated on drawings .

2.2 EQUIPMENT IDENTIFICATION

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

2.3 PRODUCTS OF ACCEPTANCE

- .1 Products from the following companies: Siemens and Schneider Electric.
- .2 Replacement products must be approved by addenda in compliance with Tenderer Instructions.

PART 3. EXECUTION

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.
- .2 Switches connected to mechanical equipment such as AHUs, pumps, etc., must be installed on an independent support or on the wall as indicated on drawings. It is forbidden to install switches on ventilation ducts or an AHU.
- .3 When a switch is installed between a VFD starter and motor, the Contractor must anticipate connecting a double contact position switch to stop the starter before power is cut to the motor. Anticipate necessary conduits and wiring between components.

END OF SECTION