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CANADIAN SPACE AGENCY
Replacement of an uninterruptible power supply

Specifications – Electrical

2021-01-18
Project: 2020-134-1001

AGENCE SPATIALE CANADIENNE

6767 ROUTE DE L'AÉROPORT

SAINT-HUBERT (QUÉBEC)

J3Y 8Y9

REPLACEMENT OF AN UNINTERRUPTIBLE POWER SUPPLY

DIVISIONS 20 AND 26

For tender
January 18, 2021

TABLE OF SECTIONS

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3.1 NOT USED

Part 1 General

1.1 DEFINITION

.1 The terms "Contractor", "General Contractor" and "Supervisor" refer to the person or entity designated as in contract with the Owner or Manager of the works.

.2 The expressions "section", "sections", "each section", "each related section", "performed by section" and "supplied by section" refers to the firm responsible for the work of that section.

.3 The terms "Engineer" and "Engineers" mean the firm or the Designated Representative of the engineering firm that issued the engineering section, specifications or plans related to the work covered by these documents.

1.2 EXAMINATION OF THE SITES

.1 Before submitting its bid, each bidder must visit and inspect the site to become familiar with everything that could affect the works in any way. No later claims due to ignorance of local conditions will be considered by the Owner.

1.3 VERIFICATION OF THE DRAWINGS AND SPECIFICATIONS

.1 Only drawings and specifications marked "for tender" should be used for the calculation of bids.

.2 Check that the copy of the documents is complete: number of drawings, specifications' number of pages.

.3 Specialties mentioned in the titles of the drawings are to facilitate the work of each section and should not be regarded as restrictive.

.4 Drawings indicate the approximate placements of equipment. Each section must check the exact emplacements before any installation.

.5 During bids, each section must study the electrical drawings and specifications and notify the Engineer at least five working days before submission of his tender of any contradictions, errors or omissions that can be observed.

.6 During the execution of the works, notify the Engineer of any inconsistency, error or omission discovered before starting the work.

.7 The Engineer reserves the right to interpret the contents of electrical drawings and specifications.

.8 No indemnity or compensation will be given for the displacement of ducts, pipes, etc., deemed necessary because of the Architecture, the structure or any other normal consideration.

1.4 PRODUCTS USED FOR TENDERS AND EQUIVALENCY

.1 Each section must prepare an overall price for a tender based only on the products described in the drawings and specifications. The person preparing the tender must not assume that the manufacturers' materials and equipment whose names appear on the "MANUFACTURER LIST" are automatically equivalent. Each section is solely responsible for the verification and validation of equivalence (and, where appropriate, of the special manufacturing requirements for it) of the product that will need to be used from a manufacturer on the list.

.2 All modifications required by the usage of an equivalent material or device to that specified is to be performed at the cost of the division supplying the device, even if it applies to other specialties and if implications are discovered after the acceptance of the substitution request.

1.5 SUBSTITUTION OF MATERIALS

.1 Equipment and materials from manufacturers other than those mentioned in the manufacturer list may be substituted only after the presenting the tender, provided that they are approved according to the following procedure:

.1 Equivalency requests must be made by the relevant section only. They must be submitted within a maximum of fifteen business days following the signing of the contract. They must be accompanied by the following documents:

.1 Original tender for the specified products.

.2 Tender received for products to be substituted.

.3 Justification of the request.

.4 Proofs of equivalency.

.2 The submission of equivalency requests to periods other than that mentioned above will only be considered for reasons truly exceptional and extraordinary.

.2 The main points of comparison are construction, performance, capacity, dimensions, weight, encumbrance, technical specifications, parts' availability, maintenance, delivery delays, the evidence of tried and true equipment in service and impact on other specialties.

.3 Any changes caused by the use of an equivalent equipment or material is to the cost of the section that provided the equipment, even when it applies to other specialties, and even if the implications are made apparent after the substitution request is accepted.

.4 Any request for substitution will be rejected if it were to impede or delay the execution of the works.

1.6 QUEBEC TENDER OFFICE (BDSQ)

.1 Each section whose work falls under the jurisdiction of the Submission Code of the Quebec Tender Office must submit a copy of their tender to the Engineer at the same time as their submission to the electronic submission system (TES) of the BDSQ.

1.7 IMPORTANT NOTE: SUPPLY AND INSTALL

.1 Supply and install all materials and equipment described in this specification and/or shown in the drawings, whether the term "supply and install" is used or not. See also the article "MINOR WORKS".

1.8 LAWS, REGULATIONS AND PERMITS

.1 All laws and regulations issued by the authorities having jurisdiction relating to the works described herein apply. Each section is required to comply with them without additional compensation.

.2 Each section must obtain, at its expense, all necessary permits and certificates, pay all costs for drawing approvals and for inspections required by organisations having jurisdiction.

.3 Submit to the Engineer a copy of the drawings bearing the seal of approval of the relevant inspection services.

.4 Upon completion of the works, obtain and submit to the Owner, complete with a copy of the mailing slip for the package sent to the Engineer, all permits, approval certificates, and other obtained from the different offices and departments that have jurisdiction over this building.

.5 Restrictions regarding tobacco usage:

.1 It is prohibited to smoke inside the building. Comply with restrictions applying to tobacco usage on the building property.

.6 Discovery of dangerous materials:

.1 If materials applied by spray or trowel, likely to contain asbestos, polychlorinated biphenyls (PCBs), moulds or other designated hazardous materials are discovered during demolition, immediately stop work.

.1 Take corrective action and immediately notify the Owner.

.2 Do not restart work until written instruction is received.

1.9 MINOR WORKS

.1 Each section is required to provide all the required components and to do all the jobs which, although not specified in the estimate, are necessary for the operation of the equipment and to complete the work included in his contract.

1.10 TOOLS AND SCAFFOLDING

.1 On the worksite, provide the full range of tools required for the proper execution of the work. Also supply, erect, and remove the scaffolding required to perform the work.

1.11 COOPERATION WITH OTHER TRADES

.1 Each section must:

- .1 Cooperate with other trades working in the same building or on the same project.
- .2 Keep itself informed of additional drawings issued to these other trades.
- .3 Ensure that these drawings do not come in conflict with its work.
- .4 Organize its work so as not to interfere in any way with other work done in the building.
- .5 Collaborate with the other sections to determine the location of accesses in walls and ceilings.

.2 During the work, if necessary, the relevant section must remove and replace the tiles or access doors to reach its equipment and repair, at its own expense, all the damage it has caused. Protect the furniture and return the premises to a clean condition when the work is completed.

1.12 SCHEDULING OF OPERATIONS

.1 Plan and execute work in such a way as to minimally disturb the normal use of the building.

.2 During the tender process of the contract, present a schedule for the work in the form of a bar graph (Gantt diagram), specifying the expected steps in the work until completion, including the project milestones. Once the schedule is reviewed and approved, take necessary action to ensure the project progresses on schedule. Do not modify the calendar without consulting the Engineer and the Owner.

.3 Perform work during "normal work hours", Monday to Friday between 7 h and 18 h.

.4 Work in occupied areas must be performed outside of normal work hours, Monday to Friday between 18 h and 7 h, as well as on Saturdays, Sundays between 7h and 18h.

.5 Notify the Engineer and the Owner 48 h before performing work during periods of inoccupation.

1.13 MATERIALS

.1 Unless otherwise indicated, use new materials clear of imperfections or defects, in the required quality, bearing the approval labels CSA, ULC, FM, AMCA, ARI and other according to the specialties.

1.14 PROTECTION OF WORKS AND MATERIALS

.1 Each section must protect its installations against all damage, from any cause, during the execution of works until the work is accepted in a definitive manner.

.2 All equipment and materials stored on-site must be adequately protected, sheltered from bad weather, or any other possible damage.

.3 Materials have to put outside of the work zone or outside of the building.

.4 At the end of each workday, seal with a screw cap or a suitable metal cap all openings in conduits of any kind.

1.15 SHOP DRAWINGS

.1 Before fabrication or order of any component, submit a PDF copy by email for approval. Each drawing or data sheet should be submitted as a distinct PDF file. The PDF name should include the section, article and name of the article title in the specifications (example: 00_00_00_0.00_Equipment XYZ.pdf).

.2 Drawings must include the dimensions, weight, number of attachment points, centre of gravity, seismic requirements, wiring schematics, capacities, controls schematics, curves, space requirements for maintenance and operation, and all other relevant information. If present, clearly indicate the location and dimensions of plumbing, heating, cooling, electrical, etc., connections by device. Each drawing must be verified, coordinated, signed, and dated by the relevant section before being submitted for approval.

.3 All correspondence and/or document submitted via project management software by the Contractor or a Sub Contractor will not be reviewed and will be not be considered as submitted/received.

.4 Shop drawings must be relevant to the proposed equipment. The sheets from general catalogs are not accepted as shop drawings. Each drawing must be preceded by a title page indicating with the name of the project, the consultant's name, the date and identification tag of the equipment shown in the drawings and specifications. The title page must also include the revision number of the documents as well as the expected delivery date of the product. Drawings must be prepared and signed by the supplier. Drawings pulled from the supplier’s website are not accepted.

.5 Drawings for non-catalogued items must be specifically prepared for the project.

.6 The verification of shop drawings is general and has the main purpose of avoiding as many errors as possible in manufacturing. This verification does not relieve the relevant section of its liability for errors, omissions, information, dimensions, quantity of equipment, etc., appearing in their drawings.

.7 The verification of the shop drawings by the Engineers does not diminish the responsibility of the supplier to ensure that the equipment meets all applicable codes and standards, as well as the requirements in this specification.

.8 When shop drawings are resubmitted or installed, inform the Engineer in writing of changes made, other than those requested by the Engineer.

.9 When equipment is manufactured before the verification of the shop drawings by the Engineer, the Engineer may refuse the equipment. The Contractor is responsible for any costs associated with the refusal.

.10 The drawings must be in English and in French.

1.16 COORDINATION DRAWINGS

.1 General:

.1 Coordination drawings, also called composite drawing, are required in all cases where interference between different trades' works need such drawings to illustrate that the work is realizable.

.2 Coordination drawings must show clearly and precisely all the work involved, those of the relevant section and those done by others.

.3 Communicate with the Engineer to procure Architectural base plans.

.2 Description:

.1 Coordination drawings consist of dimensioned plans, to scale, indicating the position of the equipment, ducts, piping, valves and other accessories with cuts and details required, complete with piping and duct dimensions, locations of sleeves, openings, anchorages and supports, relative positions with structure, architectural works, mechanical and electrical work, the positioning of the access doors, the clearances required for the maintenance of equipment and all other disciplines.

.2 Each electrical section must provide on their coordination drawings the details of their levelling bases and housekeeping pads.

.3 Preparation:

.1 Each relevant section must make their coordination drawings and coordinate them with other disciplines.

.2 All drawings must be coordinated by the Contractor in collaboration with all sections.

.3 The coordination drawings for each sector must be submitted all at once for verification.

.4 Collaboration:

.1 Close collaboration must exist between the sections in order to determine the location of their respective work and avoid incompatibilities.

.5 Distribution of coordination drawings:

.1 Before submitting the drawings to the Engineer for verification, the general Contractor and each of the sections must sign the plans.

.2 Submit to the Engineer two paper copies and one emailed digital PDF copy of the scaled coordination drawings signed by the General and Sub Contractors for verification.

.3 All correspondence and/or document submitted via project management software by the Contractor or a Sub-Contractor will not be reviewed and will be not be considered as submitted/received.

.4 Once commented on, the drawings will be corrected by the relevant section, and, if required, resubmitted.

.6 Responsibility:

.1 Each section is directly responsible for the placement and exact dimensions of openings, perforations and sleeves, the location of its equipment, pipes and ducts, whether the structural, Architectural or Engineering drawings are included or not.

.2 No compensation will be given for the modifications of the work for the purpose of coordination and integration of the electromechanical systems.

.3 Notwithstanding the responsibility of coordinating the integration, work cannot be implemented without prior verification of the coordination drawings. Each section must redo, at its expense, all work nonconforming to the coordination drawings without any compensation based on a misinterpretation of the scope and limitations of its work. Such misinterpretations do not relieve the relevant section of its responsibilities and obligations to provide complete and duly proven, ready to operate systems in fully integrated and in perfect condition.

.4 Verification of the coordination drawings by the Engineer serves to ensure that the technical requirements appear to be generally met. The Engineer does not check the quality of the coordination carried out by the Contractors.

.7 Pre-existing work:

.1 Coordination drawings should account for existing mechanical, electrical, structural and Architectural installations as well as planned work.

.8 Coordination drawings are required for:

.1 All electrical work in the server room, specially the UPS installation.

.2 Work performed by a section that could have implications on the work of another section.

.3 This clause is not restrictive. Coordination drawings may be demanded for places deemed necessary.

1.17 USING DIGITAL MODELS FOR COORIDNATION

.1 DWG plans:

.1 Where approved by the Owner Representative, the Engineer may provide to the Contractor the digital DWG plans which were used to produce contractual documents.

.2 The Contractor must respect the "RESPONSIBILITY WAIVER – DWG PLANS" form included at the end of this section, understanding the limitations of using the digital plans, and complete and sign the form. Submit the duly completed form to the Engineer.

.3 The Engineer reserves the right to not provide the design files to the Contractor and/or related sections.

.4 The Engineer reserves the right to claim fees for the conversion of design files and specifications issued "for tender" to the format or edition requested by the Contractor and/or related section.

1.18 TECHNICAL REQUESTS FOR INFORMATION

.1 The Contractor must submit all requests for information (RFIs) by email.

.2 All correspondence and/or document submitted via project management software by the Contractor or a Sub Contractor will not be reviewed and will be not be considered as submitted/received.

.3 Technical Requests for Information:

- .1 Each question must be submitted using a standardized RFI form.
- .2 Each PDF RFI form may include only one question.
- .3 Each question must be assigned a sequential number to facilitate tracking.
- .4 The Contractor is responsible to review questions submitted by other sections to ensure that answers are not present in the contractual documents or previously provided, and to track progress of the RFIs to ensure work is not delayed.
- .5 The RFI form must include, at minimum:
  - .1 Submission date of the question.
  - .2 Name of the sender and recipient.
  - .3 Subject line.
  - .4 Clearly formulated question.
  - .5 Clips of the plans, specifications and photos relating to the question.
  - .6 Proposed solutions.
  - .7 Sufficient space for the engineer to respond to the question on the form.

1.19 SAMPLES

.1 Samples of materials may be required before verification of shop drawings.

.2 After the verification, mark and identify the samples. They should serve as models for the work to be performed.

.3 Return the samples to the Contractor who is responsible for storing them in on-site storage in an appropriate location and conserving them until the end of the work. The Contractor may dispose of them at will afterwards.

.4 See the respective sections for further details.

1.20 UP TO DATE DRAWINGS

.1 Each section must, at its expense, clearly indicate all changes, additions, etc., on a separate copy of the drawings and specifications, so as to have a complete and accurate copy of the work as executed and materials installed when the contract is completed. In particular, any displacement, even minor, of underground piping must be indicated with precision

.2 This copy of the drawings must be kept up to date and be available on site.

.3 Deliver these plans to the Owner at the end of the works

1.21 OPERATION AND EQUIPMENT MAINTENANCE INSTRUCTION MANUALS

.1 Each section must provide the Owner with four copies of manuals with detailed instructions for the operation and maintenance of all equipment and appliances included in his contract. Also provide a USB flash drive. An completed and verified digital copy should be transmitted in PDF format to the Owner.

.2 These manuals must contain:

.1 A list and illustration of all equipment components: UPS, generators, fire alarms, etc.

.2 A copy of the approved shop drawings, and as executed.

.3 A diagram of the controls with explanatory text.

.4 A list of the different sub-Contractors with names, addresses, and phone numbers.

.5 A list of representatives and/or manufacturers of the installed equipment with names, addresses, and phone numbers.

.6 These instructions must contain all the graphics, curves, capacities and other data provided by the manufacturers concerning the operation and details of all mechanical and electrical equipment installed in the building.

.3 The entirety must be written in French and in English.

.4 Divide each manual in the sections using blank sheets which have coloured tabs with the necessary identification. For example: "CENTRAL SYSTEM FAN". At the beginning of the manual, insert a table of contents with the title of each section and identification of the corresponding tab.

.5 Each manual is covered with a black cardboard, allowing the binding of loose sheets with 215 mm x 275 mm (8" x 11") binding strips.

.6 Submit one PDF copy to the Engineer for comment. Once approved, provide three (3) copies of the manual to the Owner and one to the Engineer.

.7 These manuals should be submitted before final trials. Provide an empty section to later add calibration and commissioning reports.

1.22 CONCEALED WORK

.1 Do not conceal any work, material, such as pipes, boxes, etc. before the installation has been verified.

.2 If a section does not comply with this requirement, it will have to pay the cost of all work required to proceed to the examination of the works.

.3 Unless otherwise indicated, all piping and ducts must be concealed in partitions, walls, between floors, in ceilings, etc. The cost of all necessary leveling shall be borne by the Contractor.

.4 Reread the articles "COOPERATION WITH OTHER TRADES" and "TESTING".

1.23 PLACEMENT OF PIPING AND DUCTS

.1 No pipe may be in contact with another. Allow a clearance of at least 15 mm (½") between them. No piping may be in contact with any part of the building. Take special care in the case of piping through a steel beam.

.2 Take particular care to conserve space in vital areas, including in the case of piping rising along columns.

.3 Any piping or ducting that may possibly be covered by insulation must be installed at a sufficient distance from walls, ceilings, columns or other piping, ducts, and equipment to facilitate the insulation of the pipe or duct.

.4 Any piping or ducting placed horizontally must be installed to maximize the headroom of the area. This is of particular importance in rooms where ceilings are suspended, such as in parking lots and warehouses.

.5 Exposed piping should be straight and generally, parallel to the framework.

.6 Consider the symmetry with respect to the piping of the apparent equipment. Consult the Departmental Representative if necessary.

.7 Before installing a pipe or duct, make note of the location of the other mechanical, electrical, Architectural and structural work to avoid interference, otherwise the relevant section will be required to move the pipe or duct at its expense.

.8 When uninsulated piping passes through a wall or a poured concrete floor, install rigid insulation on the pipe before casting, after the installation of the pipe, so that the concrete does not come into contact with the pipe.

1.24 MANUFACTURERS' INSTRUCTIONS

.1 Install the various pieces of prefabricated materials and equipment, in accordance with the manufacturer's instructions. Obtain all relevant instructions.

.2 Ensure the presence of the manufacturers' representative to attest the conformity of the installation.

1.25 LAYOUT AND ACCESS TO THE EQUIPMENT

.1 Install the equipment so that they are easily accessible for maintenance, disassembly, repair, and moving.

.2 Pay particular attention to the motors, belts, bushings, heat exchangers and boiler tubes, fittings, valves, controls, rotating shafts, etc.

.3 If necessary, install access doors and accessories, such as extensions for the lubrication of bushings, etc.

.4 Installation of equipment:

.1 Ensure that maintenance and disassembly can be done without having to move the connecting elements of the piping and ducts, by the use of union fittings, flanges or valves, and without the building structural members or other installations being obstacles. Dismantling must be possible without emptying networks and/or stopping the power supply to other equipment.

.2 The manufacturer plates and the seals or labels of the equipment standards and approvals organizations must be visible and legible once the equipment is installed.

.3 Provide fasteners and metal accessories of the same texture, colour and finish as the support metal to which they are attached. Use non-corrosive fasteners, anchors, and shims to secure the external and internal work.

.4 Ensure that the floors or tiles on which the equipment will be installed are level.

.5 Check fittings done at the factory and retighten them if necessary to ensure the integrity of the installation.

.6 Provide a means to lubricate the equipment, including Lifetime lubricated shaft housings.

.7 Connect the equipment's drainage piping to the drains.

.8 Align the edges of the pieces of equipment, as well as those of the rectangular identification plaques, and other similar parts with the building walls.

.5 Future provisions:

.1 In any place where a space was left free for future use, ensure that this space remains free and install materials and equipment related to the work so that future connections of the added equipment can be done without needing to redo the floor, walls or ceiling, or even, a portion of the mechanical or electrical facilities.

1.26 PREVIOUSLY PLANNED OPENINGS AND SLEEVES

.1 Generally, the sleeves, the openings, and the shafts required for piping, and mechanical and electrical conduits, have already been installed before the concrete is poured.

.2 Visit the site to learn about existing shafts, openings and sleeves. View the plans available for information. Each relevant section must check the condition, location and size of these openings on-site. During the work, whenever possible, use these pre-existing openings, although in some cases, they may not be ideally located.

.3 Shafts, openings, and sleeves installed or to be installed by others are identified and may not be used for other purposes than those indicated. Any relevant section using an opening or a sleeve provided for another section will need to free the opening and the sleeve at its expense.

.4 If sleeves or openings to be installed by others are poorly located or inoperable, the section should identify the required opening in a manner acceptable to the Contractor. Drilling work to be done by another trade by the method chosen by the Contractor.

.5 However, if the physical and Architectural conditions allow it, the relevant section must change its plans so as to use the poorly located sleeves at any request from the Contractor and to no additional cost to the Owner.

.6 If the sleeves provided in the correct places are not used, either to simplify the workload or for any other valid and acceptable reason, the relevant section must make the new drilling required, at its expense, in accordance with the section "NEW OPENINGS, DRILLING IN WALLS, FLOORS, BEAMS, AND COLUMNS" and pay the cost of sealing unused openings.

1.27 NEW OPENINGS, DRILLING IN WALLS, FLOORS, BEAMS, AND COLUMNS

.1 If new openings are required, the Engineer or the Client should approve before drilling.

1.28 SUPERVISOR

.1 Each section must retain and pay for the services of a competent and permanent supervisor or superintendent who must remain on site until the works are accepted, and, having full authority to represent the section. All communications, orders, etc. supplied by the Engineer or Contractor are considered as given directly to the company responsible for the work of the section.

.2 Submit for approval the name, qualifications, and experience of the supervisor or superintendent. Following revisions made at the request by the Owner's representative, a lack of experience and qualifications relevant to the project will result in the mandatory replacement of the Superintendent by one meeting the requirements.

.3 This supervisor cannot be removed from the work site without a valid reason and prior written approval.

.4 Facilitate site inspections for the Owner and the Engineer at any time. During these visits, the supervisor must be available to them.

1.29 INSPECTIONS

.1 It is absolutely necessary before any inspection request to the Engineer, that the testing was previously conducted and successful.

1.30 TESTING

.1 Each section must cooperate with the other sections, so as to enable them to complete their tests within the time period allowed by the Contractor.

.2 Once the test is finished, readjust all the equipment used for this test, to permit their proper operation.

.3 General requirements:

.1 The Engineer may assist, at any time, in any test they deem necessary.

.2 All tests must be performed to the satisfaction of the Engineer.

.3 The Engineer may require a test of installations and equipment before accepting them.

.4 For temporary trials, obtain written permission to operate and test installations and permanent equipment before being accepted by the Engineer.

.5 Give a written 48 h notice to the Engineer before the date of the test.

.6 Provide equipment, meters, material and staff required to run tests during the project until the acceptance of installations by the Engineer and pay all fees.

.7 If a piece of equipment or device does not meet the manufacturer's data or the specified performance during a test, immediately replace the defective unit or part and pay all expenses incurred by the replacement. Make adjustments to the system to achieve the desired performance. Cover all costs, including those of new tests and repair.

.8 Prevent dust, dirt, and other foreign matter from entering the openings of installations and equipment during testing.

.9 Provide to the Engineer a certificate or letter from the manufacturer confirming that each section of the installation was implemented to their satisfaction.

.10 Submit the written test results to the Engineer.

.11 If it is impossible to test the entire installation in a single trial, it can be divided into several zones, each of which will be tested individually. The installation must be tested in several stages.

.12 Provide two copies of a written report for each of the tests performed.

.4 Special requirements:

.1 For details about the tests to perform, see the other sections of this specification.

.2 The presence of a section can be required in a test conducted by another section.

.5 Factory tests:

.1 The Engineer and the Owner reserve the right to examine the equipment in the factory and attend factory trials described in this specification.

.2 Notify the Engineer and the Owner at least one week in advance of the date, time and place where the factory testing will take place.

.3 Submit two certified copies of the factory test reports to the Engineer.

1.31 "EARLY ACCEPTANCE", "WITH RESERVATION" AND "WITHOUT RESERVATION"

.1 Refer to general conditions and additional general conditions of the Architect or Client for the definition of "early acceptance", "with reservation " and "without reservation".

1.32 FINAL TESTING

.1 Each section must include all costs of final testing to the overall price in its tender. When the work is fully completed and settings, calibrations, and preliminary tests are successfully performed, run the final tests. Notify the Departmental Representative early enough to allow him to attend any of the tests judged necessary.

.2 In order to demonstrate that the work is complete and executed satisfactorily, each piece of equipment must run for a minimum period of fifteen days and that, prior to acceptance "with reservation". During this period, all equipment must operate simultaneously and not consecutively. The operation must be in automatic mode and set on controls as planned in the operating sequences.

.3 During this time, until the acceptance "with reservation", each section must perform the normal maintenance, in compliance with the maintenance manual supplied by the Contractor. The maintenance in the period between the acceptance "with reservation" and "without reservation" will be performed by the Owner if all relevant information has been provided and training has been completed. Otherwise the Contractor is to perform the maintenance.

1.33 INSTRUCTIONS TO THE OWNER

.1 Give to the representative of the Owner all the details on the operation of the equipment specified and installed under this contract. Provide qualified personnel to operate this equipment until the Owner's representative is adequately qualified to take charge of the operation and maintenance of said equipment.

.2 This training can be combined with the final testing period provided that the Owner’s team is available.

.3 It is understood that such tests are not an automatic acceptance of equipment by the Owner.

.4 The Owner has the right to do this test as soon as the work is considered sufficiently complete by the relevant Engineer’s section, and considered in accordance with the drawings and specifications

1.34 WARRANTY

.1 Each section guarantees its work for a period of one year after acceptance "with reservation" of the work by the Owner. It is required to repair or replace, at its expense, any defects that would become apparent during this period and that, within 48 h after having been formally notified.

.2 Manufacturers must offer a one (1) year warranty from the starting operation date or eighteen (18) months from the date of delivery to the site, as appropriate. The warranty must include the cost of materials and labour, and the replacement of defective parts and/or manufacturing defect. In the case of chillers, a five-year warranty applies if the refrigerant charge is contaminated due to the compressor motor burning.

.3 The warranty is for a period greater than one (1) year (extended/or special warranties), for the areas indicated in the respective specifications.

.4 This warranty is fully independent of the article of the Civil Code concerning the five (5) year warranty.

.5 The use of permanent equipment for temporary purposes does not relieve the relevant section of its responsibilities and obligations with respect to the acceptance and guarantee of its work.

.6 The Engineer and/or the Owner reserve the right start the equipment and mechanical and electrical works without affecting the section's obligation to see to the full maintenance of its work up to acceptance "with reservation".

1.35 OBLIGATIONS DURING THE WARRANTY PERIOD

.1 During the warranty period, in addition to the obligations described in the specifications, the relevant section must provide any technical assistance required by the Engineer and/or Owner with respect to the operation of the installations and their improvements or adjustments as required.

.2 The temporary use or testing with the goal of adjusting equipment or any other purpose, or permanent use by the Owner of the mechanical and electrical works before the final acceptance of the works should not be interpreted as evidence that such works are accepted by the Owner and does not alter the terms of the warranty. During this time period, the relevant section retains responsibility for the maintenance of installation. No claim for damage or failure of any part of the work put into use will be considered by the Owner.

1.36 MAINTENANCE DURING THE CONSTRUCTION PERIOD

.1 This article applies only in cases where the equipment is used during the construction period.

.2 In addition to the responsibilities and obligations of each section, as to the temporary or permanent use of its installations and the use of equipment by the Owner or any other section during construction and before final acceptance of the work, the relevant section still remains as responsible for the operation, preventive maintenance, or other, of its equipment during the same period.

.3 For these purposes, each relevant section should, in general manner, use its own labour and its own equipment and administer the direct supervision of these tasks.

.4 However, the relevant section does not have the responsibility to provide the staff required for the equipment's operation during the construction period and before final acceptance of work. However, it remains responsible for the equipment during testing, the adjustment period, calibration, and maintenance of this equipment.

.5 Supply of spare parts, such as filters, pump belts, fans, compressors and others, as well as providing the energy required for the equipment's operation during the construction period, are the Owner's responsibility.

1.37 RENOVATIONS

.1 Continuous service:

.1 The following services are not to be interrupted without prior agreement with the Owner: telephone, electricity, lighting, intercom, fire alarms, sprinklers, fire protection water, aqueduct water, domestic water, sanitary plumbing, storm drainage, external drainage systems, ventilation – air-conditioning, etc.

.2 To ensure the continuity of services at during the hours required by the Owner, each relevant section must do all temporary works required, including labour and equipment.

.3 All major service cuts must be performed outside the occupancy hours of the building. For example: medical gas, electricity, water, steam, etc.

.2 Demolition:

.1 All demolition work is the responsibility of each concerned electrical section.

.3 Occupied rooms:

.1 The work is being done during the occupancy of rooms in the building, therefore, the work must be performed by stages in the rooms designated by the Owner.

.2 Perform work after prior agreement with the Owner and establish an acceptable work schedule with the Owner.

.3 Before undertaking work in a given area, ensure the availability of all equipment, tools, and labour required to perform the work without interruption.

.4 Follow the Owner's instructions as to the delivery to the worksite of its personnel and equipment.

.5 The Owner will indicate which staircase can be used and within what limits it is permitted to circulate in the present corridors.

.6 Take all necessary precautions to adequately protect existing installations in these areas.

.7 At no time must the traffic and the functioning of the building services be impeded. Follow all of the Owner's instructions.

.4 Noise:

.1 Because of the proximity of the occupied premises, take all necessary measures to reduce the noise from construction and demolition.

.5 Other restrictions:

.1 In order not to impair the function of the building that must remain in operation during construction:

.1 No vehicles other than trucks used to transport equipment has access to the site for the duration of the works.

.2 The use of all elevators is prohibited for construction purposes.

.3 The interior circulation outside the boundaries of the services to be renovated must be minimized.

.4 The access permitted to the various rooms, for demolition and construction purposes, must be determined by the Owner.

.2 Obey the Owner's rules and directives about signs, announcements, advertisements, smoking, etc.

.3 Limit equipment/materials to the area delimited set by the Owner for the storage of equipment. They must not congest the area. No part of the construction is to be burdened with a load of equipment that may be hazardous for it.

.4 Follow the Owner's sterility standards.

.6 Protection and contaminants

.1 The exterior of the work area must be fully protected against dust and dirt during the construction of the housekeeping pad and other work.

.2 These protections must not interfere with the operation and ventilation of the equipment operating in the room.

1.38 EQUIPMENT TO BE HANDED OVER TO THE OWNER

.1 Provide the Owner with the following items:

.1 Maintenance products and portable equipment indicated in the specification.

.2 The replacement materials indicated in the specification.

.3 The keys of all supplied equipment with locks.

.2 Obtain receipts from the Owner for each of the items mentioned above and give them to the Engineer.

1.39 CERTIFICATION OF COMPLIANCE

.1 At the end of the work, each section must submit to the Engineer a certification of compliance stating that all work was performed following the drawings and specifications, and all applicable standards and codes. Refer to example form at the end of this section.

.2 Submit the certificate to the Engineer at the same time as the request for an attestation of successful work completion.

.3 Have an administrator from the company sign this form and affix their seal to it.

1.40 CLEANING

.1 Clean the work area as work progresses. At the end of each workday, or more often if the Owner sees fit, remove the trash, carefully arrange the equipment to be used, and do the work site cleanup.

.2 Once the work is completed, remove the scaffolding, temporary protective equipment, and surplus materials. Repair any defects observed at this stage.

.3 Clean and polish glass, mirrors, hardware parts, ceramic tiles, chrome or enamel surfaces, laminated surfaces, aluminum, stainless steel or porcelain-enamel parts, floors and sanitary fixtures. Clean manufactured items in accordance with manufacturer's written instructions.

.4 Clean the areas used for the execution of works and put them in a state at least equivalent to that which existed before the work began, the cleaning must be approved by the Owner.

1.41 SECURITY SCREENING

.1 All personnel involved in the execution of the work will be subjected to a security screening. Obtain the required authorisations, as per the requirements, for all personnel who are to be present on site.

.2 Personnel will be screened every day the beginning of the workday, where they will be provided with a security pass they must carry on their person at all times, to be returned to security at the end of the day.

1.42 SECURITY ESCORT

.1 All personnel involved in the execution of the work will be required to be accompanied by a security officer when performing work in areas prohibited to the public during normal working hours. They must be accompanied in all areas when working during unoccupied times.

.2 Submit all requests for escorts at least fourteen (14) days in advance. Where requests are made within the prescribed period, the cost of the security escort will be covered by the Departmental Representative. In the case of late requests, the cost will be the responsibility of the Contractor.

.3 All requests for escorts may be cancelled, without penalty, if notice is give at least four (4) hours before the time. In the case of late requests, the cost will be the responsibility of the Contractor.

1.43 BREAKDOWN OF COSTS

.1 Before submitting a request for first payment, provide a detailed breakdown of costs relative to the contract, indicating also the overall price of the contract, as per the Engineer's instructions. Once approved by the Engineer, the breakdown will serve as a reference for payment installment calculations.

.2 Where applicable, include the following lines, as well as the related amounts, in the monthly statements of each of the specialized Contractors:

.1 Mobilization.
.2 Insurance and surety bonds.
.3 Erection drawings.
.4 Tests and trials.
.5 Equipment start-up.
.6 Commissioning of systems.
.7 Seismic measurement compliance report.
.8 Demobilization.
.9 Operation and maintenance manual.
.10 Training.
.11 Drawings "as annotated by the Contractor".

Part 2 Product

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

COMPLIANCE CERTIFICATE

Project: _____

Project address: _____

Discipline: _____

Specification section: _____

We certify that all materials and equipment used, as well as all apparent or concealed work that we have completed or that we have ordered completed, are in all aspects, compliant with the plans, specification, addenda, and changes prepared by the Engineers of Bouthillette Parizeau Inc., and with all applicable codes, laws and regulations in effect.

Company name: _____

Address: _____

Telephone number: _____

Signatory name: _____

Signature: _____

Signatory title: _____

COMPANY SEAL

RESPONSIBILITY WAIVER – DWG PLANS

The _____

Mr./Ms. _____
Bouthillette Parizeau
8580 de l'Esplanade Avenue, office 200
Montréal (Québec),
H2P 2R8

Project: _____

Subject: _____

We, _____ , relieve Bouthillette Parizeau of any liability resulting from the use of their digital drawings for the development of contractual documents and our coordination, and/or detail drawings, or for any other use related to the project.

We also recognize and agree that:

- That the electronic drawings in question are provided to us for our use only and that they cannot be disseminated without the permission of Bouthillette Parizeau.
- That no assurance is given to us as to the consistency and accuracy of the information contained in it.
- That Bouthillette Parizeau cannot be held responsible should the digital drawings in question contain certain inaccuracies or errors.
- That Bouthillette Parizeau cannot be held responsible for any errors that results from the use of the drawings by us, our subcontractors, or our suppliers.
- That we will remain fully responsible for our submitted drawings or orders, according to contract stipulations.

In addition, we will undertake to verify in site the accuracy of the dimensions and information contained within the digital drawings, as if we had created them ourselves.

Signature: _____

Name (in print): _____

Address: _____

Telephone: _____

Email: _____

END OF SECTION

TABLE OF CONTENTS

General

1.1 SUMMARY

.1 This section contains:

.1 The precise requirements for Division 26.

1.2 ELECTRICAL PLANS AND SPECIFICATIONS

.1 Electrical plans show the approximate location of devices and conduits; the exact location to be determined by the Contractor on site. In addition, the Contractor is to verify the space available on site before installing the devices and conduits and coordinate the work and spaces available with other Divisions.

.2 Do not dimension architectural or structural elements from the electrical plans.

.3 No additional remuneration will be granted for the relocation of conduits and devices which are deemed necessary due to structure, architecture or any other normal consideration.

.4 Detailed plans that are be provided to the Contractor during the construction period will also form part of the contractual documents. If the Contractor needs detailed plans, he must ask the Consultant, in writing, at least fifteen (15) working days in advance.

1.3 SCOPE OF WORK

.1 Work Includes:

.1 In general, work consists of the supply of all required materials, workforce, equipment and tools required to complete the electrical installations as described in writing, plans, and specifications. Most notably, work is comprised of:

.1 Supply, installation, connection and the commissioning of the uninterruptible power supply.

.2 All steel structural supports for conductors, cables, devices, and equipment.

.3 All specified tests.

.4 Relocation of existing equipment.

.5 Demolition and removal of equipment deemed obsolete.

.6 Installation of temporary equipment to ensure continuity of service.

.7 Connection of all special equipment.

.8 Fasteners, supports, seismic protection as well as all seismic-resistant fastenings for equipment.

.9 Removal of existing equipment that is not to be reused.

.10 The relocation of existing equipment to be reused.

.11 The removal of all recovered equipment and the reinstallation thereof.

.12 Ensuring the continuity of all existing services.

.13 Turn over to the Owner all equipment described in the contract documents, as well as any other equipment he wants to recover. The Contractor will clear the premises of anything that is not collected by the Owner.

.14 Unless otherwise indicated, the description of the work includes the supply, installation and connection of equipment and materials with all the accessories necessary for a complete installation.

1.4 RESPONSIBILITY FOR WORK

.1 Any change made to the plans and specifications, without the written authorization of the Consultant, will render the Contractor concerned solely responsible for the malfunction of the systems. He will be responsible for any defect that may arise within a year after the final acceptance of the work.

1.5 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT

.1 The Contractor is responsible for the compliance of the seismic protection systems required by his work.

.2 Refer to Section 26 05 49 – Seismic Protection System

1.6 COORDINATION BETWEEN CONTRACTORS

.1 In order to ensure full coordination of all work by the building mechanical and electrical trades, in relation to the architecture and the structure, coordination meetings will be held before any work is carried out on the site by the electrical division. In the event of adjustments made necessary by a lack of coordination on the part of one of the contractors, the one who caused the situation will be responsible vis-à-vis the other divisions.

.2 The heating and plumbing contractor has priority over other contractors to run conduits first. However, the Consultant has the right to intervene if it is judged that the heating and plumbing contractor has not taken into account the requirements of others or delays the work.

.3 Before proceeding with the purchase and installation of the electrical equipment required to connect any motors, the electrical contractor is responsible for verifying and validating with mechanical contractors the quantity, the supply rating and the type of control required for each of the motors. Any discrepancies between the information on the plans and specifications and that obtained from other contractors must be reported to the Consultant in order to establish the mitigation strategy required to meet the requirements for the electrical connection of the mechanical systems.

.4 The above-mentioned coordination and verification is to be done by the various contractors before ordering each device, as well as before starting to perform any work. If an issue arises, the Contractor must submit the case to Consultant before starting any work. If this verification is not made by the Contractor and a difficulty arises, and the Contractor must incur additional costs to overcome it, these costs will be borne by the Contractor concerned.

.5 Unless otherwise indicated, the necessary accessories must be provided to allow the installation of the items manufactured on site to be completed interfering with the proper execution of other work or the general appearance of the installation.

.6 No compensation will be awarded for the relocation of conduits, boxes, equipment, etc.

.7 Each Contractor will coordinate their own openings, anchors, supports and other arrangements required for the installation of their works and will obtain the required information in time so as not to delay the execution of the project.

1.7 EQUIPMENT AND MATERIAL

.1 Unless otherwise prescribed, use products from a single manufacturer in the case of materials and equipment of the same type or class. The equipment supplied will be from the same manufacturer to obtain maximum interchangeability between elements, among others for distribution panels, disconnectors, starters, and lighting devices of the same type.

.2 In special locations, use appropriate products; thus, in humid, dusty, etc. places, the equipment must be impervious to water, dust, etc. Also, the ends of conduits entering boxes, switchboards and similar equipment must be sealed with a special compound for this purpose.

.3 Installation and finishing:

.1 All installations must be carried out in such a way to facilitate inspections, repairs and maintenance.

.2 Contractor to install all exposed electrical installations in a symmetrical and straight manner. Also, where ceilings have acoustic tiles or panels of any kind, the Contractor must coordinate his work with that of other trades so that lighting fixtures, etc. occupy the space of a tile or row of tiles or are centered in relation to them.

.3 Unless otherwise indicated, where a device is mentioned this implies its supply along with its accessories, as well as the labor to install, connect and start it up.

.4 Carry out all minor work, whether or not specified in the plans and specifications, but which is customary and necessary for the completion of the contract.

.5 Apply a minimum of one coat of corrosion resistant primer to ferrous metal fasteners, brackets, hangers and site fabricated equipment (CGSB-IGP-140).

.6 Prime and touch up damaged surfaces to the satisfaction of the Owner.

1.8 EQUIPMENT PROTECTED BY SPRINKLERS

.1 Any electrical equipment which is enclosed in a perforated cover/box/container and that is installed in a sprinkler-protected area must be protected by a hood or non-combustible cover that is arranged in such a way that it does not impede the proper functioning of the sprinkler system.

1.9 THERMOGRAPHIC INSPECTION

.1 A thermographic inspection at all cable connection points, as well as all existing and new end-to-end distribution equipment, is to be done and compiled into a report signed and sealed by a recognized specialist engineer.

The thermographic inspection must cover all connections and all new and existing electrical distribution equipment affected by the related work such as substations, shielded busbar channels, power factor correction system, generator set, inverter, medium and low voltage switchboards, distribution panels, branch panels, circuit breakers, disconnectors, transformers, motor control centers, variable frequency drives, starters, contactors, relays, etc.

.2 Thermographic inspections will be the responsibility of the Contractor who will have the inspections carried out by a recognized specialist. The Contractor will provide all labor and tools necessary for the disassembly and reinstallation of the covers and access points of the distribution equipment, complete with all components including all fittings for a complete inspection.

.3 Thermographic inspections must be carried out under load at all stages of the project and any anomalies detected must be corrected immediately by the Contractor.

.4 Integrate the thermographic inspections carried out on the equipment into the equipment check sheets requested in the specifications sections.

1.10 FIREPROOFING

.1 Where cables or conduits pass through floors and fire walls or rooms with halon fire protection systems, fire and smoke tightness must be ensured using products 3M, CP25, 303, FS195, CS195 and the 7902 and 7904 series sealing kits. All sealant to be installed according to the manufacturer's recommendations and CAN2 19.13-M82 and modifications October 1984.

1.11 COORDINATION OF PROTECTIVE DEVICES

.1 Make sure that circuit protective devices such as overcurrent devices, relays and fuses are installed, that they are of the desired rating and that they are set to the required values.

.2 Make sure that circuit protection devices, such as overcurrent releases, relays and installed fuses, comply with the required capacities, and are set to the required values, as indicated.

1.12 QUALITY CONTROL

.1 Perform tests for the following elements:

.1 Insulation resistance test:

.1 Measure, using a 500 V megohmmeter, the insulation value of circuits, distribution cables and devices with a nominal voltage of up to 350 V.

.2 Measure, using a 1000 V megohmmeter, the insulation value of circuits, distribution cables and devices with a nominal voltage between 350 and 600 V.

.3 Check the value of the resistance to ground before applying voltage.

.2 Perform tests in the presence of the Engineer.

.3 Provide the measuring devices, indicators, devices and personnel required for the execution of the tests during the execution of the work and upon its completion.

.4 Verifications to be carried out on site by the manufacturer:

.1 Obtain a written report from the manufacturer confirming the compliance of the work with the specified criteria with regard to the handling, implementation, application of the products, as well as the protection and cleaning of the products, then submit this report in accordance with the article "DOCUMENTS /SAMPLES TO BE SUBMITTED FOR APPROVAL / INFORMATION ”of Part 1.

.2 The manufacturer must make recommendations regarding the use of the product(s), and carry out periodic visits to check whether the implementation has been carried out according to his recommendations.

1.13 TESTING

.1 The electrical contractor must collaborate with other trades so as to enable them to carry out their tests within the time limits required by the project manager.

.2 Once a test is completed, adjust all the devices relating to the test, so as to allow their correct operation.

.3 General requirements:

.1 All tests must be done in the presence of the Engineer and to his satisfaction.

.2 The Engineer may require tests of the installations and devices before accepting them.

.3 For temporary testing, obtain written permission to start up and test permanent installations and devices, prior to their acceptance by the Engineer.

.4 Give forty-eight (48) hours written notice to Engineer before date of testing.

.5 Provide the devices, meters, equipment and personnel required for the execution of the tests during the project until the installations are accepted by the Engineer and pay all the costs thereof.

.6 If a piece of equipment or a device does not meet the manufacturer's data or the performance specified during a test, replace without delay the defective unit or part and pay all costs incurred by this replacement. Make adjustments to the system to obtain the desired performance. Pay all costs, including re-testing and overhaul.

.7 Prevent dust, dirt and other foreign matter from entering openings of facilities and equipment during testing.

.8 Provide the Engineer with a certificate or letter from the manufacturers confirming that each system or part of the entire installation has been put in place to their satisfaction.

.9 Send the results of the tests in writing to the Consultant.

.10 The tests must be carried out and accepted before the installation of any thermal insulation.

.11 Do not hide or embed any conduit, accessory or device before the tests have been carried out and accepted.

.4 Special requirements:

.1 The presence of the electrical contractor may be required during tests carried out by another trade body.

.5 Factory testing:

.1 The Engineer and the Owner reserve the right to examine the equipment at the factory and to attend the factory tests described in this specification.

.2 Notify Engineer and Owner at least one week in advance of date, time and location of factory testing.

.3 Provide two certified copies of the factory test reports to the Engineer.

1.14 EQUIPMENT START-UP

.1 Instruct operating personnel in the mode of operation and methods of maintaining the installation, its devices and its components.

.2 Retain and pay for the services of an Engineer from the manufacturer's plant to supervise the start-up of the installation, to check, adjust, balance and calibrate the various components and to instruct the operating personnel.

.3 Provide these services for a sufficient period of time, scheduling the number of visits necessary to start up devices and ensure that operating personnel are familiar with all aspects of their maintenance and operation.

Part 2 Product

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

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Part 1 General

1.1 SUMMARY

.1 This section includes:

.1 Materials and accessories for wire and box connectors.

1.2 REFERENCES

.1 CAN/CSA International:

.1 CAN/CSA C22.2 no 18 – Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CAN/CSA C22.2 no 65 – Wire connectors (Trinational standard with NMX-J-543-ANCE-03 and UL 486A-486B).

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC):

.1 EEMAC 1Y-2-1961 – Bushing Stud Connectors and Aluminum Adapters (1 200 A Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA).

1.3 ACTION AND INFORMATION SUBMITTALS

.1 Submit documents and samples in accordance with Section 26 00 10 –Mechanical and Electrical General Instructions.

.2 Submit Shop Drawings for the following:

.1 Multi-port wire connectors for parallel conductor joints.

.2 Terminal blocks.

.3 Interference Drawings:

.1 Interference drawings showing proposed locations and dimensions of junction boxes for distribution conductors (i.e. conductors between distribution equipment, not branch wiring).

.4 Installation Sheet:

.1 Information required for Multi-port wire connectors for parallel conductor joints:

.1 Identification of junction box.

.2 Quantity and size of conductors.

.3 Model number of the connector used.

.4 Tightening torque used.

.5 Tightening marked.

.6 Dielectric test results.

.7 Infrared photo of the joint.

Part 2 Product

2.1 MATERIALS

.1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper or aluminum alloy sized to fit copper or aluminum conductors as required.

.2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 and NEMA to consist of:

.1 Connector body and stud clamp for copper conductors.

.2 Clamp for copper conductors.

.3 Stud clamp bolts.

.4 Bolts for copper conductors.

.5 Bolts for aluminum alloy conductors.

.6 Sized for conductors as indicated.

.4 Clamps or connectors for Teck cable as required to: CAN/CSA-C22.2 no.18.

2.2 WIRE CONNECTORS

.1 Mechanical connectors for conductor size 8 AWG or less, use Scotchlock Electrical Spring Connectors from 3M or Marette from Thomas & Betts.

.2 Mechanical connection for copper-to-copper conductors of size 6 AWG or larger, use type H split bolt connectors from Thomas & Betts.

.3 Mechanical connection for copper-to-Nual conductors of size 6 AWG or larger, use type APS split bolt connectors from Thomas & Betts.

.4 Mechanical connection for Nual-to-Nual conductors of size 6 AWG or larger, use type HPS split bolt connector from Thomas & Betts.

2.3 MULTI-PORT WIRE CONNECTORS

.1 Insulated mechanical connector for wire termination:

.1 Multi port connection block with clamping screw.

.2 Insulation rated to 600 V, 90 deg C.

.3 Removable port and screw plugs.

.4 Dual rated for copper or aluminum conductors.

.5 Pre-filled with oxide inhibitor.

2.4 WIRE TERMINATIONS

.1 The contractor is responsible for coordinating the size of the equipment connection lugs with the conductor sized indicated on drawings. Where it is not possible to connect the conductors, the Contractor may use insulated compression reducing connectors.

.2 Insulated Compression Reducer Connector:

.1 Offset connecting stem.

.2 Insulation rated to 600 V, 90 deg C.

.3 Dual rated for copper or aluminum conductors.

.4 Pre-filled with oxide inhibitor.

2.5 TERMINAL BLOCKS

.1 All wire connection in junction boxes and panels for fire-alarm, low-voltage lighting control, other low-voltage systems, etc., will be made on terminal blocks in sufficient quantities for each wire connection.

.2 Terminal blocks shall be from Wieland brand, model 9700B, 10 A, 300 V, complete with DIN rail, end plates, identification, extremity flanges and jumpers.

2.6 ACCEPTABLE MANUFACTURERS

.1 Wire connectors:

.1 3M.

.2 Burndy.

.3 Thomas & Betts.

.4 Or approved equivalent.

.2 Multi-Port wire connectors:

.1 Burndy Black Unitap series.

.2 Ilsco PBTD series.

.3 Thomas & Betts AMT series.

.4 Or approved equivalent.

.3 Insulated compression reducer connector:

.1 Burndy AYPO series.

.2 Ilsco ACO series.

.3 Thomas & Betts 619 series.

.4 Or approved equivalent.

.4 Terminal Blocks:

.1 Staffel

.2 Weidmüller

.3 Wieland

.4 Or approved equivalent.

Part 3 Execution

3.1 EXAMINATION

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

.1 Visually inspect substrate in presence of Consultant.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied

3.2 TIGHTENING OF MECHANICAL CONNECTIONS

.1 Use a torque wrench adjusted to the manufacturer's recommended torque value for all torque lug connections.

.2 Mark terminals with a yellow paint marker after clamping.

3.3 INSTALLATION

.1 Remove insulation carefully from ends of conductors and cables 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 CAN/CSA-C22.2 no.65.

3.4 CONDUCTOR JOINTS

.1 Wrap connectors not having their own insulation with at least two (2) rows of 3M # 88 tape or approved equivalent.

.2 The dielectric characteristics of the joint wrapping shall not be less than that of the conductor insulation.

.3 Gaskets and connectors that do not have a smooth surface must be wrapped with 3M Scotchfil or approved equivalent prior to being wrapped.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 SUMMARY

.1 This section includes:

.1 Copper, ACM alloy and aluminum conductor requirements from 0-1000 V and common electrical insulation and covering materials.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)/CSA International:

.1 C22.2 no 38 – Thermoset-Insulated Wires and Cables (Tri-National Standard, with UL 44 and ANCE NMX-J-451-2014).

.2 C22.2 no 131 – Type Teck 90 Cable.

.3 C22.2 no 51 – Armoured Cables.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit the required documents and samples, in accordance with Section 20 00 10 - Mechanical and Electrical General Instructions.

.2 Shop Drawings:

.1 Submit a general drawing for each conductor and cable type and indicate all gauges used.

.3 Calculations:

.1 Submit cable pull calculations for materials installed in buried duct banks. Include description of pulling method for installing 600 V conductors.

1.4 CLOSEOUT SUBMITTALS

.1 Submit the required documents, in accordance with Section 20 00 10 - General Instructions for Mechanical and Electrical.

.2 Operation and Maintenance Data: submit operation and maintenance data for wire and cables for incorporation into manual.

Part 2 Products

2.1 CONDUCTOR WIRE GAUGE

.1 Unless otherwise indicated, the minimum gauge of copper cabling to be:

.1 12 AWG for dedicated circuits in dedicated conduit.

.2 10 AWG for multiple circuits grouped in a common conduit.

.2 Solid wire for size no. 10 AWG conductors and smaller.

.3 Stranded wire for size no 8 AWG conductor and larger.

.4 Conductor size indicated on drawings represents minimum requirements. If not indicated, provide and install conductor of type and size as required by the applicable electrical code, latest edition, specifically:

.1 Refer to appendices to determine the size of conductors given the routing distance.

.2 Apply correction factors for de-rating of current carrying capacity as required by the electrical code, including but not limited to Table 5C when conductors are grouped in a common conduit.

2.2 BUILDING WIRES

.1 All wiring connected to a 600 V system shall have minimum 600 V insulation.

.2 Unless otherwise indicated, provide copper-conductors for circuits rated less than 100 A, size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.

.3 Unless otherwise indicated, provide ACM alloy or aluminum conductors for circuits rated 100 A or greater, size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.

.4 Conductors for low voltage system (25 V and less) integrated in multi-conductor cables, PVC insulation, minimum 18 AWG gauge.

.5 Conductors and cables shall be marked at minimum with manufacturer’s name, type of insulation, wire gauge and voltage. Markings shall be permanent and imprinted at regular intervals.

2.3 CONDUCTOR COLOUR

.1 In branch circuits of three-phase systems, the phase colours to be: black, red, blue, etc., and the neutrals to be white.

.2 No. 4/0 gauge and smaller neutral conductors to have white insulation and those of 250MCM gauge and larger to be painted white.

.3 Grounding conductors to be installed in all P.V.C., E.M.T. type conduits, and empty flexible metal conduits. The grounding conductors to have green insulation and to be the sized according to the Electrical Code.

.4 Grounding conductors used for equipment, special outlets, insulated outlets, to have green insulation and to be sized according to the Quebec Electrical Code.

2.4 EQUIPMENT IDENTIFICATION

.1 Identify equipment in accordance with Section 26 05 53 – Identification of Electrical Equipment

2.5 RECOMMENDED MANUFACTURERS

.1 Conductors:

.1 General Cable.
.2 Nexans.
.3 Prysmian.
.4 SouthWire.
.5 Or approved equivalent.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 20 00 10.

.2 Perform tests before energizing electrical system.

.3 Tests shall be completed by competent personnel.

.1 Provide all materials and instruments necessary to complete the tests.

.4 Check the phase of each conductor and identify the phase of each individual conductor for all circuit.

.5 Check continuity of all circuits. Ensure all circuits are free from faults and leakage current.

.1 Ensure resistance to ground of each circuit is not less than 50 megaohms or as recommended by cable manufacturer.

.6 Splice Tests:

.1 After laying or pulling cables, but before splicing and connecting, measure the insulation resistance of each phase conductor using a 1000 V megohmmeter.

.2 After the completion of each splice and / or connection, check the insulation resistance to ensure the distribution system is ready for the acceptance test.

.7 Dielectric Strength Tests:

.1 Ensure all circuit terminations and all ancillary equipment are disconnected.

.2 Ground shields, ground wires, metallic armor and conductors not being tested.

.3 Carry out dielectric strength tests in accordance with Manufacturer's recommendations.

.4 Measure dielectric value of circuits, power cables and equipment with a maximum voltage of 350 V using a 500 V megohmmeter.

.5 Measure dielectric value of circuits, power cables and equipment with a voltage range from 351 V to 600 V using a 1000 V megohmmeter.

.6 For the above noted test cases, ensure that the value of the grounding resistance prior to energization is not less than the manufacturer's requirements.

.7 Provide a certificate stating that all conductors have been tested and verified, and that all defective conductors have been replaced.

.8 Completely remove and replace the total and complete length of cable which does not meet the test criteria.

3.2 GENERAL CABLE INSTALLATION

.1 Terminate cables in accordance with Section [26 05 20 – Wire and Box Connectors – 0 – 1 000 V].

4. Cable Colour Coding: to Section 26 05 00- Common Work Results for Electrical.

.2 Conductor length for parallel feeders to be identical.

.3 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.4 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.

.5 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be two (2) wire circuits only, i.e. common neutrals not permitted.

.6 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

.7 Supply and install wires and cables required for the connection of all electrical equipment and devices to make them fully operational even if the wires or cables are not specifically shown on the drawings.

.8 Install conductors or cables in conduits or metal sheaths as indicated in this section.

.9 Install a neutral conductor bypass circuit at 120 V.

.10 Use only lubricants approved by the manufacturer for cable pulling.

.11 Install cables and leads continuously without joints from their point of origin to the powered device. If necessary, create joints in approved boxes.

.12 Support conductors in vertical conduit with Type M carriers, manufactured by O-Z Products. Space them as follows:

.1	Conductors of size 1/0 and smaller:	supports every 30 m.
.2	Conductors of size 2/0 to 4/0:	supports every 25 m.
.3	Conductors of size 250 to 350 MCM:	support every 20 m.
.4	Conductors of size 350 to 500 MCM:	supports every 15 m.
.5	Conductors of size 600 to 700 MCM:	supports every 12 m.

3.3 INSTALLATION OF BUILDING WIRES

.1 Provide armored cable with "Liquid-Tight" connections for the final connection to interior motors and transformers from a nearby junction box.

.2 Unless otherwise indicated in the plans or specification, all flexible connections to motors sand other devices inside cleaning rooms or in damp areas and exposed to dripping will be made with "Seal Dry" or " Cab Tire " type 24" minimum length, fitted with suitable watertight fittings, from a threaded galvanized steel conduit.

.3 Unless otherwise indicated in the plans, provide an additional green insulated conductor of the appropriate size to ensure the continuity of the ground in each thin-walled duct (EMT type).

.4 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

END OF SECTION

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Part 1 General

1.1 SUMMARY

.1 This section includes:

.1 This section is about equipment, material, accessories and specific prescriptions for appropriate for the installation of grounding and bonding of electrical system and continuous grounded system.

1.2 REFERENCES

.1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE):

.1 ANSI/IEEE 837-02 – IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

.2 Building Industry Consulting Service International (BICSI):

.1 Telecommunications Distribution Methods Manual (TDMM), 13th Edition.

.3 American National Standards Institute/Telecommunications Industry Association:

.1 ANSI/TIA-606-B – Administration Standard for Telecommunications Infrastructure.

.2 ANSI/TIA-607-B – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit the required documents and samples, in accordance with Section 20 00 10 - Mechanical and Electrical General Instructions.

.2 Submit grounding compliance certificate complete with test results.

Part 2 Products

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.2 Rod electrodes: copper clad steel 19 mm diameter by minimum 3 m long.

.3 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.

.4 Insulated grounding conductors: green, copper conductors, size as indicated.

.5 All grounding conductors shall be minimum gauge 6 AWG.

.6 High-conductivity wrought copper compression lug, electro-tin plated, 600 V certified, for copper conductors:

.1 One (1) hole for conductors smaller than 1/0AWG.

.2 Two (2) hole long barrel for 1/0 AWG conductors or larger.

.3 Silicone bronze bolts.

.7 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 Thermite welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

.7 Silicone bronze bolts.

.8 Alumino-thermic welded connectors:

.1 Alumino-thermic welded connectors with characteristics as follows:

.1 Alumino-thermic welds between conductors and grounding rods where the connection is made below ground.

.2 Alumino-thermic welds of type "Cadweld", approved by the Consultant.

2.2 RECOMMENDED MANUFACTURERS

.1 Grounding material :

.1 Burndy Corp.

.2 Ilsco.

.3 Thomas & Betts.

.4 Or approved equivalent.

.2 Alumino-thermic welded connectors:

.1 Erico.

.2 Thomas and Betts.

.3 Pentair.

.4 Or approved equivalent.

2.3 EQUIPMENT IDENTIFICATION

.1 Identify grounding equipment in conformance with Section 26 05 53 – Identification of Electrical Equipment

Part 3 Execution

3.1 EXAMINATION

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

.1 Visually inspect substrate in presence of Consultant.

.2 Inform Consultant-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 Consultant.

.2 Perform tests in accordance with Section 20 00 10 – General Instructions for Electrical and Mechanical.

.3 Measure and verify resistance to ground for all conductors to earth. Measure at ground bar using methods appropriate to local conditions. Resistance to ground must not exceed 5 ohms.

.4 Perform all tests prior to energizing electrical system.

.5 During testing, make all pertinent disconnections, such as a ground leakage indicator.

3.2 INSTALLATION

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories as outlined in Chapter V – Electrical Code of Construction of Québec.

.2 Arrange the grounding conductors in radial form and route all connections directly to a single common point grounding. Avoid loop connections.

.3 Install connectors in accordance with manufacturer's instructions.

.4 Protect exposed grounding conductors from mechanical injury.

.5 Conduct by thermite welding with the help of permanent mechanical connectors or compressed connectors in wrought copper as per the ANSI/IEEE 837 standard, buried connections, connections to the electrodes and connections to conduct groundwater with good conductivity.

.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

.7 Soldered joints not permitted.

.8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.9 Grounding continuity for electrical systems:

.1 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.2 Install a ground conductor in concrete encased metallic conduits installed in slab on grade.

.3 Install ground conductor in all PVC conduits.

.4 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end

.10 Grounding continuity, general:

.1 Ground secondary service pedestals, sanitary piping, rainwater piping and gas piping.

.2 Ensure conductive continuity across any electrically insulated part of a metallic domestic water distribution system. Conductive continuity across backflow preventers, water meters, pumps or other equipment shall be assured using bonding conductors.

.3 Connect building structural steel and metal siding to ground by welding copper to steel.

.4 Fuel piping and fuel tanks.

3.3 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral at secondary side of service.

3.4 EQUIPMENT GROUNDING

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

.2 Ground motor frames or other vibrating equipment by installing a separate green insulated ground conductor in the flexible conduit servicing the equipment. Terminate the green insulated conductor to a rigid surface at each end of the flexible conduit.

3.5 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.

.2 Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections size 2/0AWG.

3.6 COMMUNICATION SYSTEMS

.1 Install grounding connections for telephone, sound, fire alarm, security systems, intercommunication systems as indicated.

3.7 ALUMINO-THERMIC WELDING

.1 Perform alumino-thermic welding in accordance with manufacturer’s recommendations and instruction.

.2 Welding molds shall be appropriately dried prior to use according to manufacturer requirements.

.3 Conductors are to be cleaned and dried at weld locations.

.4 During welding, conductors shall be held in place and correctly positioned in the mould.

.5 Re-use welding molds in accordance with manufacturer recommendations. Do not use the same mold more than fifty (50) times.

.6 Clean mold prior to each use.

.7 All alumino-thermic welds shall be verified by the Consultant prior to backfill. All welds shall undergo stress test to verify weld integrity (light kick of steel toe boot).

.8 The contractor shall provide all necessary equipment to perform the welds at no additional cost.

3.8 LAY-IN MECHANICAL GROUND CONNECTOR

.1 Make connections using clamps as recommended by the manufacturer.

.2 Use clamps or suitable size for size and type of mechanical piping.

END OF SECTION

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Part 1 General

1.1 SUMMARY

.1 This section includes:

.1 U shape support channels for surface mounting, suspended installation or recessing in concrete walls or ceilings.

1.2 REFERENCES

.1 CSA International:

1. CAN/CSA G164-18 – Hot Dip Galvanized of Irregularly Shaped Articles.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit the required documents and samples, in accordance with Section 20 00 10 - Mechanical and Electrical General Instructions.

.2 Provide shop drawings for: U shape support channels.

Part 2 Products

2.1 SUPPORT CHANNELS

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

.1 Material and Finish:

.1 Interior: Pregalvanized zinc coated steel (mill galvanized).

.2 Exterior for temporary installation: Hot-dipped galvanized steel.

3. Permanent exterior installations: Aluminum.

.2 Fasteners used for exterior installations or damp locations shall be stainless steel.

2.2 ACCEPTABLE MANUFACTURERS

.1 Supports:

.1 Eaton.

.2 Hilti.

.3 Pentair.

.4 Thomas & Betts.

.5 Unistrut.

.6 Or approved equivalent.

Part 3 Execution

3.1 INSTALLATION

.1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with lead anchors [nylon shields].

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.

.7 Suspended support systems.

- .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use channels at 1 m on centre spacing.

.9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.11 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.

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

.14 Coat (touch-up) all scratched, altered or cut surfaces with a galvanized coating product.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 SUMMARY

.1 This section includes:

.1 General and specific requirements for junction, pull boxes and cabinets.

1.2 REFERENCES

.1 CSA Group (CSA):

.1 CSA C22.2 No. 40, Junction and Pull Boxes.

.2 CSA C22.2 No. 76, Splitters.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide shop drawings: for splitters, pull boxes, and cabinets in accordance with Section 20 00 10 – Mechanical and Electrical General Instructions

.2 Coordination drawings:

.1 Coordination drawings showing the location and dimensions of junction, pull boxes with identified circuits and distribution cables.

Part 2 Products

2.1 SPLITTERS

.1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position, of 14 gauge.

.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 [or lugs] on each connection or lug block sized less than 400 A.

.4 Continuous copper bars, complete with soldered terminals, capacity indicated in the plans.

2.2 JUNCTION AND PULL BOXES

.1 Construction: 14 gauge minimum steel, welded steel cans, painted with a coat of paint applied with an electrostatic process, dimensions as indicated.

.2 Covers Flush Mounted: 25 mm minimum extension all around.

.3 Covers Surface Mounted: screw-on flat covers.

.1 General use and dimensions less than 400 mm with screw on flat covers.

.2 With terminals or the dimensions more than 400 mm with flat covers on hinges.

.4 Without knockouts.

.5 When apparent, TC type with frame, covered/concealed hinges, lock, no visible screws.

.6 Boxes with large dimensions as 600 mm x 600 mm equipped with steel angle frame to form a rigid assembly, easily removable lids.

2.3 ACCEPTABLE MANUFACTURERS

.1 Junction and pull boxes:

.1 Bel Products.
.2 Hammond.
.3 Hoffman.
.4 Iberville.
.5 Roger Girard.
.6 Or approved equivalent.

2.4 EQUIPMENT IDENTIFICATION

.1 Identify equipment as per the requirements of Section 26 05 53 – Identification of Electrical Equipment

Part 3 Execution

3.1 SPLITTER INSTALLATION

.1 Mount plumb, true and square to building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND 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 Unless otherwise indicated, install cabinet with the top at 2m maximum from the finished floor.

.4 Only main junction and pull boxes are indicated. The dimensions and locations are for information. The contractor is the only responsible to locate and size the junction and pull boxes. Install additional pull boxes as required by CSA C22.1.

.5 Install all junction and pull boxes as indicated in the plans or where necessary.

END OF SECTION

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Part 1 General

1.1 SUMMARY

.1 This section includes:

.1 Rigid and flexible conduits, fasteners and fittings, and related installation methods.

1.2 REFERENCES

.1 Canadian standards association (CSA)/CSA International :

.1 CAN/CSA-C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.

.2 CSA C22.2 No. 45, Rigid Metal Conduit.

.3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.4 CSA C22.2 No. 83, Electrical Metallic Tubing.

.5 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.

.6 CAN/CSA-C22.2 No. 227.3, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

.7 CAN/CSA-C22.2 No. 262-04(R2018) – Optical Fiber Cable and Communication Cable Raceway Systems

.8 Building Industry Consulting Service International (BICSI):

.1 Telecommunications Distribution Methods Manual (TDMM), 13th Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit the required documents and samples, in accordance with Section 26 00 10 - Mechanical and Electrical General Instructions.

.2 Shop drawings:

.1 Electrical metallic tubing (EMT).

.2 Large radius elbows as indicated on drawings.

.3 End caps to sizes as indicated on drawings.

.3 Interference drawings:

.1 Interference drawings indicating placement and dimensions of junction and pull boxes.

Part 2 Products

2.1 CONDUITS

.1 All conduits shall be colour coded in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Electrical metallic tubing (EMT): to CSA C22.2 no. 83, with couplings, and expanded ends.

.3 Flexible metal conduit: to CSA C22.2 no. 56, liquid-tight flexible metal aluminum.

.4 The size required by Chapter V – Electricity of the Quebec Construction Code (Code d'Électricité du Québec), unless otherwise indicated, is a minimum of 21 mm diameter.

.5 Galvanized steel, rigid, thin-walled, unless otherwise indicated.

.6 Galvanized steel, flexible waterproof kind, between the ductwork and the unit's connections box (± 900 mm in length) for connecting motors and kitchen appliances.

.7 Sealed conduit connectors and fittings for electrical metallic tubing.

2.2 CONDUIT FASTENINGS

.1 One (1) hole, steel straps to secure surface conduits where the diameter is equal to 53 mm or less.

.1 Two (2) hole, steel straps for conduits larger than 53 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits.

.4 Threaded rods, 10 mm diameter, to support suspended channels.

.5 Maximum spacing of conduit fasteners:

.1 All rigid metal conduits of same size shall be securely fastened to supports or suitable surface such that the maximum spacing between the fastening points shall be (OESC Rule 12-1010 (1)):

1. 1.5 m for conduits sized 21 mm in diameter
2. 2 m for conduits sized 27 to 35 mm in diameter
3. 3 m for conduits sized 41 mm in diameter or greater.

.2 Grouped mounting of rigid metal conduits of different sizes shall maintain maximum fastener spacing as indicated in Item 2.3.5.1 for the smallest conduit size in the grouping. (OESC Rule 12-1010 (2))

.3 Flexible metal conduits shall be secured at intervals not exceeding 1.5 m and shall be secured within 300 mm of a termination to an enclosure or box. In cases where flexible metal conduit is pulled and flexibility is required at the termination, the conduit shall be permitted to be secured within 900 mm in lieu of 300 mm. (OESC Rule 12-1010 (3))

2.3 CONDUIT FITTINGS

.1 Fittings: to CAN/CSA C22.2 no. 18, manufactured for use with conduit specified. Coating: same as conduit.

.2 Ensure factory "ells (L)" where 90° bends for conduits 27 mm and larger if the space is not practicable for a 90° curve.

.3 Watertight connectors and couplings for EMT.

2.4 FISH CORD

.1 Polyester pre-stretching rope with integral measurement, equal to Greenlee Measuring Tape N435 of approved equivalent.

.2 For optical fibre and Category 3 multipair cabling, use flat pull cord, 9.525 mm, having a minimum tensile strength of 220 lbs. The rope shall include a 22 gauge tracer wire.

2.5 ACCEPTABLE MANUFACTURERS

.1 EMT or rigid metal ducts:

.1 Columbia-MBF.
.2 RepubliConduit.
.3 Wheatland.
.4 Or approved equivalent.

.2 Flexible conduit:

.1 Anamet Canada.
.2 Columbia-MBF.
.3 Thomas & Betts.
.4 Or approved equivalent.

2.6 IDENTIFICATION

.1 Equipment identification to conform with section 26 05 53 – Electrical system identification.

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 Conduits indicated on plans are shown in schematic form only. Place exposed conduit such that the available vertical clearance of the space is not reduced. Before start of work, review location of conduits with Consultant.

.2 Parallel conductor conduit runs shall be of the same length.

.3 Arrange and allow for cutting and drilling of openings and other structural work necessary to install electrical conduits, cables, pull boxes and terminal boxes.

.4 Openings in concrete beams, walls and floors shall be approved by the Structural Engineering Consultant.

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)

.4 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.5 Bend cold conduit.

.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.6 Mechanically bend steel conduit over 21 mm diameter.

.7 Install fish cord in empty conduits.

.8 Remove and replace blocked conduit sections.

.9 Do not use liquids to clean out conduits.

.10 Dry conduits out before installing wire.

.11 Unless otherwise indicated, all ducts are to be concealed in walls, floors, ceilings and suspended ceilings.

.12 Install protruding ducts in parallel with structural lines and so as not to harm the equipment of other trades.

.13 No drilling is to be done through the beams for the passage of conduits.

.14 Maintaining the continuity of the grounding throughout the facility, taking care to make solid connections between the conduits and equipment. A green wire grounding must be added to each flexible conduit connecting a device capable of vibrating, such as, motors and all ducts are to be installed in concrete.

.15 The inner radius of curvature of the ducts is at least six times the internal diameter of the pipe. When a group of ducts run side by side, the bending radii are concentric.

.16 During construction, equip ducts with plugs to prevent foreign bodies from entering.

.17 Conduit raceways between two outputs, pull boxes or sliding sleeves must not have more than three 90° elbows or equivalent or be more than 60 m in length, except the external telephone network, where indicated in the plans.

.18 Attach conduits as follows:

.1 Supply and install all the necessary supports [galvanized] [steel] for electrical work.

.2 Conduits:

.1 When the insulated conduits are in contact with a surface of concrete or masonry, affix them using cast iron or steel straps.

.2 Where a group of passages (four or more) flows in parallel, affix them to the steel supports by anchoring them directly to the frame or by means of threaded rods or other supports.

.3 The size of the rods, supports, and spacing of supports are based on weight bearing as required by the code. When conduits of various sizes are grouped, the spacing of the supports is determined by the smallest conduit of the group.

.3 Install cross braces spaced up to 12 m center-to-center and longitudinal braces on all horizontal runs of suspended conduits to 300 mm of the ceiling tile. This requirement may be omitted if the maximum diameter is less than 65 mm for a conduit or if conduits of an individual group has a total weight less than 15 lb/m.

.19 Support conduits suspended using galvanized brackets, as described elsewhere in this book.

.20 Use liquid tight waterproof conduit for connections to equipment in damp, wet or corrosive locations.

.21 The spacing of supports and fasteners must be in accordance with the latest edition of the Electrical Code of Québec.

.22 Support vertical conduits at floor level and use intermediate supports required by the code.

.23 In suspended ceilings, support the metal sheath cables to the frame and not the ceiling structure.

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 [suspended] [surface] channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.5 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 or in concrete slabs.

3.6 CONDUITS IN CONCRETE BASES, HOLES AND SLEEVES

.1 Be responsible for the establishment of the location, and size of all openings and concrete bases necessary for the performance of his work.

.2 Coordinate in advance with other divisions so that all sleeves, openings, and concrete pads necessary for the proper installation of electrical devices are carried out in a timely manner. When housekeeping pads cannot be provided with concrete, provide the required structure using C irons with drawings submitted and approved by the Engineer.

.3 Where it is impossible to warn the interested parties in time, or the contractor is negligent in doing so, carry out or have carried out this work at their own expense, including any repair that becomes necessary thereafter. Housekeeping pads must be built for each piece of self-supporting equipment, such as substations, motor control centers, transformers. The housekeeping pads will be 100 mm high and must exceed the perimeter of the equipment with 25 mm chamfered edges by 100 mm.

.4 In the event that the drilling of a floor is carried out after pouring, provide the appropriate sleeve with three (3) support studs which prevent it from slipping in the hole. Seal the space between it and the concrete with a suitable and approves watertight sealant.

.5 No matter what conduit, etc. passes through a partition, or wall with a prescribed fire resistance, provide and install an appropriate metal sleeve. The external sealing of the sleeve will be carried out by the Contractor. When the conduit, etc. is installed prior to the construction of the wall, the sleeves will line up on the conduits, etc., and the positioning will be the responsibility of the contractor erecting the wall.

.6 If the Contractor cannot or fails to supply and install these sleeves, inserts, frames in time, or if they are not correctly located, assume the cost of the drilling and subsequent repairs.

.7 Obtain permission from the structural Engineer before carrying out any drilling in floors, walls and ceilings, beams or any other part of the structure and obtain permission.

.8 Unless otherwise indicated on the plans, all drilling and openings of 150 mm in diameter and less will be carried out by the Contractor and coordinated with the general contractor and the Structural Engineer. Larger holes or openings will be carried out by another Contractor.

.9 Provide all openings for the passage of conduits or gutters, so as to allow expansion, contraction or insulation, as the case may be. In the case of an opening on the roof, take all the necessary precautions to ensure that it is watertight. Supply and install all steel supports necessary for the installation of equipment, ducts, etc.

.10 All holes made that will not be used and openings no longer needed must be plugged by the Contractor who is responsible for them using poured concrete and / or materials having the same characteristics as the floors and / or walls they pass through.

.11 The Contractor is responsible for damage to existing hidden services (conduits / electrical and telecommunications wiring, piping, structure or others) while making holes required for this work. Perform all the checks required to prevent damage to existing services. To this end :

.1 Consult the existing plans (if available).

.2 Consult the Owner and technical personnel having knowledge of the premises.

.3 Make small openings to ensure that larger openings are located between rebars and that they are not cut. Space holes by approximately 150 mm.

.12 The Contractor for each division will be responsible for locating and supplying all the sleeves necessary for the execution of this work, in accordance with the previous paragraph.

3.7 PULL CORDS

.1 Contractor to supply a flat tracking cord to ensure correct placement when installing fiber optic cables in new conduits or when pulling fiber optic cables and category 3 multipair cables in existing conduits.

.2 The pull cord must be installed inside the fiber conduit at the same time as the cable pull. When a conduit enters pull box or an access shaft, the Contractor shall enter the rope and leave a minimum length of 2 m inside the shaft and secure it near the cover.

.3 Provide a fish cord in empty conduits.

END OF SECTION

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Part 1 General

1.1 SUMMARY

.1 This section includes:

.1 Design, supply and installation of complete SRS for all systems, equipment specified for installation on this project. This includes UPS systems, electrical light fixtures, transformers, MCC's, diesel generators, fire protection, conduit, communications, electrical equipment and systems, both vibration isolated and statically supported.

1.2 SEISMIC STANDARDS

.1 Unless otherwise indicated, the seismic restraint system should be designed and selected to meet the requirements of the latest edition of:

.1 Building Code of Québec.

.2 CSA S86, S832.

.3 FEMA-450rl (for existing buildings, and for reference).

.4 Best practices as detailed in ASHRAE (Handbook and Practical Guide to Seismic Restraint) and SMACNA (Seismic Restraint - Manual Guidelines for Mechanical Systems).

.5 FEMA -172 standards and FEMA -365 must be used for the seismic rehabilitation of existing buildings.

.2 Seismic zone as follows:

.1 Montreal: $S_a(0.2) = 0.64$

.3 The acceleration factor of the location, F, to be considered in the calculations from the data transmitted by the engineering structure which is related to the soil profile (location category). As part of this project: the location category is E.

.4 Seismic risk coefficient, I_E:

.1 Electrical conduits anchored directly (rigid fasteners) to the structure:

.1 Emergency preparedness: $I_E = 1.5$

.5 If the value $S_a(0.2)$ is less than 0.12, seismic measurements can be omitted.

.6 Other coefficients (Cp, Ar, Ax, Rp) according to the Building Code of Québec.

.7 For non-ductile assemblies, adhesives or compressive cartridge fixings, Rp value is 1.0.

.8 Superficial anchors, chemicals, epoxy resin or anchors embedded, the Rp value is 1.5 if the embedding length / diameter ratio is less than 8.

.9 Cartridge fasteners and simply placed anchors should not be used as an anchor to resist pull loads.

.10 Electrical conduits connected to generator systems, UPS, communications, security systems, etc. I = 1.5.

.11 Electrical conduits supported by vibration isolators (flexible mountings): I = 1.5.

.12 Equipment and devices anchored directly (rigid attachments) on vibration isolators (flexible fasteners) to the frame : I = 1.5.

.13 For I_E = 1.5: the following systems shall remain operational during and after an earthquake:

.1 Communications systems.

.2 Static, uninterruptible power supply.

.3 Emergency generator.

.4 Fire detection and alarm system.

.5 Elevators.

.6 Those identified by the owner.

.14 Presenting a complete dynamic analysis of systems and equipment referred to above, provide details of the maximum forces applied to the material and make recommendations for changes or additions to support structures to maintain the equipment in good operating condition.

.15 In general:

.1 Montreal:

.1 For I_E = 1.5

Description	Location Category	Lateral Force (g)		
		Ground Level	Mid-height	Roof
Electric cable paths, busbar ducts, conduits (CCQ-2010, No. 17 Table 4.1.8.18).	A	0.11	0.22	0.33
Rigid components with ductile materials or non-ductile assemblies (CCQ-2010, No. 19 Table 4.1.8.18).	A	0.22	0.44	0.65
Machinery, accessories, equipment, conduits and reservoirs (with contents) (rigid, rigid and flexible assembly, flexible assembly) (CCQ-2010, Table No. 11 4.1.8.18).	A	0.22	0.44	0.65
Electric cable paths, busbar ducts, conduits (CCQ-2010, No. 17 Table 4.1.8.18).	B	0.12	0.25	0.37
Rigid components with ductile materials or non-ductile assemblies (CCQ-2010, No. 19 Table 4.1.8.18).	B	0.25	0.49	0.74
Machinery, accessories, equipment, conduits and reservoirs (with contents) (rigid, rigid and flexible assembly, flexible assembly) (CCQ-2010, Table No. 11 4.1.8.18).	B	0.25	0.49	0.74
Electric cable paths, busbar ducts, conduits (CCQ-2010, No. 17 Table 4.1.8.18).	C	0.14	0.29	0.43
Rigid components with ductile materials or non-ductile assemblies (CCQ-2010, No. 19 Table 4.1.8.18).	C	0.29	0.58	0.86
Machinery, accessories, equipment, conduits and reservoirs (with contents) (rigid, rigid and flexible assembly, flexible assembly) (CCQ-2010, Table No. 11 4.1.8.18).	C	0.29	0.58	0.86
Paths of electric cables, busbar duct, conduits (CCQ-2010No. 17 Table 4.1.8.18).	D	0.16	0.33	0.49
Rigid components with ductile materials or non-ductile assemblies (CCQ-2010, No. 19 Table 4.1.8.18).	D	0.33	0.66	0.99

Description	Location Category	Lateral Force (g)		
		Ground Level	Mid-height	Roof
Machinery, accessories, equipment, conduits and reservoirs (with contents) (rigid, rigid and flexible assembly, flexible assembly) (CCQ-2010, Table No. 11 4.1.8.18).	D	0.33	0.66	0.99
Paths of electric cables, busbar ducts, conduits (CCQ-2010, No. 17 Table 4.1.8.18).	E	0.16	0.33	0.49
Rigid components with ductile materials or non-ductile assemblies (CCQ-2010, No. 19 Table 4.1.8.18).	E	0.33	0.66	0.99
Machinery, accessories, equipment, conduits and reservoirs (with contents) (rigid, rigid and flexible assembly, flexible assembly) (CCQ-2010, Table No. 11 4.1.8.18).	E	0.33	0.66	0.99

1.3 CALCULATIONS

.1 The Engineer specializing in seismic design must obtain electrical plans and specifications, all information relating to equipment, including electrical conduits required for the calculation of seismic measurements (weight, number, raceway type, spacing between supports, groupings on trapezoidal supports).

.2 The Engineer specializing in seismic design must obtain from each device manufacturer, the characteristics required in Article "SHOP DRAWINGS" in Section 26 00 10 (weight, location of the center of gravity, number of fixing points, the center of gravity location of fixing points, speed, seismic fragility of the internal components, etc.).

.3 The Engineer specializing in seismic design must verify all calculation parameters, calculations, and installation details of the anchor bolts and seismic restraint measures.

.4 For vertical loads or equipment at risk of inversion, use the detailed equations in FEMA standard 450-1.

.5 Provide for information the earthquake engineering design report, the parameters or values used in compliance with the Building Code of Québec, the basis of calculations, data equipment or systems analyzed, calculations for seismic braces and inversion, overturning moments, anchor calculations, recommendations, measures and installation details for each system, piece of equipment, and device installed. Provide plans indicating measurements and sketches for each device, along with product specifications.

.6 In the event that the weight of equipment/tank and its contents have a mass greater than 10% of the mass of the floor, seismic forces will be subject to rational analysis.

.7 Confirm by calculations that if rigid braces are installed, no undue force will be applied to the supports.

.8 See the article "SEISMIC STANDARDS".

1.4 DESCRIPTION

.1 Seismic protection systems must be perfectly integrated and compatible with the following:

.1 Acoustic and vibration of prescribed devices.

.2 Building design features, as well as electrical and mechanical installations.

.2 It is not necessary that all hardware and operating systems remain protected during and after an earthquake, except those listed in the article "SEISMIC STANDARDS", which must remain operational during and after a disaster. During an earthquake, seismic protection devices and systems are used to prevent materials and equipment from moving, falling or tipping over, which could injure the occupants.

.3 The design of seismic protection devices and systems should be done by an engineer specialized in the field of seismic engineering and recognized in the province of Quebec.

1.5 INFORMATION/DOCUMENTS/SAMPLE SUBMITTALS

.1 Submit documents and samples required in accordance with Section 20 00 10.

.2 ~~Shop Drawings: the submitted shop drawings stamped and signed by professional engineer - registered or licensed in Canada, in the province of Quebec~~.

.3 Submit a design report for each electromechanical system, including:

.1 The name and number of the project as it appears on the plans and specifications.

.2 The name of the electromechanical system to which the report applies.

.3 The design criteria for the seismic protection system of the electromechanical system, including:

.1 The project location.

.2 The value of $S_a(0.2)$, as given in the CCQ, for the location of the project.

.3 The project location category based on the seismic response for the location.

.4 The value of Fa as a function of the location category and the value of $S_a(0.2)$.

.5 The building risk category.

.6 The risk coefficient for loads and effects due to earthquakes I_E.

.7 The height hn of the building above the ground.

.8 The technical components of the electromechanical system exempted, and the reason for the exemption.

.9 List of all technical components of the electromechanical system that must be protected against seismic loads.

.4 Calculations of the seismic loads created by the seismic stresses of all required technical components, showing:

.1 The identification of the technical component, as it appears on the plans and specifications.

.2 The location of the technical component, including its height h_x.

.3 The type of technical component (example: heat pump, heat exchanger, etc.).

.4 The manufacturer's model.

.5 The weight of the technical component and its coefficients C_p, A_r and R_p.

.6 The calculated lateral design load V_p of the technical component.

.7 Loads on the building structure.

.5 Equipment overturn calculations for ground, slab, or rooftop base, showing::

.1 The dimensions of the technical component, including the length L, the width or depth P, the height H and the center of gravity h_{cg}.

.2 Overturning moments.

.3 Moments resistant to overturning.

.6 The means of countering the calculated seismic stresses, including:

.1 The method for resisting seismic stresses.

.2 A sketch showing the planned installation to mitigate seismic loads.

.3 Plans showing the location and type of longitudinal, transverse, as well as longitudinal and transverse seismic restraints.

.4 Specification of acceptable products for each part that will be used for seismic protection, including anchors, bolts and nuts, aircraft cables and other equipment.

.7 The signature of the Engineer who produced the design report and his membership number with the Ordre des Ingénieurs du Québec, his professional address, his telephone number and his email address.

.4 At the completion of work, have the structure inspected and submit a compliance report for each electromechanical system, including:

.1 The project title and number as it appears in the specifications.

.2 The discipline to which the report applies.

.3 The title of the design standard report against which compliance is analyzed.

.4 The analysis of the seismic restraint of each technical component for which the design report required seismic protection.

.5 Photos showing the seismic restraint system applied to each technical component.

.6 A conclusion that the seismic restraint system installed meets the requirements of the design report and the reference codes and standards.

.7 The signature of the Engineer who produced the design report and his membership number with the Ordre des Ingénieurs du Québec, his professional address, his telephone number and his email address.

.8 The certificate waiving all claims of ownership and copyright to models, diagrams, working drawings, details and specifications in favor of the Owner.

.5 .5 Submit to the Framing Professional, for examination, the points of connection of the seismic restraint devices and systems to the building frame. Provide shop drawings and technical data sheets.

Part 2 Product

2.1 GENERAL

.1 All seismic restraint systems must be fully integrated and compatible with the noise reduction requirements and anti-vibration systems of electrical equipment and related systems, as specified in the documents.

.2 Seismic restraint systems must be compatible with the electrical and structural design of the building. They must not impede the normal operation of mechanical and electrical systems. They must be designed and installed to withstand calculated acceleration forces.

.3 In attached buildings, seismic measures must be designed to accept a multiplicative factor of two times the movement of the expansion joints, as calculated by the structural Engineer.

.4 Any equipment braced or not required to be braced, must not cause harm to an essential distribution system.

.5 Seismic measures should be able, in an earthquake, to prevent permanent shifts in all directions caused by lateral movement, ascent or rocking.

.6 The Consultant specializing in seismic measures must validate vibration isolators, integrated and separated seismic dampers, the cable fastening and restraint systems from other manufacturers that regularly produce the same material, in agreement with the proposed installation of the relevant section.

.7 Seismic protection systems must be able to oppose the applied forces in all directions.

.8 Fasteners and connection joints must withstand the same maximum loads as the seismic restraining devices.

.9 For longitudinal braces, the conduit must be attached to the conduit.

.10 Seismic bracing must be located near the supports (maximum distance of 100 mm (4 ")) for piping systems, ventilation pipes or electrical conduit.

.11 Depending on the type of service and its manufacturing material, the position and quantity of bracing must consider the shift length, maximum permissible ("offset") according to the forces involved throughout the course of the distribution.

.12 Seismic fasteners installed on conduit systems and cable trays must be compatible with the requirements of anchors and guides for the conduit systems and cable trays.

.13 Do not add rigid seismic restraints to existing electrical conduits supports without checking the ability of these supports to withstand the increased forces.

.14 Provide resistant expanding mechanical anchors to secure seismic restraints to concrete structures. Cartridge fasteners and anchors simply placed must not be used for loads under tension. The use of anchors and fasteners by nail gun is prohibited.

.15 The use of cast iron supports or those made of threaded pipes or other brittle materials is prohibited.

.16 Seismic restraint devices installed on conduit systems and related fasteners attached to electrical equipment must be compatible with the vibration and anti-seismic devices for these components.

.17 Seismic restraint devices must not interfere with the operation of fire devices or compromise their integrity.

.18 Vertical supports, including vibration isolators, should in no way develop reverse forces during normal operation of the system or equipment.

.19 Mounted services must include seismic measures and follow the recommendations contained in this discipline.

.20 When required, to prevent buckling, stiffeners on suspension rods to be added.

.21 For buildings $I_E = 1.5$: accessories such as diffusers and lighting fixtures installed in suspended ceilings, must be stabilized everywhere, including the exit corridors.

2.2 CONDUITS AND ELECTRICAL CABLE SHELVES

.1 Electrical conduit supports must withstand all static and dynamic conditions, including:

- .1 The weight of the conduit, accessories, and internal wires.
- .2 Inclement weather, such as ice, wind, and seismic forces.

.2 Conduit shall be provided with longitudinal and transverse bracing. They can be rigid or flexible types (cable). At the same bracing, always use identical spacers (do not use a spacer with a stiff wire), as per the installation diagrams in SMACNA.

.3 Seismic measures will be based on the recommendations of Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

- .1 Seismic Restraint Manual Guidelines for Mechanical Systems – SMACNA
- .2 Appendix E – Seismic Restraint Manual Guidelines for Mechanical Systems – Addendum SMACNA.

.4 Use one or more of the following methods depending on the installation conditions:

- .1 Fasten conduits securely to the frame.
- .2 Strengthen conduit in all directions.
- .3 Strengthen attachment points to the conduit frame.
- .4 Fasten conduit with bracing. Fixing of conduits by bracing prevents oscillation in the horizontal plane, swinging in the vertical plane, and the sliding and buckling in the axial direction.

.5 Seismic bracing may be omitted:

- .1 Electrical conduits individually suspended, the length between the top of the conduit and the anchorage is 300 mm (12") or less. If the installation is made on a trapeze, the permissible length of 300 mm (12") is located between the bottom of the trapezoid and the anchor.
- .2 Electrical conduits less than 65 mm (2½") in diameter. If electrical conduits of 65 mm are installed on the trapezoids and the total weight is less than the weight of the pipe or the equivalent of 14.9 kg/m (10 lb/in).

.6 Maximum spacing between seismic bracing shall be as follows, unless otherwise specified in the various tables (see Tables of SMACNA):

Description	Electrical Conduit	
	Transversal	Longitudinal
0.25 g	15.2 m (50')	24.4 m (80')
0.5 g	12.2 m (40')	24.4 m (80')
1.0 g	12.2 m (40')	24.4 m (80')
2.0 g	6.1 m (20')	12.2 m (40')

.7 Cross bracing must be installed at each end if the conduit length is less than the allowed distance. Cross bracing must be installed at each elbow and at each end of a segment. The minimum number is two per length of conduit.

.8 When conduits pass through a seismic joint or a building expansion joint or the pipeline is connected to a device based on vibration isolators, flexible joints must be installed multi-directionally.

.9 A rigid conduit must not be anchored to a structure or part of the building that responds differently to earthquakes.

.10 Raised pipes must be supported laterally at each floor (see details SMACNA).

2.3 DEVICES WITH VIBRATION ISOLATORS

.1 Surfaces must withstand all static and dynamic conditions, including:

.1 Their weight with accessories, insulation and internal fluids.

.2 Forces imposed by the thermal stress of expansion and contraction.

.3 Reactions during starts and stops.

.4 Vibration.

.5 In general, other occasional conditions, such as ice, wind and seismic forces.

.2 These devices must be securely anchored to the building structure to prevent tipping or sliding:

.1 Apply one or more methods, depending on the location conditions.

.1 Use anti-vibration devices with integrated damping systems.

.2 Use dampers separated into more anti-vibration devices.

.3 Use a damping system made of a compound of structural elements and an elastomeric material, with the approval of the Engineer.

.3 Damping effect exerted due to an elastomeric material or other means must be smooth and regular so as to prevent high impact loads.

.4 Seismic measures should not interfere with vibration isolators. They must not operate in case of earthquake and will not cause any overturning.

.5 Each device must have at least four seismic dampers installed as close as possible near the corners of the device.

.6 Each type of seismic shock must have the following characteristics:

.1 The impact surface must be high quality, un-cemented, elastomeric, in place for ease of replacement.

.2 Resilient material must be easily accessible for inspection and replacement in the case of damage.

.3 The assembly must reduce movement in all directions.

.4 Dampers must be tested by independent laboratories and certified by a registered Engineer in this discipline.

.5 In general, a maximum spacing of 6 mm (¼") between the unit and the seismic shock.

.7 Piping, conduit, and devices supported with vibration isolators:

.1 To avoid transmitting the vibrations normally by rigid bracing, these components have suspended cables relaxed, galvanized steel or stainless steel, see F-type seismic dampers.

.2 Seismic equipment fasteners must have the characteristics described for pipes and ventilation ducts without vibration isolators.

.8 Types of seismic shock:

.1 In general, seismic shock absorbers will be integrated with vibration isolators. When seismic forces are too high or when vibration isolators are existing, they must be separate.

.2 Description:

Type A	Separate omnidirectional absorber consisting of a molded element replaceable neoprene 3/16" minimum thickness, maximum capacity of 1 000 lb/in² minimum clearance of 1/8", minimum of two bolts, similar to the model No. Z 1225 by Mason.
Type B	Separate omnidirectional absorber consisting of a molded member replaceable neoprene ¾" minimum thickness, maximum capacity of 1 000 lb/in², clear 1/8" to ¼" maximum, minimum number of two bolts, similar to model No. Z-1011 by Mason.
Type C	Integrated omnidirectional absorber comprised of one or more springs shock with neoprene linings, placed inside of a housing ductile iron (gray cast iron housings cast are not accepted), minimum clearance ¼" minimum number of two bolts, similar to SLR models SSLFH by Mason.
Type D	Integrated omnidirectional damper composed of two molded elements replaceable neoprene placed inside a housing ductile iron minimum number of six bolts, similar to BR model by Mason.
Type E	Integrated omnidirectional damper for guiding or anchoring the riser pipes consisting of two steel tubes separated by ½" 60 durometer neoprene, load capacity of 500 lb/in², anchor plate to the base using two bolts, similar to the model ADAH by Mason.
Type F	Aircraft type, pre-stressed cable in galvanized steel or stainless steel, complete with the appropriate hardware (fasteners at the ends, assembly lugs, etc.), similar to the SCR model Vibron Mountings & Controls. Use a multiplication factor of 2 if it is of SCR model.

Type G	Hoses, rubber, spherical expansion with several layers of nylon, capable of withstanding 250 lb/in² at 170°F and 165 lb/in² at 250°F, fitting similar right to MFTNC model and 90° fitting similar to MFNEC model by Mason.
Type H	Steel platform suspended with steel frame, able to withstand seismic forces imposed by the weight of the equipment.
Type K	Separate shock absorber composed of framing elements and neoprene cushions, minimum number of two bolts, similar to Kinetics KSS model (Vibro Acoustics).
Type L	Separate shock absorber consisting of two neoprene sleeves and two steel washers, allowing the bolt to anchor the metal panels to the surface on a wall, similar to Mason's PB model.

2.4 LIST OF MANUFACTURERS

.1 Stiffeners on suspension rods:

- .1 B-Line (Cooper Industries)
- .2 Mason Industries Inc. (Tecoustics Ltd, Oakville, Ontario)
- .3 Power-Strut by Grinnell
- .4 Unistrut (Routleco Inc.)
- .5 Vibro-Acoustics, Vibration Mountings & Controls Inc. Korfund Dynamics Co. Inc. (Racan).
- .6 Vibron Ltd, Kinetics Noise Control (Patrick Garneau & Associates Inc.)

.2 Supports mechanical pipes and electrical conduits without vibration isolators:

- .1 B-Line (Cooper Industries)
- .2 Mason Industries Inc. (Tecoustics Ltd, Oakville, Ontario)
- .3 Power-Strut by Grinnell
- .4 Unistrut (Routleco Inc.)
- .5 Vibro-Acoustics, Vibration Mountings & Controls Inc. Korfund Dynamics Co. Inc. (Racan).
- .6 Vibron Ltd, Kinetics Noise Control (Patrick Garneau & Associates Inc.)

.3 Seismic dampers:

- .1 B-Line (Cooper Industries)
- .2 Mason Industries Inc. (Tecoustics Ltd, Oakville, Ontario)
- .3 Novibra
- .4 Vibro-Acoustics, Vibration Mountings & Controls Inc. Korfund Dynamics Co. Inc. (Racan).
- .5 Vibron Ltd, Kinetics Noise Control (Patrick Garneau & Associates Inc.)

.4 Steel Structures external to certain equipment cabinets:

- .1 B-Line (Cooper Industries)
- .2 Power-Strut by Grinnell
- .3 Unistrut (Routleco Inc.)

Part 3 Execution

3.1 GENERAL

.1 The seismic protection system design Engineer must ensure that the installation of the seismic restraint system by the Contractor meets the requirements of his design report.

3.2 MANUFACTURER INSTRUCTIONS

.1 Compliance: comply with requirements, recommendations and manufacturer's written data, including product technical bulletins, instructions for handling, storage and product installation, and technical information sheets.

3.3 INSTALLATION CRITERIA FOR SEISMIC DEVICES

.1 Seismic devices must not interfere with the normal functioning of the building or its technical components.

.2 Diffusers in dropped ceilings of exit corridors must be anchored to the suspended ceiling or to the building structure.

.3 Fixtures in dropped ceilings shall be secured to the structure with 16 gauge aircraft cable or 12 gauge steel wire at least at two (2) opposite corners.

.4 Any pendant type luminaire must be restrained to the structure by means of a flexible attachment - cable or steel wire - having an allowable load of at least two (2) times the weight of the luminaire. In addition, the luminaire must be able to oscillate through 45 ° without the risk of touching anything.

.5 If the dropped ceiling is seismic certified, luminaires weighing less than 9 kg can be attached to the structure of the suspended ceiling bars instead of directly to the building structure.

3.4 INSTALLATION

.1 Install the seismic fasteners for each electromechanical system as described in the design report.

.2 Seismic protection devices must not be anchored to two (2) different structures, such as a wall and a ceiling, and they cannot be attached to another component.

.3 Seismic bracing must be located near the supports (maximum distance of 100 mm (4 ")) for piping, ventilation ducts or electrical conduits.

.4 Fastening devices and bonding points:

.1 Ensure that the bonding points and fixing devices can withstand the same maximum loads of devices and seismic protection systems in all directions.

.5 Restraining cables:

.1 Connect restraining wire to suspended fixtures so that their axial impact corresponds to the center of gravity of the equipment.

.2 Use wire passes, spades and other appropriate hardware parts to ensure alignment of seismic devices and systems and to prevent the cables from bending at bonding points.

.3 In the case of piping systems, install the transversal retaining cables at intervals of not more than 10 m and the longitudinal wires at intervals not exceeding 20 m or according to the limits imposed by their performance characteristics or those of the anchors.

.4 For purposes of seismic protection, small diameter pipes may be connected to larger diameter pipes; however, the opposite practice is not permitted.

.5 In the case of equipment hanging from the ceiling, ensure an angle of 90° in the restraint cables relative to each other (in the plane), and attach them to the building frame at a 45° angle.

.6 Adjust the tension of the cables so they do not appear loose, but ensure they do not impede the normal operation of anti-vibration devices.

.7 Tighten the cables in order to reduce slack, 40 mm under thumb pressure. Under normal operating conditions, the cables must not support the weight of the restrained equipment.

.6 Install seismic devices and systems at least 25 mm from any machinery or any utility line.

.7 Isolating Miscellaneous equipment against vibration:

.1 Bolt the equipment to the mounting base and then to the building frame with the aid of through anchor bolts.

.8 Coordinate operations with the other trades involved.

3.5 TRAINING REQUIREMENTS FOR THE INSTALLATION CONTRACTOR

.1 The seismic protection system design Engineer is responsible for ensuring that the Contractor and his staff have the required skills and have received the necessary training to carry out the installation of the seismic system that meets the requirements of the design report.

.2 The seismic protection system design Engineer must ensure that the Contractor and his staff take into account the following issues:

.1 The thermal expansion and contraction of piping.

.2 The vibration of technical components.

.3 The springs and shock absorbers used to support technical components.

.4 Protection of the waterproof roof membrane.

3.6 FREE SPACING

.1 All seismic measurements should be verified after the mechanical and electrical systems have been switched on to ensure that the recommended free spacings are obtained. No more than recommended, as the fragility of the unit may be affected. Make adjustments where required. Be sure that the seismic restraints do not cause short circuits with vibration isolators.

.2 A minimum clearance of 25 mm (1") must be provided between the seismic protection devices, other equipment, and service elements.

3.7 ON-SITE QUALITY CONTROL AND INSPECTION INSPECTION

.1 After installing all rigid and flexible bindings and ensured their proper functioning in normal conditions, carry out inspections and repairs as per seismic measures.

.2 A consultant specializing in seismic measures will inspect the entire installation and remark and provide seismic measures it has calculated. Submit a written report signed by the same Engineer who produced the design report including, among others:

.1 Installation errors with corrective actions required.

.2 Improperly selected seismic dampers.

.3 Other deficiencies that could affect the operation of seismic measurements with corrective actions required.

.4 Steps to correct installations.

.5 The certificate of conformity to the standards listed previously for the electromechanical system signed by the SRS Engineer issued once all defects or errors have been corrected. This report must be submitted to the project owner or his representative before the acceptance of work.

END OF SECTION

TABLE OF CONTENTS

Partie 1 General

1.1 SUMMARY

.1 This section includes:

.1 The general requirements for the identification of electrical equipment.

1.2 LABELS AND NAMEPLATES

.1 Use the identifications for devices as indicated on plans.

1.3 ACTION AND INFORMATION SUBMITTALS

.1 Submit the required documents and samples, in accordance with Section 20 00 10 - Mechanical and Electrical General Instructions.

.2 Shop Drawings: Nameplates for electrical equipment.

Partie 2 Products

2.1 EQUIPMENT IDENTIFICATION

.1 Fabrication:

.1 General characteristics: 3 mm thick plastic lamicoids, with square corners, lettering accurately aligned and machine engraved into core.

.2 Sizes as follows:

Nameplate Sizes	Dimensions (L x H)	Dimensions: lettering height in mm or Arial font sizing			
		First Line	Second Line	Third Line	Fourth Line
1	300 mm x 100 mm	8 (30)	22 (80)	10 (36)	---
2	150 mm x 50 mm	6.5 (24)	13 (50)	6.5 (24)	---
3	100 mm x 30 mm	4.5 (16)	8 (30)	4.5 (16)	---
4	100 mm x 40 mm	4.5 (16)	8 (30)	5.5 (20)	4.5 (16)
5	75 mm x 35 mm	3 (12)	6 (22)	3 (12)	---
6	75 mm x 20 mm	6 (24)	3 (12)	---	---
7	50 mm x 10 mm	3 (12)	---	---	---

.3 Colours:

Type	Lettering	Background
Normal "N "	Black	White
Conditional Emergency Power	White	Red
Emergency – Personal security	Red	White
Emergency - Delay	Blue	Yellow
UPS Power	White	Blue

2.2 OUTLET AND SWITCH IDENTIFICATION

.1 Materials:

.1 Normal power: "P-Touch" type labels or approved equivalent. Size 9mm with black lettering on white tape.

.2 Emergency power: "P-Touch" type labels or approved equivalent. Size 9mm with red lettering on white tape.

2.3 EMERGENCY LIGHTING IDENTIFICATION

.1 Materials:

.1 Identify all emergency lighting devices with a round red sticker 6 mm in diameter with a plasticized finish resistant to cleaning.

2.4 ELECTRICAL EQUIPMENT IDENTIFICATION

.1 Materials:

.1 Normal power: "P-Touch" type labels or approved equivalent. Size 12mm with black lettering on white tape.

.2 Emergency power: "P-Touch" type labels or approved equivalent. Size 12mm with red lettering on white tape.

.3 UPS power: "P-Touch" type labels or approved equivalent. Size 12mm with blue lettering on white tape.

2.5 FIRE ALARM SYSTEM IDENTIFICATION

.1 Materials:

.1 "P-Touch" type labels or approved equivalent. Size 9mm with black lettering on clear tape.

2.6 UNILINGUAL IDENTIFICATION

.1 The labels used to identify the systems and elements must be written in French.

Partie 3 Execution

3.1 GENERAL REQUIREMENTS

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

.2 The procedure for identifying equipment numbers is provided in the legend.

.3 Circuit identification must be installed from each device and / or outlet, up to the supply power source.

.4 Circuit numbers must be marked on all junction box covers using a black felt-tip pen.

3.2 NAMEPLATE LOCATIONS

.1 Nameplates must clearly identify devices and must be located such that they will be visible and legible from the work floor.

.2 Do not apply paint or heat insulation to nameplates.

3.3 OUTLETS, SWITCHES AND ELECTRICAL DEVICES

.1 Provide identification labels on all receptacle plates, switches and other similar devices.

.2 Install tape across the width of the plate and turn the tape to the inside on each side of the plate.

.3 Write circuit numbers on the inside of all outlet boxes and switches. Use white tape and secure it to the wiring inside the box.

.4 The circuit number must be identified in full and include the distribution panel number followed by the circuit number (example: PS-1, 22).

.5 For "hospital" grade outlets, install a size 7 lamicoid plate above the outlet cover.

3.4 ELECTRICAL EQUIPMENT

.1 Information to include on nameplates:

Equipment	Format	First Line	Second Line	Third Line	Fourth Line
Substation or Service Entrance	2	Source (room)*	Equipment number	Capacité/Tension	---
Départ	6	No d'équipement alimenté	Room	---	---
Panneau de distribution (PD)	3	Source (room)*	Equipment number	Voltage, upstream protection	---
Starter	6	Supplied equipment number	(If TX, supplied panel), (room)	---	---
Motor Control Centre (MCC)	3	Source (room) (*)	Equipment number	Voltage/Room number	---
Starter	5	Protection /HP	Supplied equipment number	Room number if different	---
Interlock (starter)	3	Supplied equipment number	Interlocked with	Panel number of alternate source	
Transfer switch (TS) and equipment supplied from two (s) sources	4		Equipment number	Voltage/Upstream protection	Supplied equipment number
Source 1	6	Source (room) (*)			
Source 2	6	Source (room) (*)			
Transformer (TR)	4	Source (room) (*)	Equipment number	kVA-Voltage	Supplied equipment number
Supply panel (P)	3	Source (room) (*)	Equipment number		---

Equipment	Format	First Line	Second Line	Third Line	Fourth Line
Non-fused safety switch (IT)	5	Source	Equipment number	(room), S.F. amps	---
Fused safety switch (IT)	5	Source	Equipment number	Fuse size	---
Individual Starter/contactor (DEM)	5	Source	Equipment number	Protection/HP	---
Z32 Outlet	7	CCT (panel.)	---	---	---
(*) Only if the source is not in the same room.					

3.5 EXISTING SYSTEMS

.1 With a black marker, write circuit numbers on all junction boxes of existing circuits to be kept or relocated.

.2 When circuit wiring is removed up to a junction box, write on the box the number of the circuit with the inscription "RESERVED".

3.6 WIRING DESIGNATIONS

.1 Conductors to be identified by the CSA C22.10-2007 colour codes.

.2 In each fire alarm panel and in all junction boxes, each conductor will be identified by the circuit and loop number and an Electrovert Type Z identifier or approved equivalent suitable for the size of the wire; or by a sticker made from a printer designed for this purpose.

3.7 CONDUIT, BOX AND CABLE DESIGNATIONS

.1 Colour coding of metallic conduits: Apply colour marks (paint or plastic tape) to cables or conduits every 15 m and at the points where they penetrate a wall, ceiling or floor.

System	Conduit colour
Emergency 480/600 V	Black
Emergency 120/208 V, 120/240 V	Orange
Normal 480/600 V	Green
Normal 120/208 V, 120/240V	Violet
25 kV in rigid threaded steel conduit	Galvanized steel
Fire Alarm	Red
Telecommunications	Blue
Security	Yellow
Guard call	White
Building controls, GBM, Ground	Natural Galvanized Steel

.2 Add to the colour mark of the metal conduits a secondary colour marked with a 19 mm plastic tape coloured according to the colour codes indicated in the following table:

Secondary colour	
Mechanical	---
Medical	White
Building services (GBM)	Black
Ground	Green
Isolated ground	Green and yellow

.1 Apply color markings (plastic tape) to cables or conduits at the points where they enter a wall, ceiling or floor, electrical / mechanical room, and at each box and piece of equipment.

.3 Permanently and indelibly mark with colored plastic tape the conductors for each power circuit. The Contractor must identify the phases according to the colour codes indicated in the following table:

Building conductor colour codes	
Phase A	Red
Phase B	Black
Phase C	Blue
Neutral	White
Ground	Green
Isolated ground	Green and Yellow

.1 On the visible face of box covers, indicate the circuit numbers and the name of the panel, or its function. Use a "P-Touch" type sticker or approved equivalent.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 SUMMARY

.1 This section includes:

.1 Requirements of various types of moulded case circuit breakers available with optional features.

1.2 REFERENCES

.1 CSA Group (CSA)

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 20 00 10 – Mechanical and Electrical General Instructions.

.2 Shop Drawings :

.3 Without exception, shop drawings are required for the following items:

.1 All circuit breaker types covered by this section.

.2 Include time-current characteristic curves for breakers with ampacity of 60 A and over or-with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

.4 Certificates:

.1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit three 3 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.

.1 Production certificate of origin must be submitted Consultant for approval.

.2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.

.3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Consultant. Unless complying with this requirement, Consultant reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.

4. Production certificate of origin must contain:

.1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.

.2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.

.3 Contractor's name and address and person responsible for project.

.4 Name and address of building where circuit breakers will be installed:

1. Project title (title indicated in specifications or on plans).
2. End user's reference number.

Part 2 Products

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers to standard CSA C22.2 No. 5.

.2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.3 Plug-in moulded case circuit breakers: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

.4 Common-trip breakers: with single handle for multi-pole applications.

.5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from [3 and 8] times current rating.

.6 Circuit breakers rated 400 A or greater to include electronic trip unit.

.7 Circuit breakers with interchangeable trips as indicated.

.8 Circuit breakers to have interrupting capacity rating as indicated.

2.2 THERMAL MAGNETIC BREAKERS

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

2.3 ENCLOSURE

.1 Sprinkler-proof housing.

2.4 ACCEPTABLE PRODUCTS

.1 Eaton

.2 Général Électrique

.3 Groupe Schneider

.4 Siemens

.5 Or approved equivalent.

2.5 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 53 – Identification of Electrical Systems.

Part 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

.2 Provide hardware fittings when required.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 SUMMARY

.1 This section includes:

.1 This section describes a three phase, in-line, double conversion, solid state, continuous duty, static uninterruptible power supply referred to in these documents as “UPS”

1.2 RÉFÉRENCES

.1 American National Standards Institute (ANSI)/Underwriters Laboratories (UL) :

.1 ANSI/UL 94 – Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

.2 UL 1778 (Underwriters Laboratories of Canada) – UL Standard for Safety Uninterruptible Power Systems.

.2 CSA Group (CSA)/CSA International :

.1 CSA International CAN/CSA-C813.1 – Performance Test Method for Uninterruptible Power Supplies

.2 CSA C22.2 no 107.1 – Power Conversion Equipment

.3 CSA International CAN/CSA C22.2 no 107.2 – Battery Chargers

.4 CAN3-Z299.3 – Quality Assurance Program – Category 3

.5 CAN/CSA G40.20/G40.21 – General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality

.3 National Electrical Manufacturers Association (NEMA) :

.1 NEMA-PE-1 – UPS Specification and Performance Verification

.4 Internalional Electrotechnical Commission (IEC/CEI) :

.1 IEC 62040-1-1 – Uninterruptible Power Systems (UPS) – Part 1-1: General and safety requirements for UPS used in operator access areas.

.2 IEC 62040-1-2 – Uninterruptible Power Systems (UPS) – Part 1-2: General and safety requirements for UPS used in restricted access locations.

.3 IEC 62040-3 – Part 3 : Method of Specifying the Permofance and Test Requirements.

.5 Institute of Electrical and Electronic Engineers (IEEE) :

.1 IEEE 587 (ANSI C62.41Categories A and B (International Electrical and Electronics Engineers) – Guide for Surge Voltages in Low-Voltage AC Power Circuits

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit the required documents and samples in accordance with Section 20 00 10 – Mechanical and Electrical General Instructions

.2 Product Data: include information as follows:

.1 Catalogue information.

.2 Shipping weight.

.3 Schematic diagram showing interconnection of rectifier, inverter, battery, bypass switch, meters, controls and indicating lamps.

.4 Description of system operation, referenced to schematic diagram, for:

.1 Manual control during initial start-up and load transfer to bypass and back to inverter output.

.2 Inverter.

.3 Bypass.

.5 Estimate with supporting data for Mean Time to Repair factor (MTTR).

.6 Full load kVA output at lagging power factor of 0.95%.

.7 Efficiency of system at 25, 50, 75 and 100% rated load.

.8 Type of ventilation: natural or forced.

.9 Battery:

.1 Number of batteries, cells.

.2 Maximum and minimum voltages.

.3 Type of battery.

.4 Type and catalogue number.

.5 Catalogue data with battery, cell trade name and type.

.6 Size and weight of each battery.

.7 Battery charge and discharge curves of voltage, current, time and capacity.

.8 Derating factor for specified temperature range.

.9 Nominal ampere hour capacity of each battery in amperes-h.

.10 Maximum short circuit current.

.11 Maximum charging current expected for fully discharged condition.

.12 Recommended low voltage limit for fully discharged condition.

.13 Expected life.

.14 Full load voltage at the terminals of each storge cell.

.15 Full discharge voltage across each cell.

.16 Hydrogen release data and ventilation requirements.

.10 Inverter:

.1 Type and catalogue number.

.2 D.C. current at minimum battery voltage to produce full load A.C. output.

.11 Rectifier:

.1 Type and capacity, with catalogue number.

.2 Battery charging sequence.

.3 Current-time data for Silicon Controlled Rectifier (SCR) protective devices.

.4 Guaranteed noise level.

.5 Estimated life.

.6 Metering.

.7 Alarms.

.12 Manufacturer's field experience with UPS of similar ratings including engineering expertise, manufacturing facilities and listing of UPS units manufactured and installed during last 5 years including model, customer, location and installation dates.

.13 Evaluation of Canadian content.

.14 Heat losses at no load, 25, 50, 75 and 100% of rated output, in kW.

.15 Cooling air required in m^3/s.

.16 List of recommended spare parts, tools and instruments with catalogue numbers and current prices.

.17 Typical operation and maintenance manual.

.18 Description of factory test facilities.

.19 Manufacturer's written installation recommendations.

.20 The following characteristics of the external bypass cabinet:

.1 Details of manual key interlock, as well as the release of a key via a solenoid controlled by the UPS allowing for seamless transfer between internal and external bypass.

.2 Full characteristics of power transformers (when present), including circuit breakers and connection lugs.

.3 Dimensions, weight, anchors and required clearances.

.4 The maximum heat dissipated by conversion losses in kW (when present), at the maximum capacity of the UPS input (including battery recharging).

.3 Shop Drawings:

.1 Include outline schematics showing arrangement of cubicles, meters, controls, recommended clearance for aisles, battery rack(s) and cabinets, battery arrangement and dimensions.

1.4 PROTECTION OF SYSTEMS

.1 Integral circuit breakers to isolate from load and from mains for safe working on equipment, and for manual blocking of bypass automatic control to prevent inadvertent operation of bypass during work on inverter.

.2 Automatic circuit breakers and protection included in:

.1 AC input to rectifier.

.2 Battery input.

.3 Bypass circuit input.

.4 Inverter output.

.3 Surge suppressors:

.1 To protect system against supply voltage switching transients.

.2 To protect internal circuits where necessary against voltage transients.

.4 Current limiting devices, with panel front indication of device operation, to protect inverter SCR's.

.5 Suitable devices, with panel front indication of device operation, to protect rectifier diodes.

.6 Failure of circuit or component not to cause equipment to operate in dangerous or uncontrolled mode.

1.5 QUALITY ASSURANCE

.1 Submit for approval to the Consultant records which include the calibration certificates of instruments and metering devices installed as part of and integral to the system.

1.6 CLOSEOUT SUBMITTALS

.1 Submit all documents and items as required by these specifications.

.2 Operation and Maintenance (O&M) Data: submit operation and maintenance data for UPS for incorporation into O&M manual.

.3 Submit an interim, draft final and final Operation and Maintenance (O&M) manual. The final manual shall be approved by the Consultant. Submit interim copies before notification of factory acceptance test (FAT) date.

.4 Operation and Maintenance Manual to include:

.1 Operating and maintenance instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operations maintenance and repair work.

.2 Provide details regarding the installation of batteries, storage cell elements of each battery and the interconnections of all battery elements.

.3 Technical data shall include the following:

.1 Approved shop drawings.

.2 Time current characteristic curves for automatic circuit breakers and protective devices.

.3 System Calculation Data

.4 Technical description of components.

.5 Parts lists with names and addresses of suppliers.

1.7 WARRANTY

.1 The UPS shall be warrantied for 100% of parts and labour for a period of thirty-sex (36) months from the final date of commissioning of the unit by the supplier.

.2 The warranty period of all batteries will be one hundred and twenty (120) months.

.1 The warranty is for 100% replacement of its value during the first thirty six (36) months and prorated in equal yearly decreasing increments during the eighty-four (84) months thereafter until expiration of warrant at end of one hundred and twenty (120) months from the date of Certificate of Substantial Completion.

.3 Provide in separate prices not included in bases bid the hourly rate for emergency service calls for years 4 to 5 inclusive (after the first three years of full warranty).

.4 Preventive maintenance: provide a price for two (2) annual preventive maintenance exercises, one minor and one major, for the first three (3) years.

.5 Preventive maintenance: provide a separate price not included in base bid for two (2) annual preventive maintenance exercises, one minor and one major, for year 4 to 5 inclusive.

1.8 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit required replacement materials / equipment.

.2 Replacement materials / equipment shall include the following :

.1 One (1) fan set for each type of fan used for cooling all cabinets encompassing the UPS system.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 All elements required to provide a complete and functional UPS system must be provided by a single supplier in order for the monitoring of the warranty for complete assembly and for each comprising element is provided by a single party.

.2 Normal capacity of the UPS module shall be 50 kVA with a maximum real power of 30 to 50 kW, in accordance with the output power factor of the module.

.3 The UPS system shall consist of a base 480V module with input and output voltages rated at 480V. The configuration shall include an input auto transformer rated at 600-480V and an output isolation transformer rated at 480-120/208V. The power supply from the main electrical room is rated at 600V and thus no additional transformer shall be required upstream of the UPS system.

.4 The UPS system shall include the following main components:

.1 The UPS module comprised of a rectifier, an inverter, a battery charger, an internal static bypass circuit, and a control and monitoring panel. Modular type UPS unit with swappable load sharing power modules shall not be accepted.

.2 A storage battery in one or two matching cabinets providing a minimum 13 minute run time upon power loss at rated full load output power, ie minimum 48 kW.

.3 An external bypass circuit integral to the equipment in a matching cabinet.

.4 Input / output transformers shall be mounted in suitable cabinet enclosures forming a part of the complete assembly.

.5 The UPS system shall be a high efficiency type. Under normal operating conditions during in-line double conversion mode of operation, the unit shall provide 94.5% efficiency at loading conditions ranging from 40% to 100% of UPS rated capacity. If the alternative option is provided, include the losses of the isolation transformer required at the output of the inverter, to transform the voltage from 480V to 120/208V, and do not include the losses of the input autotransformer.

.6 The equipment must be able to operate continuously, without supervision.

.7 Ensure the UPS system is compatible with critical computer loads rated at 120/208V.

.8 The UPS system shall be mounted in matching NEMA 1 cabinets for free-standing installation on the floor. Access fr maintenance shall be provided from the front and will be equipped with drip screens to protect components located within the cabinets.

.9 The UPS system shall have exterior panels requiring special tools for access to internal components.

.10 Minimum symmetrical short circuit current rating shall be rated at 35 kA.

2.2 PERFORMANCE AND MODES OF OPERATION

.1 The UPS system shall be designed to operate as an uninterruptible power supply system with the following modes of operation:

.1 Operation in “normal” mode:

.1 The critical AC load is continuously supplied by the inverter of the UPS system.

.2 The rectifier/charger shall include the necessary equipment to rectify the AC power supply in order to supply the inverter and storage battery. The storage battery shall be appropriately supplied in order to maintain its appropriate full charge.

.2 Operation in “emergency mode” mode (via storage battery):

.1 Upon loss of AC supply power, the critical load shall be maintained by the inverter, which without any mechanical transfer is energized from the storage battery. **There shall be no interruption of power to the critical load during a failure or return of power to the AC service.**

.2 Automatic switching of the system to storage battery:

.1 Following an operator selection at the control panel.

.2 Following a power failure.

.3 In the event the supply voltage varies by more than 10% from the nominal voltage level, or in the event the supply frequency varies by ± 0.5 Hz from 60 Hz.

.4 In the event the main power supply is restored, and the supply voltage is within 10% of the nominal value, and the supply frequency is within 0.3 Hz of the nominal value of 60 Hz, then the system shall be switched automatically back to the main power supply.

.5 The rate of frequency deviation during the period of synchronization and automatic switching to the main power supply, and vice versa, must be within 0.5 and 1 Hz per second.

.3 Operation in "transfer" mode (or internal static bypass):

.1 In the event the UPS module is required to be bypassed for maintenance or repair, then the static transfer switch shall transfer the load to the main power supply. The transfer shall occur without any interruption to the critical load. The static transfer switch shall be provided with the necessary electrical isolation devices to allow safe servicing of the UPS module.

.2 Upon completion of maintenance work, the switching of load from the main power supply to the UPS system shall be done automatically via a manual operation of the selector located at the control panel.

.3 The automatic switching of the load to the main power supply shall be done within one quarter (1/4) of an AC cycle including the detection time. The transfer shall occur while the inverter remains energized, however the inverter shall be disconnected from the load in the following events:

.1 Overload at inverter (beyond established overload settings).

.2 A short circuit event at any point in the load.

.4 The automatic return of the load to the UPS module must be done without interruption to the critical load as soon as the events listed above are resolved.

.5 In the event of an internal UPS fault, automatic switching of the load to the main power supply shall be carried out within one quarter (1/4) of an AC cycle including the detection time and shutdown period of the inverter.

.6 The automatic switching of the load to the main power supply shall occur without interruption to the load prior to the inverter shut down in the following events:

.1 Overheating harmful to the system.

.2 Loss of forced ventilation.

.3 Insufficient DC voltage supply to the inverter.

.7 The bypass device shall be capable to close and withstand a momentary fault current at 800% of the nominal full load current for 0.01 seconds.

.4 Operation in "recharge" mode:

.1 Upon return to the main AC power supply, the rectifier/charger shall supply power to the inverter and simultaneously recharge the storage battery. This function shall be automatic and shall not cause interruption to the critical load.

.5 Operation in "without battery" mode:

.1 In the event that only the battery is required to be disconnected from the rectifier and inverter for maintenance, then it shall be possible to do so manually by operating the external battery circuit breaker.

.6 Operation in "bypass" mode:

.1 When in "transfer" mode, the cabinet housing the UPS module shall be completely isolated and the critical load shall be supplied via the external bypass. When in "transfer" mode, the UPS module shall release a key, via a solenoid, allowing manual switching, without disconnecting the load, with overlap of the two circuit breakers supplying the critical output bus of the bypass cabinet. The bypass cabinet circuit breaker supplying the UPS module cabinet input can then be opened.

.2 Following this procedure, the system shall be in "bypass mode" and the UPS cabinet shall be electrically isolated.

.3 Returning the critical load to supply via the inverter is done according to the same procedure in reverse order.

.4 The supplier must identify possible improper handling and connections in order to ensure the procedure is carried out safely and without interruption to the critical load. This procedure shall be documented in writing as well as on a limacoid plate at the front of the bypass cabinet.

2.3 NOMINAL OPERATING CHARACTERISTICS OF THE UPS

.1 UPS System input:

.1 Three-phase power supply, 600V, 3 PH, 3 W, with transformer and base UPS module at 480 V, 3PH, 3W. See item "System Description".

.2 Normal power supply of main, in AC.

.3 Emergency power supply by a diesel generator set with automatic operation with the option of adjusting the parameters for limiting the UPS input current according to the following criteria:

.1 Rectifier / charger input current limit adjustable from 100% to 115% of specified full load input current.

.2 Battery recharge current limit adjustable from 10% to 15% of UPS full load input current, irrespective of actual UPS load.

.4 Total harmonic distortion (THD) at the input shall be less than 5%.

.5 Start-up demand load: the power demand must be able to gradually increase to the nominal value specified for the UPS and it shall be adjustable for a duration three (3) to sixty (60) seconds.

.2 UPS System output:

.1 Power supply circuit as indicated on drawings, 120/208V, 5W, double neutral, 60Hz. The output of the UPS assembly shall be implemented using an isolation transformer rated at 480V-120/208V. See item “System Description”.

.2 Nominal output power as indicated in item “System Description”.

.3 Overload capacity: 125% of rated full load current at unity power factor and rated voltage for ten (10) minutes and at 150% of rated full load current for sixty (60) seconds.

.4 Fixed nominal frequency at 60 Hz:

.1 Adjustable from 58 Hz to 62 Hz.

.2 Maximum variation of 0.3 Hz from the setpoint, irrespective of load variations and transient events.

.3 Maximum displacement of 0.6 Hz from the setpoint after two (2) months of normal operation under an ambient temperature range of 0 to 40 deg Celsius.

.5 Regulation of output voltage:

.1 Continuous regulation under load within a minimum of 3% of the nominal voltage.

.2 The output voltage shall not deviate by more than 1% during load increase from 0 to 100%, or during prescribed period of full load energization after a failure of the main power supply.

.3 The variation in transient voltages must not exceed ± 10% of the nominal voltage followed by the stabilization of the voltage to its nominal level within 3 Hz during the following conditions:

.1 A momentary increase or decrease of the demand load equal to not more than 50% of the rated load.

.2 Upon loss or return of the normal main power supply during full load conditions.

.3 Upon bypass of the full load from the inverter to the branch circuit or vice versa.

.4 Harmonic values for all loading conditions:

.1 The total RMS value of harmonics must not exceed 5% of the overall output voltage for non-linear loads and 2% for linear loads.

.2 The value of any individual harmonic must not exceed 3% of the overall output voltage.

.5 The relation of phase angle must be maintained within 4 degrees for an imbalance of up to 20% of the load.

.6 Battery equalizing charge: an equalizing charge shall be able to be applied to the battery cells via automatic or manual means.

.7 Interference suppression:

.1 If the UPS system generates electromagnetic RF interference at levels which adversely affects other equipment in vicinity, install suppression circuits or shielding as required to eliminate such interference. The UPS system shall comply with FCC Rules and Rules 47, Part 15 for Class A devices.

.2 If harmonics reflected back to the main supply bus from the rectifier adversely affect other loads connected to the same bus, install appropriate filters to prevent this situation.

.3 Electrostatic discharge (ESD): the UPS shall comply with the specifications of IEC 801-2. The UPS shall be capable of withstanding a 25 kV pulse without damage or disturbance to the critical load.

2.4 ELECTRICAL REQUIREMENTS

.1 The electrical assembly must comply with Section 20 00 10.

.2 Bring out test points to protected coded pin jacks at convenient locations to permit testing without hazard, including:

.1 Inverter output ahead of output switch, three (3) phase and neutral.

.2 Mains power three (3) phase and neutral.

.3 Voltage across each SCR.

.4 Points requiring monitoring for on-site alignment, for determination of faulty sub-assemblies or printed circuit cards, including indication of oscillator pulse and operation of voltage control.

.3 No battery other than main battery incorporated in design.

.4 Wires number tagged or colour coded with same designation on drawings. Tags: non deteriorating type.

.5 Variable resistors: fine adjustment, rheostat type.

.6 Phasing marked on input and output terminals, viewed from front of equipment:

.1 Left to right.

.2 Top to bottom.

.3 Front to back.

.7 Indicator lamps: long life incandescent or neon, rated for continuous duty, with sockets having adequate heat dissipation of lamps and dropping resistor if used.

.8 Solid state circuits used where more reliable than mechanical timers or control relays.

.9 Standard components available from commercial sources used throughout, with ten (10) years minimum shelf life.

.10 Arrangement to permit easy removal of defective components to facilitate servicing, by replacing with stock spares.

.11 Small components, related to specific function, removable plug-in modular sub-assembly or printed circuit card.

.12 Heavy sub-assemblies easily accessible, or slide on runners of anti-friction material, and have flexible leads and bolted connections.

.13 Components and sub-assemblies accurately made for interchangeability.

.14 A manual changeover for external maintenance CDSA and completely isolate the rectifier, inverter and static switch. The transfer will take place without stopping the critical load.

.15 Provide all transformers, circuit breakers and filters required.

.16 The inverter must be located in a separate compartment and allow maintenance without stopping the charging system.

.17 An interlock key between circuit breakers for the maintenance inverter must prevent the simultaneous closing of the latter.

2.5 CABINET ENCLOSURE CHARACTERISTICS

.1 NEMA 1 enclosure, dead front, free standing c/w drip shield, minimum 2.5mm thick sheet steel.

.2 All cabinets including rectifier / charger, inverter, storage battery, internal static bypass switch and external bypass cabinet shall be placed side by side in a row and have maximum total dimensions of 1010mm deep and 3450mm wide. These dimensions are based on the limited space available in the computer room.

.3 Access from front only.

.4 Meters, indicating lamps and controls group mounted in panel front.

.5 Panel front enclosed by hinged doors to prevent tampering and to protect instruments and controls during shipping.

- .1 Doors formed wrap-around type, rigid, to open and close smoothly, locking type handle with two (2) keys.
- .2 Front facing hinges such that is is not necessary to remove the front completely to access the interior.

.6 Cubicle maximum height: 2050mm.

.7 Connection of inter-cabinet cables shall be provided at their respective side faces, and external cable connections at top of cubicle through bolted plate for drilling at site to suit.

.8 Ambient temperature range during operation: 0 degrees C to +40 degrees C. Natural or forced ventilation as required.

- .1 For forced ventilation, power from inverter output and fan directly driven by single phase motor mounted on vibration isolators.
- .2 Each enclosure to have fan failures alarmed. Air inlet and outlet opening protected with screens.

.9 Disposable air filters on fan cooled enclosures. Method of attachment and opening locations to make removal convenient and safe.

.10 Maximum operating sound level not to exceed 73 dBA as measured on sound level meter with A class weighting and slow response, at distance of 1.0 m.

.11 Enclosure frames interconnected by ground bus with ground lug for connection to ground.

2.6 RECTIFIER

.1 Input power supply from:

.1 A.C. mains.

.2 Automatic diesel engine driven generating unit.

.2 Input disconnect: bolt-on moulded case, single, three (3) pole air circuit breaker, quick make, quick break type for manual or automatic operation, temperature compensated for 40°C ambient, magnetic instantaneous trip element.

.3 Isolating transformer: connected between A.C. input and rectifier input.

.4 Surge suppressor: to protect equipment from supply voltage switching transients.

.5 Rectifier:

.1 Silicon controlled rectifier assembly or sealed silicon diodes.

.6 Filter: for rectifier D.C. output.

.7 Fuse: to protect D.C. output.

.8 Meters:

.1 D.C. voltmeter, switchboard type, accuracy ± 2% of full scale, to measure rectifier output voltage.

.2 D.C. ammeter, switchboard type, accuracy ± 2% of full scale, to measure rectifier output current.

.3 Digital display on front of cabinet.

.9 Adjustments and controls:

.1 Line voltage adjusting taps to allow for ± 10% variation from nominal.

.2 Manual adjustment of float voltage with range of ± 5%.

.3 Manual adjustment of equalizing voltage.

.4 Automatic current limiting on rectifier adjustable between 80 and 120% of normal rating.

.5 Provision to disconnect rectifier from inverter and battery if rectifier dc output exceeds safe voltage limits of battery.

.10 Metres, adjustments and controls to be grouped on front panel.

.11 Performance of rectifier:

.1 Automatically maintain battery in fully charged state while mains power available, and maintain DC float voltage within ± 1% of setting, no load to full load, during mains voltage variations up to ± 10%.

.2 Battery charging rate such that after battery has provided full load power output for specified duration, charger returns battery to 95% of fully charged state in 4 h.

.3 Automatic equalize charging circuit to initiate equalize charging of battery for 24 h after discharge of 5% of ampere hour battery rating.

.4 Manually initiated equalize charging feature with automatic timer adjustable from 0 to 24 hours to return unit to float charge.

2.7 INVERTER

.1 Input power supply from:

.1 Rectifier D.C. output.

.2 Battery D.C. output.

.2 Input disconnect: bolt-on moulded case, single pole, circuit breaker, quick make, quick break type, for manual or automatic operation, temperature compensated for 40°C ambient, magnetic instantaneous trip element.

.3 Input filter: with separately fused computer grade capacitor banks and indicator lights, to eliminate inverter source noise and restrictions on input cable length.

.4 Power stage: high frequency switching type, dual cooled disc type silicon controlled rectifier (SCR). Components, solid state devices capable of satisfactory operation under ambient conditions of -35 to +55°C.

.5 Logic module:

.1 Integrated circuit logic.

.2 Silicon semiconductors.

.3 Plug-in modules.

.4 Gold plated plug-in connector.

.5 Front accessible field adjustments for voltage and frequency.

.6 Front accessible test points: suitably protected coded pin jacks.

.7 Frequency reference module.

.8 Current limiting module, automatic high speed by controlled reduction of output voltage.

.9 Voltage regulator.

.6 Output filter: output of high frequency switching stage contains elements of carrier frequency which are filtered to low harmonic sine wave.

.7 Meters:

.1 AC voltmeter: switchboard type, accuracy ± 2% of full scale, to measure inverter output voltage with seven (7) position selector switch to select phase to neutral, phase to phase, off.

.2 AC ammeter: switchboard type, accuracy ± 2% of full scale, to measure inverter output current with [our (4) position selector switch to select each phase and ("off").

.3 Wattmeter: switchboard type, accuracy +/-2% of full scale to measure inverter load.

.4 Frequency meter: switchboard type, scale 58 to 62 Hz, pointer type, to measure inverter output frequency.

.5 Synchroscope: with switch to check inverter output potential against supply mains potential.

.8 Output disconnect: bolt-on, moulded case, [single] [two] [three] pole circuit breaker, quick make, quick break type, for manual or automatic operation, temperature compensated for 40°C ambient, magnetic instantaneous trip element.

.9 Meters and controls: grouped on front panel.

2.8 BATTERY

.1 The battery shall be lead acid type, sealed, maintenance free, with a warranty as specified in the article item “WARRNATY”.

.2 Number of cycles: useful life of two hundred (200) total discharge cylces, when used and maintained in accordance with manufacturer specifications.

.3 The UPS shall be equipped with a DC circuit breaker to isolate it from the battery. The circuit breaker shall be mounted in a separate compartment in the battery cabinet(s). When opened, there should be no battery voltage present in the DC breaker cabinet. UPS shall automatically be isolated from the battery or when controlled by other control functions. The UPS shall have a push button allowing the tripping of the battery circuit breaker from the control panel.

2.9 BATTERY ACCESSORIES

.1 Four (4) spare connections, with associated bolts and nuts.

2.10 STATIC BYPASS SWITCH

.1 Two (2) solid state closed circuit automatic transfer switches.

.2 Logic unit with three (3) normal source voltage sensors, which monitor overvoltage under-voltage and loss of voltage.

.3 High speed automatic transfer from normal voltage to alternate source when:

.1 Normal source voltage lost: transfer time and sensing ¼ cycle;

.2 Normal source: under-voltage at 80% of nominal value; adjustable.

.3 Normal source: over voltage at 110% of nominal value.

.4 Loss of normal source static switch continuity.

.5 Short circuit on normal source trips normal source breaker.

.4 Return to normal source:

.1 When normal source remains within return voltage limits of 95 to 110% of nominal value (adjustable) for approximately one (1) second timing interval, circuit checks voltage balance and phase synchronization, then initiates return with zero switching time.

.5 Switch position lights and contacts.

.6 Synchronizing verification light.

.7 Manual reset pushbutton.

.8 Transfer test switch.

.9 Alternate power source monitor light.

.10 Accessories:

.1 Manual bypass switch for maintenance and testing without load disturbance.

.2 Continuity monitor: automatic transfer to alternate source in event of static switch discontinuity.

.3 Alternate power source loss alarm contacts.

.11 Continuity detection device : feature shall allow for automatic switching to emergency power in the event of a lack of continuity due to a defective static transfer switch.

.12 Alarm contacts in the event of emergency power failure.

.11 DISPLAY AND CONTROL

.13 Control or touch screen:

.1 The system control function shall be:

.1 UPS bypass transfer push button.

.2 ± 5% adjustment of AC output voltage.

.3 UPS emergency stop push button with protective cover.

.4 Stop push button c/w audible alarm.

.5 Push button activating controls.

.6 Display control buttons: forward, reverse, selection.

.7 Alarm reset switch.

.14 Manual procedures:

.1 Start-up, load transfer and shutdown procedures shall be detailed on the display panel in text and graphics.

.15 Start-up:

.1 Step-by-step procedure on the screen indicating UPS voltage, bypass voltage and phase synchronization.

.2 Transition display scree simultaneously indicating DC voltage, output voltage, and input phase ampacities at start-up.

.3 Single line diagram indicating power flow.

.16 Load transfer:

.1 Step by step procedure indicated on screen.

.2 Single line diagram indicating power flow.

.17 Stop:

.1 Step by step procedure indicated on screen.

.2 Single line diagram indicating power flow.

.18 Emergency stop:

.1 The UPS control panel shall be equipped with a local emergency stop station. When engaged, the emergency stop button will cause:

.1 Opening of the input, output and isolating battery circuit breakers.

.2 Fully disconnecting the UPS from the main power source.

.2 Provision for the installation of a circuit with a remote emergency stop button shall be provided allowing for complete disconnection of power from the critical load bus when activated.

.19 Display:

.1 Current status display:

.1 The control system shall monitor and display all of the following parameters on the current status display:

.1 Phase to phase input voltage for each of the three (3) phases.

.2 Input current for each of the three (3) phases.

.3 Phase to phase output voltage for each of the three (3) phases.

.4 Output current for each of the three (3) phases.

.5 Output frequency.

.6 Battery voltage.

.7 Battery current.

.8 Load in kW.

.2 The parameters of the three (3) phases shall be displayed simultaneously. The current and voltage parameters shall all be monitored at the true RMS value for an accurate (± 1%) representation of a non-sinusoidal waveform typical of computers and other sensitive loads.

.2 Status history file:

.1 The control system shall retain information within discrete 4 millisecond windows, updating memory on a “first come, first served” basis. This shall allow for event recall over a period of at least 256 milliseconds (sixty-four (64) windows), 160 milliseconds prior to a fault (forty (40) windows), and 96 milliseconds after the fault (twenty-four (24) windows).

.20 Event history file:

.1 The control system shall maintain a history of alarm condition events that have occurred during system operation. The system memory shall be able to store one hundred and twenty-eight (128) events in memory.

.21 Diagnostic tools:

.1 The UPS shall include the following internal diagnostics to facilitate troubleshooting and system adjustments:

.1 Rectifier in control mode.
.2 UPS in synchronization with load bus.
.3 DC positive bus bar ground fault.
.4 DC negative bus bar ground fault.
.5 Bypass frequency higher than system output frequency.
.6 Bypass frequency lower than system output frequency.
.7 Automatic transfer of seized static switch.
.8 Command given to close the inverter output circuit breaker.
.9 Command given to close the branch circuit breaker.
.10 Command given to open inverter output circuit breaker / branch circuit breaker.
.11 Degree of overload.
.12 Low voltage trip event of the input circuit breaker.

.22 Alerts:

.1 Alarm states shall be displayed locally and also transmitted by the remote supervision system.

.2 The control panel shall allow for the transmission of the alarms listed below. An audible alarm shall be activated in the presence of one of the following alarms:

.1 Loss of power.
.2 Loss of power to controls.
.3 DC ground fault.
.4 DC circuit breaker open.
.5 Discharging of battery.
.6 Low battery warning.
.7 Low battery shutdown.
.8 DC overvoltage shutdown.
.9 Load in bypass.
.10 Static switch off.
.11 Bypass not available.
.12 Incorrect phase sequence.
.13 High / low output frequency.
.14 Output undervoltage.
.15 Output overvoltage.

.16 Overload condition.
.17 Transfer on overload.
.18 Overload shutdown.
.19 Inverted energization.
.20 Hardware shutdown.
.21 Emergency stop.
.22 High ambient temperature.
.23 Loss of fan.
.24 Equipment overheating.

2.11 FABRICATION

.1 All elements and cabinets and cabinets forming a complete static uninterruptible power supply system must be factory assembled and fitted. To facilitate transportation, the battery may be installed inside the cabinet on site.

.2 Perform tests at the factory, as recommended by the manufacturer and including test specified in item “FACTORY QUALITY CONTROL”

.3 Provide a factory acceptance test demonstrating that all elements have been successfully tested and that the assembly constitutes a complete static uninterruptible power supply.

~~.4~~ Only ship the UPS system to site after the Construction Professional has approved the test report indicated in item “FACTORY QUALITY CONTROL”. Allow five (5) working days in the schedule for the Professional to review and approve the report.

2.12 MANUFACTURERS

.1 Models from the following manufacturers, meeting the requirements of the specifications are accepted:

.1 Galaxy VM de Schneider Electric (système existant)
.2 Mitsubishi
.3 Toshiba, série G9000
.4 Eaton Powerware
.5 Liebert (Vertiv), série EXM

.2 The supplier shall have practical experience in the installation of uninterruptible power supply (UPS) systems of an equivalent power rating.

.3 The supplier shall have the technical skills and appropriate number of experienced staff to provide the required support during troubleshooting or maintenance operations.

.4 Le fournisseur doit posséder une expérience pratique quant à l'installation de systèmes d'alimentation sans interruption (ASSC) de même puissance nominale. The repair shop for the UPS components shall be in Canada. The repair provider shall off various maintenance contract options which shall be presented to the Owner for information.

.5 The supplier shall provide details of the manufacturing factory, as well as a list of UPS system manufactured and installed in the last five (5) years in Quebec. Indicate the model number, the customer, the location and the dates of installation for each past project.

2.13 EQUIPMENT IDENTIFICATION

.1 Supply and install the data plates in accordance with section 26 05 53 – Identification of Electrical Systems.

.2 For major components such as AC input power circuit breaker, inverter circuit breaker and bypass circuit breaker: size 5 nameplates.

.3 For operation mode indicator lights, alarm devices, and measuring devices: size 3 nameplates.

2.14 EXTERNAL BYPASS CABINET

.1 The external maintenance bypass cabinet shall include the following:

.1 All material and interconnecting cables for connection to the UPS module cabinet.

.2 An external maintenance bypass to isolate the UPS module cabinet from the main AC power supply input and the critical load. The bypass system shall allow for complete electrical isolation of the UPS module cabinet for maintenance and/or to allow for complete removal of the UPS module cabinet for replacement, while continuing to energize the critical load.

.3 The external bypass cabinet shall have two overlapping (2) circuit breakers c/w mechanical key interlock and a solenoid controlled by the UPS module with the functionality of releasing a key in order to perform transfers without interruption and to prevent incorrect operation or loss of energization to the critical load.

.4 If the alternative option is selected, the cabinet shall also include an input autotransformer and an output isolation transformer. See item “SYSTEM DESCRIPTION”

2.15 REMOTE SUPERVISION

.1 The UPS network adapter and supervision software: the UPS shall be equipped with a communication interface to allow data exchange between the UPS module and the supervisory control and electrical data acquisition system (SCADA). The Modbus TCP / IP protocol shall be used to communicate with the supervisory control and electrical data acquisition system (SCADA). If this protocol is not supported by the UPS, it shall be the responsibility of the manufacturer to supply and install the gateway and programming required to allow the transfer of data to the supervisory control and electrical data acquisition system (SCADA).

.2 UPS supervision software: this system shall be able to continuously supervise the critical power components of the UPS using the communication ports of each of the UPS modules and a computer supplied by the Client.

.3 The system shall be able to send, in the even of a problem, a remote alarm by e-mail, pager or test message in addition to sending an alarm to the building management system.

.4 The wiring connecting the UPS to the supervisory control and electrical data acquisition system (SCADA) must be provided according to the requirements of this specification.

.5 The UPS shall be capable of being supervised and managed via a standard web browser (example: Internet Explorer) and the building management system.

.6 All optional hardware interfaces shall be “hot swappable” (with UPS continuing to power critical equipment when interfaces are replaced).

.7 The time and labor required for the programming and verification necessary for the integration of the data from the UPS to the supervisory control and electrical data acquisition system (SCADA) shall be included in the price of submission and coordinated with the Construction Professional.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for uninterruptible power systems static (UPS) installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of the Consultant.

.2 Inform the Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Consultant.

3.2 INSTALLATION

.1 Locate UPS cubicles, battery rack and battery as indicated.

.2 Assemble and interconnect components to provide complete UPS as specified.

.3 Connect A.C. mains to main input terminal.

.4 Connect UPS output to load.

.5 Start-up UPS and make preliminary tests to ensure satisfactory performance.

.6 Install batteries in their cabinet.

.7 Clean terminals and connectors, coat with anti-oxidation compound.

.8 Tighten nuts using torque wrench to torque recommended by supplier.

.9 Connect the battery to the charging circuit prior to energization.

3.3 FACTORY ACCEPTANCE TEST

.1 The complete system, including rectifier, inverter, internal bypass switch, external bypass cabinet, remote sensing annunciator panel, control devices and battery must be tested at the factory.

.1 The Construction Professional reserves the right to attend factory tests. Notify the latter at least two weeks in advance for coordination.

.2 Testing method:

.1 Prepare forms and blank check sheets to record results.

.2 As the tests porgress, point to the verification sheet and write the results on the form, in two (2) copies. Attach the records of the measuring devices.

.3 Submit a duplicate of the results at the end of the test.

.4 Incorporate data from the original tests into operations and maintenance manual.

.3 Test equipment:

.1 The instruments used during the tests, including the measuring devices incorporated in the system, must be accompanied by a recent calibration certificate.

.2 For testing purposes, provide an appropriate dummy load adjustable to 150% of the nominal system capacity c/w unity power factor. The load of each phase shall be adjustable from 0 to 100% to allow testing of an unbalanced three-phase load.

.4 Tests:

.1 Complete a visual inspection of the system to confirm the following:

.1 Materials, fabrication and assembly conform to design requirements.

.2 All parts are new and free from defects.

.3 The battery and associated components are not damaged.

.4 All battery elements are of the same manufacturer and construction.

.5 The correct polarity of each battery cell and the associated connections to the inverter have been respected.

.6 Installed fuses are appropriately rated.

.7 The scale of the measuring devices is appropriate for the application.

.8 The accessories are in place.

.9 Portable measuring devices used for acceptance tests are suitable for the associated tests and their measuring transformers are correctly connected.

.2 Demonstrate the following sequence of operation and operating characteristics:

.1 Starting and stopping the system.

.2 Operation during a failure of the normal main power supply. Note the value of the output current during the failure and after restoring the normal power supply using an oscilloscope and image capturing accessories.

.3 All possible settings.

.4 Record values measured at test point by means of an oscilloscope, a digital multimeter, and a data recording oscillograph.

.5 Correct operation of protective deices and measuring devices. Record the system response and note the operation of remote indicators and the bypass switch. Test the following cases:

.1 Actuation of annunciator indicator lights.

.2 Overcurrent at the output of the inverter.

.3 Overvoltage and lack of voltage at the output of the inverter.

.4 Low DC voltage the inverter input. Gradually reduce the DC voltage at the input of the inverter while the inverter is supplied power at full load. Confirm the load automatically switches to the bypass circuit and the inverter shuts down. Record the input and output values.

.6 With a hot air blower, heat the sensor to simulate an overheating condition.

.7 Simulate a blown fuse to verify correct indicator light actuation.

.8 Simulate a fan failure.

.9 Automatic operation of the internal bypass switch: record the stability of the current and absence of any disturbances using digital meters during the automatic bypass switching.

.10 DC overvoltage at rectifier output

.3 Harmonics performance check:

.1 Using a power quality analyzer to monitor the output, determine the total harmonic distortion at no load, half load and full load conditions.

.2 Using a power quality analyzer to monitor, determine the amplitude of each harmonic.

.3 Measure the amplitude at each phase to netural at unity power factor and a lagging power factor of 0.8.

.4 Transients:

.1 Upon normal input power conditions, record the voltage and current values by means of oscilloscopes while applying a step load of 100% and when reducing a step load of 100%.

.2 Record voltage and current values using oscilloscopes.

.3 Measure the efficiency of the rectifier, the inverter and the entire system.

.5 Steady Load:

.1 Connect the system to normal AC electrical power, start the inverter and apply a dummy load at a power factor of 0.9

.2 Operate the system at full rated load for twenty-four (24) hours and at 125% rated load for fifteen (15) minutes, at an ambient temperature of 40 deg C.

.3 At the start of the test, and at every thirty (30) minute interval, take a recording of the following parameters:

.1 Input frequency.

.2 Input voltage of each phase.

.3 Input current of each phase.

.4 Input power in kW.

.5 Output voltage of from phase to phase and phase to neutral.

.6 Output current per phase.

.7 Output power in kW.

.8 Temperature at forced ventilation air intake.

.9 Temperature at forced ventilation exhaust.

.10 Temperatures in critical areas.

.11 DC voltage at inverter input.

.12 DC current at inverter input.

.13 DC current at rectifier input.

.6 Variable loads:

.1 Following the “Steady Load”, record the parameters listed in Item 3.3.4.5.3 at no load, 25% load, 50% load, 75% load and 125% load.

.2 Measure the efficiency of the rectifier, the inverter and the complete UPS system, including transformers.

.7 Unbalanced loads:

.1 Adjust the loading connected to the inverter such that two phases are at 100% load and the third phase is at 80% load.

.2 Adjust the loading connected to the inverter such that two phases are at no load and the third phase is at 20% load.

.3 In both cases, record all phase voltages, line voltages, line currents and phase shits to demonstrate a steady load supply in unbalanced conditions.

.8 Battery:

.1 Charge batter to ensure all cells are fully charged. Once the voltage has stabilized at the completion of charging record the following parameters:

.1 Ambient temperature.

.2 Temperature at each battery unit.

.3 Battery voltage.

.4 Voltage at each battery unit.

.5 Charging current.

.6 Relative density of the electrolyte of each cell (unsealed lead acid battery only).

.2 Discharge the battery by running the UPS at full load and disconnecting the main supply for the period specified in the design requirements. Record the following parameters at five (5) minute intervals:

.1 Battery voltage.

.2 Current.

.3 Voltage at 10% of battery units, taken at random.

.4 Ambient temperature.

.5 Battery temperatures.

.6 Relative density of the electrolyte of 10% of the units (unsealed lead acid battery only).

.3 Recharge the battery automatically for four (4) hours, restoring the normal power supply and while the system is connected to a dummy load. Record the following parameters at fifteen (15) minute intervals:

.1 Battery voltage.

.2 Load current.

.4 At the beginning and at the end of the charging period, note the ambient temperature, the battery temperature, and the relative density of the electrolyte cell (unsealed lead-acid battery only)

.5 Repeat the tests and discharge reading to demonstrate that the battery is recharged to at least 95% during the four (4) hour charging period.

.6 Recharge the battery.

.7 Perform the tests on the battery with an infrared camera in operation. The costs required for thermography must be included in the tender price.

.8 Provide a report of the testing to the Consultant for approval.

.9 Sound Level:

.1 The operator of the acoustic meter shall take reading by holding the sensor in front of him and orienting it such that it is perpendicular to the direction of the sound produced by the system. The sensor shall be held at a height of 1.2m and a distance of 1 m from the equipment being tested.

.2 Measure the sound level of the system while the ambient sound level is low.

3.4 TESTING

.1 Perform tests in accordance with CAN/CSA-C813.1.

.2 Provide:

.1 Competent field personnel to perform test, adjustments and instruction on UPS equipment.

.2 Dummy load adjustable to 150% of system rated output.

.3 Allow for all necessary equipment to complete the tests specified. Costs associated with testing shall be included in the tender price.

.4 The required measuring devices shall include calibration certificates completed within the past year. Allow for all measuring devices to record specified values

including but not limited to oscilloscopes, a digital multimeter, and a power analyzer.

.3 Notify the Consultant fifthteen (15) working days in advance of test date.

.4 Tests:

.1 Inspection of cubicles, battery rack and battery.

.2 Inspection of electrical connections.

.3 Inspection of installation of remote mode lights and alarms.

.4 Demonstration of system start-up and shut-down.

.5 Demonstration of all modes of operation and load transfers between the inverter, the internal bypass and the external bypass to confirm that all functions are carried out without load interruption. Carry out demonstrations while recording the wave quality at the output.

.6 Run UPS for minimum period of four (4) hours at full rated load to demonstrate proper operation with AC mains input, emergency generator input, no A.C. input.

.7 Discharge battery by operating UPS with A.C. mains open for specified duration of full load. Record readings of temperature of each cell.

.8 Recharge battery automatically with full rated load on UPS for four (4) hours and record readings of voltage of each cell.

.9 All verification and testing procedures recommended by the manufacturer shall be carried out.

.10 For all site tests:

.1 Prepare form and blank check sheets to record results.

.2 As tests progress, point to the verification sheet and write the results on the form, in two (2) copies. Attach the records of measuring devise.

.3 Submit a duplicate of the results at the end of the test.

.4 Submit a clean (typewritten) copy of the test results in the form of a test report to the Consultant for approval.

.5 Incorporate data from site tests into operations and maintenance manual.

3.5 START-UP

.1 Arrange with the Consultant:

.1 For factory service engineer to supervise start-up of system, checking, adjusting and testing on site.

.2 For instruction of personnel on theory, construction, installation, operation and maintenance of system:

.1 After installation and during site testing.

.2 Provide formal training, complete with final written documentation, for the entire UPS system. Training shall be minimum four (4) hours for a group of approximately four (4) to six (6) people. All procedures shall be presented, including but not limited to the transfer between the inverter,

the internal bypass, the external bypass and the return of load to the inverter.

.3 Provide detailed lesson plan, at least two weeks in advance, for comments and approval by the Owner and / or Construction Professional.

.2 Advise on:

.1 Expected failure rate of equipment.

.2 Type of expected failures.

.3 Estimated time between major overhauls based on twenty (20) year equipment life.

.4 Estimated cost of major overhaul based on current costs and excluding travelling expenses.

.5 Type and cost of test equipment needed for fault isolating and performing preventive maintenance.

END OF SECTION

APPENDIX NO. 1 –ROOM No A-102 NEW ELECTRICAL PLANS

APPENDIX No. 2 – DOCUMENTATION, TRAINING AND TESTING REQUIREMENTS

TESTS INDEX

Projet : Replacement of an uninterruptible power supply

Projet no : 2020-134-1001

Par : Robert Bigras, ing. Date : 2021-01-18

Section	Date	Contents
26 05 00		Insulation Resistance Testing for Conductors
26 33 53		UPS – Factory Testing
26 33 53		UPS – Site Testing

TRAINING INDEX

Projet : Replacement of an uninterruptible power supply

Projet no : 2020-134-1001

Par : Robert Bigras, ing. Date : 2021-01-18

Section	Date	Contents
26 33 53		UPS – Four Hour Training

LIST OF LAYOUT DRAWINGS

Projet : Replacement of an uninterruptible power supply

Projet no : 2020-134-1001

Par : Robert Bigras, ing. Date : 2021-01-18

Sections	Description	Comments
	26 05 20 – WIRE AND BOX CONNECTORS (0 – 1 000 V)	
	– Materials	
	26 05 21 – WIRES AND CABLE (0 – 1 000 V)	
	– Building wires	
	26 05 28 – GROUNDING - SECONDARY	
	– Materials	
	26 05 53 – IDENTIFICATION OF ELECTRICAL EQUIPMENT	
	– Nameplates for electrical equipment	
	26 33 53 – UNINTERRUPTIBLE POWER SUPPLY (UPS)	
	– System description	
	– UPS module accessories	
	– Operational modes and performance	
	– UPS nominal operating characteristics	
	– Requirements – Electrical installation	
	– Control cabinet	
	– Rectifier/Charger	
	– Inverter	
	– Battery storage cabinets	
	– Accumulators	
	– Accumulator accessories	
	– Static bypass switch	

Projet : Replacement of an uninterruptible power supply
Numéro : 2020-134-1001
Date : _____

UPS - Section 26 33 53						
Factory tests						
Specification article		Description	Succeed (YES)	Succeed (NO)	Comments	By
3.3.4.1		**Visual inspection of the system to confirm the following:**				
	3.3.4.1.1	Materials, fabrication and assembly conform to design requirements.				
	3.3.4.1.2	All parts are new and free from defects.				
	3.3.4.1.3	The battery and associated components are not damaged.				
	3.3.4.1.4	All battery elements are of the same manufacturer and construction.				
	3.3.4.1.5	The correct polarity of each battery cell and the associated connections to the inverter have been respected,				
	3.3.4.1.6	Installed fuses are appropriately rated.				
	3.3.4.1.7	The scale of the measuring devices is appropriate for the application.				
	3.3.4.1.8	The accessories are in place.				
	3.3.4.1.9	Portable measuring devices used for acceptance tests are suitable for the associated tests and their measuring transformers are correctly connected.				
3.3.4.2		**Demonstrate the following sequence of operation and operating characteristics:**				
	3.3.4.2.1	Starting and stopping the system.				
	3.3.4.2.2	Operation during a failure of the normal main power supply. Note the value of the output current during the failure and after restoring the normal power supply using an oscilloscope and image capturing accessories.				
	3.3.4.2.3	All possible settings.				
	3.3.4.2.4	Record values measured at test point by means of an oscilloscope, a digital multimeter, and a data recording oscillograph.				

Projet : Replacement of an uninterruptible power supply
Numéro : 2020-134-1001
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UPS - Section 26 33 53							
Factory tests							
Specification article			**Description**	**Succeed (YES)**	**Succeed (NO)**	**Comments**	**By**
	3.3.4.2.5		**Correct operation of protective deices and measuring devices. Record the system response and note the operation of remote indicators and the bypass switch. Test the following cases:**				
		3.3.4.2.5.1	Actuation of annunciator indicator lights.				
		3.3.4.2.5.2	Overcurrent at the output of the inverter.				
		3.3.4.2.5.3	Overvoltage and lack of voltage at the output of the inverter.				
		3.3.4.2.5.4	Low DC voltage the inverter input. Gradually reduce the DC voltage at the input of the inverter while the inverter is supplied power at full load. Confirm the load automatically switches to the bypass circuit and the inverter shuts down. Record the input and output values.				
	3.3.4.2.6		With a hot air blower, heat the sensor to simulate an overheating condition.				
	3.3.4.2.7		Simulate a blown fuse to verify correct indicator light actuation.				
	3.3.4.2.8		Simulate a fan failure.				
	3.3.4.2.9		Automatic operation of the internal bypass switch: record the stability of the current and absence of any disturbances using digital meters during the automatic bypass switching.				
	3.3.4.2.10		DC overvoltage at rectifier output				
3.3.4.3			**Harmonics performance check**				
	3.3.4.3.1		Using a power quality analyzer to monitor the output, determine the total harmonic distortion at no load, half load and full load conditions.				
	3.3.4.3.2		Using a power quality analyzer to monitor, determine the amplitude of each harmonic.				
	3.3.4.3.3		Measure the amplitude at each phase to netural at unity power factor and a lagging power factor of 0.8.				
3.3.4.4			**Transients**				
	3.3.4.4.1		Upon normal input power conditions, record the voltage and current values by means of oscilloscopes while applying a step load of 100% and when reducing a step load of 100%.				
	3.3.4.4.2		Record voltage and current values using oscilloscopes.				
	3.3.4.4.3		Measure the efficiency of the rectifier, the inverter and the entire system.				

Projet : Replacement of an uninterruptible power supply
Numéro : 2020-134-1001
Date : _____

UPS - Section 26 33 53							
Factory tests							
Specification article			Description	Succeed (YES)	Succeed (NO)	Comments	By
3.3.4.5			Steady Load				
	3.3.4.5.1		Connect the system to normal AC electrical power, start the inverter and apply a dummy load at a power factor of 0.9				
	3.3.4.5.2		Operate the system at full rated load for twenty-four (24) hours and at 125% rated load for fifteen (15) minutes, at an ambient temperature of 40 deg C.				
	3.3.4.5.3		**At the start of the test, and at every thirty (30) minute interval, take a recording of the following parameters:**				
		3.3.4.5.3.1	Input frequency.				
		3.3.4.5.3.2	Input voltage of each phase.				
		3.3.4.5.3.3	Input current of each phase.				
		3.3.4.5.3.4	Input power in kW.				
		3.3.4.5.3.5	Output voltage of from phase to phase and phase to neutral.				
		3.3.4.5.3.6	Output current per phase.				
		3.3.4.5.3.7	Output power in kW.				
		3.3.4.5.3.8	Temperature at forced ventilation air intake.				
		3.3.4.5.3.9	Temperature at forced ventilation exhaust.				
		3.3.4.5.3.10	Temperatures in critical areas.				
		3.3.4.5.3.11	DC voltage at inverter input.				
		3.3.4.5.3.12	DC current at inverter input.				
		3.3.4.5.3.13	DC current at rectifier input.				
3.3.4.6			Variable loads				
	3.3.4.6.1		Following the “Steady Load”, record the parameters listed in Item 3.3.4.5.3 at no load, 25% load, 50% load, 75% load and 125% load.				
	3.3.4.6.2		Measure the efficiency of the rectifier, the inverter and the complete UPS system, including transformers.				
3.3.4.7			Unbalanced loads				
	3.3.4.7.1		Adjust the loading connected to the inverter such that two phases are at 100% load and the third phase is at 80% load.				
	3.3.4.7.2		Adjust the loading connected to the inverter such that two phases are at no load and the third phase is at 20% load.				

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Specification article			Description	Succeed (YES)	Succeed (NO)	Comments	By
	3.3.4.7.3		In both cases, record all phase voltages, line voltages, line currents and phase shits to demonstrate a steady load supply in unbalanced conditions.				
3.3.4.8			**Battery**				
	3.3.4.8.1		**Charge batter to ensure all cells are fully charged. Once the voltage has stabilized at the completion of charging record the following parameters:**				
		3.3.4.8.1.1	Ambient temperature.				
		3.3.4.8.1.2	Temperature at each battery unit.				
		3.3.4.8.1.3	Battery voltage.				
		3.3.4.8.1.4	Voltage at each battery unit.				
		3.3.4.8.1.5	Charging current.				
		3.3.4.8.1.6	Relative density of the electrolyte of each cell (unsealed lead acid battery only).				
	3.3.4.8.2		**Discharge the battery by running the UPS at full load and disconnecting the main supply for the period specified in the design requirements. Record the following parameters at five (5) minute intervals:**				
		3.3.4.8.2.1	Battery voltage.				
		3.3.4.8.2.2	Current				
		3.3.4.8.2.3	Voltage at 10% of battery units, taken at random.				
		3.3.4.8.2.4	Ambient temperature.				
		3.3.4.8.2.5	Battery temperatures.				
		3.3.4.8.2.6	Relative density of the electrolyte of 10% of the units (unsealed lead acid battery only).				
	3.3.4.8.3		**Recharge the battery automatically for four (4) hours, restoring the normal power supply and while the system is connected to a dummy load. Record the following parameters at fifteen (15) minute intervals:**				
		3.3.4.8.3.1	Battery voltage.				
		3.3.4.8.3.2	Load current.				
	3.3.4.8.4		At the beginning and at the end of the charging period, note the ambient temperature, the battery temperature, and the relative density of the electrolyte cell (unsealed lead-acid battery only)				
	3.3.4.8.5		Repeat the tests and discharge reading to demonstrate that the battery is recharged to at least 95% during the four (4) hour charging period.				
	3.3.4.8.6		Recharge the battery.				

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Specification article		**Description**	**Succeed (YES)**	**Succeed (NO)**	**Comments**	**By**
	3.3.4.8.7	Perform the tests on the battery with an infrared camera in operation. The costs required for thermography must be included in the tender price.				
3.3.4.9		**Sound Level**				
	3.3.4.9.1	The operator of the acoustic meter shall take reading by holding the sensor in front of him and orienting it such that it is perpendicular to the direction of the sound produced by the system. The sensor shall be held at a height of 1.2m and a distance of 1 m from the equipment being tested.				
	3.3.4.9.2	Measure the sound level of the system while the ambient sound level is low.				

For all site tests:
Dummy load adjustable to 150% of system rated output.
The required measuring devices shall include calibration certificates completed within the past year. Allow for all measuring devices to record specified values including but not limited to oscilloscopes, a digital multimeter, and a power analyzer.
Prepare form and blank check sheets to record results.
As tests progress, point to the verification sheet and write the results on the form, in two (2) copies. Attach the records of measuring devise.
Submit a duplicate of the results at the end of the test.
Submit a clean (typewritten) copy of the test results in the form of a test report to the Consultant for approval.
Prepare form and blank check sheets to record results.