Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

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

.2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.2 DEFINITIONS

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

1.3 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates, labels for control items in English.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit for review single line electrical diagrams.

.1 Electrical distribution system in main electrical room.

.3 Shop drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

.3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.

.4 Quality Control:

.1 Provide CSA certified equipment.

.2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.

.3 Submit test results of installed electrical systems and instrumentation.

.4 Permits and fees: in accordance with General Conditions of contract.

1.5 QUALITY ASSURANCE

.1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.

.1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

.2 Site Meetings:

.1 Site Meetings: as part of Manufacturer's Field Services, schedule site visits to review Work at stages listed.

.1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of Work, after cleaning is carried out.

.3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.

1.7 SYSTEM STARTUP

.1 Instruct operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant will aspects of its care and operation.

1.8 OPERATING INSTRUCTIONS

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.3 Safety precautions.

.4 Procedures to be followed in event of equipment failure.

.5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

.1 Provide equipment in accordance with Section 01 61 00 - Common Product Requirements.

.2 Equipment to be CSA certified. Where CSA certified equipment are not available, obtain special approval from inspection authorities before delivery to site and submit such approval.

.3 Factory assemble control panels and component assemblies.

2.2 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of inspection authorities Departmental Representative.

.2 Decal signs, minimum size 175 x 250 mm.

2.3 WIRING TERMINATIONS

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

2.4 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates and labels as follows:

.1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, matt white finish face, lettering accurately aligned and engraved into core, mechanically attached with self-tapping screws.

.2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters

Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.

.4 Allow for minimum of twenty-five letters per nameplate and label.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.7 Terminal cabinets and pull boxes: indicate system and voltage.

.8 Transformers: indicate capacity, primary and secondary voltages.

2.5 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.6 CONDUIT AND CABLE IDENTIFICATION

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

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

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

2.7 FINISHES

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

.1 Paint indoor switchgear and distribution enclosures light gray.

Part 3 Execution

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

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

3.3 CONDUIT AND CABLE INSTALLATION

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

.1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 1400 mm.

.2 Panelboards: as required by Code or as indicated.

3.5 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.6 FIELD QUALITY CONTROL

.1 Load Balance:

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct following tests.

.1 Power distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Carry out tests in presence of Departmental Representative.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.5 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.7 CLEANING

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

1.2 CODES AND STANDARDS

.1 Institute of Electrical and Electronics Engineers (IEEE)

.1 IEEE 242-2001, IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

.2 IEEE 1584b-2011, IEEE Guide for Performing Arc-Flash Hazard Calculations - Amendment 2.

.2 National Fire Protection Association (NFPA)

.1 NFPA (Fire) 70E, Standard for Electrical Safety in the Workplace, 2015 edition.

1.3 SUBMITTALS

.1 The short-circuit and protective device coordination studies shall be submitted to the Departmental Representative prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Departmental Representative may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

.2 The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Two bound copies of the complete final report shall be submitted, along with electronic pdf version.

.3 The report shall include the following sections:

.1 Executive Summary.

.2 Descriptions, purpose, basis and scope of the study.

.3 Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.

.4 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.

.5 Fault current calculations including a definition of terms and guide for interpretation of the computer printout.

.6 Details of the incident energy and flash protection boundary calculations.

.7 Recommendations for system improvements, where needed.

.8 One-line diagram.

1.4 QUALIFICATIONS

.1 The short-circuit/device evaluation, protective device coordination and arc flash hazard analysis studies shall be performed or reviewed and sealed by a licensed Professional Electrical Engineer registered to practice in the Province of Ontario skilled in performing and interpreting the power system studies.

.2 The licensed Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.

.3 The Registered Professional Electrical Engineer shall have a minimum of five years of experience in performing power system studies.

.4 The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.

1.5 GENERAL

.1 Include in the tender all costs for preparation of a complete System Coordination/Short Circuit/ Device Evaluation Study in accordance with IEEE 242, 'Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems', and IEEE 1584, 'Guide for Performing Arc-Flash Hazard Calculations'.

.2 The scope of the studies shall include:

.1 The Study shall include all relevant distribution and protective devices within the following scope:

.1 Upstream from the local Utility feeder protection devices.

.2 Downstream to the affected branch circuit panels.

.3 Upstream from the existing 1135 kW diesel generator feeder protection devices.

1.6 COORDINATION STUDY

.1 The work of the Coordination Study shall include:

.1 Liaison with the local Utility for information on relays and other protective devices, and system and substation capacities which affect the coordination of this system for both primary and any standby feeders.

.2 Liaison with distribution equipment and switchgear manufacturers to obtain actual trip curves of existing and proposed protective devices for new & existing equipment.

.3 Sending a trained and qualified representative on site to gather data on existing equipment within the scope of the study; such as transformers, cables, and lengths, breakers, fuses, and all adjustable protective device settings. The information gathered will include the method of installation where such installation impacts upon the Study.

.4 Recommendations shall be included, listing all deficiencies within the scope of the study and proposing methods of correction for each deficiency.

.2 The Coordination Study report shall include the following:

.1 Each Time-Current graph shall be printed in colour. The selected colours will allow the end-user to easily discriminate between different device curves, especially on complicated graphs where devices overlap.

.2 The Time-Current curves shall be drawn on special log-log graphs with time coordinate range of 0.01 to 1,000 seconds and current coordinate ranges of 4 orders. Separate graphs are to be provided for phase and ground protection for each portion of the system. The entire distribution system shall be subdivided into portions so that the curve for each device clearly shows its relationship to associated upstream and downstream devices. The coordination study should separate the emergency power from the normal power distributions. Each graph for a portion of the system shall include/show the following:

.1 The portion of the distribution system represented by the devices on the graph shall be represented by a single line diagram drawn in the corner of the Time-Current coordination graph.

.2 Each device curve shall end at the 3 phase symmetrical fault level calculated for that bus.

.3 Cable, Bus, or Conductor damage curves shall be shown where appropriate. All Transformer inrush, damage and overload curves shall be shown.

.4 Motor starting curves and protective devices shall be shown for all motors larger than 75 HP.

.5 On the graphs, or on the same page as the graph, all protective device curves within the scope of the graph shall be shown with the following information:

.1 Relay curves with text indicating; Manufacturer, Type, Current Transformer size, Tap or Pickup setting, Time Dial settings, and curve type.

.2 Fuse curves with average melting curve for low voltage fuses and minimum melt and total clearing for high voltage fuses with text indicating; Manufacturer, Type, Ampacity, Voltage, and Speed.

.3 Static-Trip Breaker curves with text indicating; Breaker and Trip Unit Manufacturer and type, Current Transformer and Sensor Type, and all trip unit settings.

.4 Thermal-Magnetic Breaker curves with text indicating; Breaker type, Trip rating, and instantaneous trip settings.

.3 Include tables within the Study that clearly list all protective devices within the scope of the study and all associated information. These tables are to be based on settings established and noted in the coordination curves. The tables shall be

logically arranged and grouped to effectively present the following information. The tables shall include:

.1 Relays; including manufacturer, type, curve, CT, and all protective settings.

.2 Transformers; including size, type, manufacturer, configuration, voltage, and impedance.

.3 Fuses; including manufacturer, type, ampacity, voltage, speed.

.4 Static Trip Units; including manufacturer, type, CT, sensor or plug, all protective settings.

.5 Thermal-Magnetic Trip Units; including manufacturer, rating, and instantaneous setting.

.6 Motor Protectors (Overloads); include manufacturer, type, rating, all protective settings.

.7 All protective devices shall be listed with clear descriptive text to identify their place within the distribution system.

.8 All protective devices shall have a reference to the Time-Current graph where they are shown.

.4 The tables shall list all existing and recommended settings of all protective devices within the scope of the study. This will allow the end-user to identify and plan for required changes to protective device settings, and to determine which settings have been implemented and modified.

1.7 SHORT CIRCUIT/DEVICE EVALUATION STUDY

.1 The work of the Short Circuit study shall include:

.1 Evaluation and documentation of three phase single phase & ground fault short circuit fault levels at all distribution busses, motor control centres and main panel board locations within the scope listed above.

.2 The output of the short circuit study shall be a printed tabulation of asymmetrical and symmetrical RMS short circuit current values for both interrupting duty and momentary duty, including X/R ratios.

.3 All significant sources and impedances shall be evaluated, including but not limited to, Utility and Emergency Sources, motors, cables and their lengths, transformers, reactors, and any other devices impacting upon the available short circuit.

.2 The work of the device evaluation study shall include:

.1 All pertinent interrupting devices within the scope of the job shall be listed with its interrupting rating or its series interrupting rating as applicable.

.2 A cross reference in table form shall be provided whether the protective devices at each bus are appropriate for the available fault current at each bus.

1.8 ARC FLASH HAZARD ANALYSIS

.1 Arc Flash Hazard Analysis

.1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E, Annex D.

.2 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

.3 The Arc-Flash Hazard Analysis shall include all locations in the systems.

.4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm^2.

.5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

.6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

.7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

.1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.

.2 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

.8 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

.9 When performing incident energy calculations on the line side of a main breaker, the line side and load side contributions must be included in the fault calculation.

.10 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

.11 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific situation.

.2 The electrical contractor shall ensure that the recommendations of the study are implemented as part of the contract.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 FIELD ADJUSTMENT

.1 Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

.2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

.3 Notify Departmental Representative in writing of any required major equipment modifications.

3.2 ARC FLASH WARNING LABELS

.1 The contractor of the Arc Flash Hazard Analysis shall provide 89 mm x 127 mm thermal transfer type label of high adhesion polyester for each work location analyzed.

.2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the Departmental Representative and after any system changes, upgrades or modifications have been incorporated in the system.

.3 The label shall include the following information, at a minimum:

.1 Location designation

.2 Nominal voltage

.3 Flash protection boundary

.4 Hazard risk category, PPE

.5 Incident energy

.6 Working distance

.7 Engineering report number, revision number and issue date.

.8 Labels shall be machine printed, with no field markings.

.4 Arc flash labels shall be provided in the following manner and all labels shall be Warning Labels based on recommended overcurrent device settings.

.1 For each 600, and applicable 208 volt panelboard, one arc flash label shall be provided.

.2 For each low voltage switchboard, one arc flash label shall be provided.

.3 For each switchgear, one arc flash label shall be provided.

.4 For medium voltage switchgear one arc flash label shall be provided.

END OF SECTION

Part 1 General

1.1 RELATED SECTION

.1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

1.2 DEFINITIONS

.1 SRS: acronym for Seismic Restraint System.

1.3 GENERAL DESCRIPTION

.1 This section covers design, supply and installation of complete SRS for all systems, equipment specified for installation on this project by Division 26. This includes, but is not limited to, electrical light fixtures, transformers, MCC's, UPS, diesel generators, fire protection, conduit, communications, electrical equipment and systems, both vibration isolated and statically supported.

.2 Cable restraint systems, rod stiffener clamps and seismic isolator capacities to be verified by an independent test laboratory. Connection materials and site specific designs to be by the Seismic Engineer. The Seismic Engineer may specify material and anchors provided by the contractor where this is appropriate. It is the contractors' responsibility to ensure that the Seismic Engineers' requirements and specification have been met.

1.4 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA S832-14, Seismic Risk Reduction of Operational and Functional Components (OFCs) of Buildings.

.2 Ontario Regulation

.1 ONTARIO OBC-2012, 2012 Ontario Building Code.

.3 National Research Council Canada

.1 NBCC-2015, National Building Code of Canada 2015.

1.5 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 26 05 00 - Electrical General Requirements.

.2 Submit seismic restraint shop drawings, c/w seal of Professional Engineer registered in Province of Ontario, clearly identifying equipment/systems reviewed and the equipment/systems requiring restraint. Shop drawings must clearly show all forces transferred to structure.

.3 Seismic Design Engineer shall provide a spreadsheet identifying all equipment and systems requiring or not requiring seismic restraints and include all circulations.

.4 Submit additional copy of shop drawings and product data to project Structural Engineer for review of connection points to building structure.

1.6 MAINTENANCE DATA

.1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 26 05 00 - Electrical General Requirements.

1.7 SEISMIC FORCE

.1 The Importance Factor for this project is:

.1 I = 1.0 - All other buildings i.e.: Office & General Buildings.

.2 Note: As per OBC and NBCC.

Part 2 Products

2.1 SRS MANUFACTURER

.1 SRS to be from one manufacturer regularly engaged in production of same, 5 years experience.

.2 Acceptable materials: Korfund-Sampson, Mason Industries, Tecoustics, Vibra-Sonic Control, Vibron.

2.2 GENERAL

.1 Design to be by Professional Engineer specializing in design of SRS and registered in Province of Ontario. Division 26 to include all costs associated with this work as it relates to Division 26 installations.

.2 SRS to be fully integrated into, compatible with:

.1 Noise and vibration controls specified elsewhere in this project specification, telecommunications.

.2 Structural, mechanical, electrical design of project.

.3 During seismic event, SRS to prevent systems and equipment from causing personal injury, interfering with other systems, and from moving from normal position.

.4 Design and installation in accordance with OBC, NBCC, CSA S832.

.5 SRS to provide gentle and steady cushioning action and avoid high impact loads

.6 SRS to restrain seismic forces in all directions.

.7 Fasteners and attachment points to resist same load as seismic restraints.

.8 SRS of conduit systems to be compatible with:

.1 Expansion, anchoring and guiding requirements.

.2 Equipment vibration isolation and equipment SRS.

.9 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.

.10 Attachments to RC structure:

.1 Use high strength mechanical expansion anchors.

.2 Drilled or power driven anchors not permitted.

.11 Seismic control measures not to interfere with integrity of fire stopping.

2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS

.1 Floor-mounted equipment, systems:

.1 Anchor equipment to equipment supports.

.2 Anchor equipment supports to structure.

.3 Use size of bolts scheduled in approved shop drawings.

.2 Suspended equipment, systems:

.1 Use one or combination of following methods:

.1 Install tight to structure.

.2 Cross-brace in all directions.

.3 Brace back to structure.

.4 Slack cable restraint system.

.2 SRS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.

.3 Hanger rods to withstand compressive loading and buckling.

2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT

.1 Floor mounted equipment, systems:

.1 Use one or combination of following methods:

.1 Vibration isolators with built-in snubbers.

.2 Vibration isolators and separate snubbers.

.3 Built-up snubber system approved by Departmental Representative, consisting of structural elements and elastomeric layer.

.2 SRS to resist complete isolator unloading.

.3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.

.4 Cushioning action to be gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.

.2 Suspended equipment, systems:

.1 Use one or combination of following methods:

.1 Slack cable restraint system.

.2 Brace back to structure via vibration isolators and snubbers.

Part 3 Execution

3.1 INSTALLATION

.1 Install Seismic Restraint Systems in accordance with Seismic Engineer's and manufacturer's recommendations.

.2 Install SRS at least 25 mm from all other equipment, systems, services.

.3 Co-ordinate connections with all disciplines.

3.2 INSPECTION AND CERTIFICATION

.1 SRS to be inspected and certified by Manufacturer upon completion of installation.

.2 Seismic Design Engineer shall provide written report to Departmental Representative certifying that SRS has been installed in accordance with the SRS drawings. The report shall bear the seal and signature of the SRS Design Engineer.

3.3 COMMISSIONING DOCUMENTATION

.1 Upon completion and acceptance of certification, hand over to Departmental Representative complete set of construction documents, revised to show "as-built" conditions.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 ANSI/IEEE 837-2014, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

.2 CSA International

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect grounding equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 EQUIPMENT

.1 Clamps for grounding of conductors, size as required to electrically conductive underground water pipe.

.2 Rod electrodes, copper clad steel 19 mm dia by 3 m long.

.3 Buried grounding conductors, bare stranded copper, tinned, soft annealed, size #4/0 AWG or as indicated

.4 Insulated grounding conductors: green, type RW90 copper.

.5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

.6 Perimeter ground bus, 6 mm x 50 mm copper, mounted 150 mm above floor on insulated spacers 600 mm on centre.

.7 Ground bus mounting spacers

.1 Stand off insulators to UL 891

.2 25 to 32 mm high waterproof glass fibre reinforced polyamide

.3 750V insulated

.4 UL 94VO self extinguishing

.5 Bichromated zinc plated threaded steel inserts

.8 Communication and Computer room raised floor ground clamps: Burndy Uniground

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including, electrodes, conductors, connectors, accessories, as indicated, to conform to requirements of local authority having jurisdiction over installation.

.2 Ground electrical equipment and wiring in accordance with Ontario Electrical Safety Code and ANSI/IEEE Standard 142-1982.

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

.4 Protect exposed grounding conductors from mechanical injury.

.5 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.

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

.7 Soldered joints not permitted.

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

.9 Install separate ground conductor in all conduits. Ground conductor shall be sized as per Table 16 of CSA C22.1 with one ground conductor for every three hot conductors. Minimum size of ground conductor shall be #12 AWG copper.

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

.11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.12 Install grounding conductors outside electrical rooms and electrical closets in conduit and conceal where possible.

.13 Provide separate ground wire for every feeder, sized as per Table 16 of the OESC

3.2 ELECTRODES

.1 Make ground connections to continuously conductive underground water pipe on street side of water meter. Install water meter shunt.

.2 Install rod and plate electrodes and make grounding connections.

.3 Provide rod electrodes at corners of main electrical room and connect to perimeter ground bus.

.4 Bond separate, multiple electrodes together.

.5 Use size 4/0 AWG copper conductors for connections to electrodes.

.6 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails

3.3 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit insulated copper grounding connections to neutral of secondary systems and for common grounding conductors per CSA C22.1 Table 16.

.2 Install insulated copper grounding conductor for service raceways and service equipment per CSA C22.1 Table 16.

.3 Install grounding conductors in conduit

3.4 EQUIPMENT GROUNDING

.1 Install insulated copper bonding connections per CSA C22.1 Table 16 to typical equipment including, but not necessarily limited to following list: Service equipment, transformers, frames of motors, starters, control panels, building steel work and panels, outdoor lighting.

.2 Install bonding conductors in conduit.

3.5 FIELD QUALITY CONTROL

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

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

END OF SECTION

1 General

1.1 REFERENCES

.1 CSA International

.1 CSA C22.2 No.40-M1989(R2009), Cutout, Junction and Pull Boxes.

.2 CSA C22.2 No. 45.1-07(R2012) Rigid Metal Coated Conduit - Steel

.3 CSA C22.2 No. 83-M1985(R2013) Electrical Metallic Tubing

.4 CSA C22.2 No. 136 Rigid PVC Conduit

.5 CSA C22.2 No. 56-13 Flexible Metal and Liquid-Tight Flexible Metal Conduit

.6 CSA C22.2 No 211.2-06(R2011) Rigid PVC Conduit

.1 Conduit accessories, conduits and fittings to CSA C22.2 No. 18.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for raceway and boxes and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for raceway and boxes for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry locations and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect raceway and boxes from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2 Products

2.1 CONDUITS

.1 Rigid hot dipped galvanized steel threaded conduit

.2 Epoxy coated rigid galvanized steel conduit: with zinc coating and corrosion resistant epoxy finish inside and outside equal to Columbex Green Guard II

.3 PVC coated hot dipped galvanized rigid steel conduit: with 40 mil PVC exterior coating, 2 mil urethane interior and thread coating equal to Rob Roy Plastibond RedHot

.4 Electrical metallic tubing (EMT), hot dipped galvanized: with couplings.

.5 Rigid PVC conduit.

.6 Flexible metal conduit and liquid-tight flexible metal conduit.

.7 Conduit shall be of sufficient size to allow easy removal of conductors at any time. Conduit sizes, where shown, are minimum and shall not be reduced.

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.

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

.3 Channel type supports for two or more conduits.

.4 Six mm dia threaded rods to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90° bends are required for 25 mm and larger conduits

.3 Insulated throat steel set screw or raintight insulated throat steel compression connectors and couplings for EMT.

.4 Threaded or compression type raintight/concrete tight insulated throat zinc plated steel connectors and couplings for rigid steel conduit.

.5 Raintight insulated throat steel connectors at all surface panelboards, switchboards and other electrical equipment in sprinklered areas for all conduit terminations.

2.4 EXPANSION FITTINGS

.1 Electrogalvanized steel with internal grounding for EMT suitable for 100 mm linear conduit movement.

.2 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

.3 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

.4 Concrete type, water tight, corrosion resistant for conduit installations embedded in concrete

.5 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

.1 Polypropylene

3 Execution

3.1 EXAMINATION

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

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

.3 Use electrical metallic tubing (EMT) except: in cast concrete, underground or where installed exposed within 2.0 m of floor.

.4 Use rigid galvanized steel conduit where installed surface mounted within 2.0 m of floor.

.5 Use rigid PVC conduit in slab on grade cast concrete and underground. Do not use PVC conduits in slabs above grade. All conduits shall be surface mounted to minimize risks of future damage when core drilling during future renovations. Where localized congestion or circumstances forces the use of conduits in the floor slabs, they shall be epoxy coated rigid galvanized steel.

.6 Provide PVC conduit with ground wire as per Table 16 of Ontario Electrical Safety Code.

.7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment

.8 Use explosion proof flexible connection for connection to explosion proof motors.

.9 Install conduit sealing fittings in hazardous areas. Fill with compound.

.10 Use raintight connectors or hubs for terminating conduits at all surface or floor mounted panelboards, switchboards, and other equipment located in sprinklered areas or where at risk of exposure to dripping liquids.

.11 Install wiring in conduit unless otherwise specified.

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

.13 Mechanically bend steel conduit over 19 mm dia.

.14 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.15 Install fish cord in empty conduits.

.16 Run two 25 mm spare conduits up to ceiling space and two 25 mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in flush concrete type box.

.17 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.

.18 Dry conduits out before installing wire.

.19 Conduit manufacturer's touch up enamel shall be used to repair all scratches and gouges on epoxy-coated conduit.

.20 Install junction boxes or cable anchor boxes wherever necessary for proper pulling or anchoring of cables. Install so as to be accessible after building is completed and set to come within finished lines of building.

.21 Where EMT or rigid PVC is used, run green insulated ground wire in conduit, with minimum one ground conductor per three ungrounded conductors.

.22 Provide expansion couplings, with bonding jumper and ground clamps where raceways cross building control joints.

.23 Where conduits or cables are installed under raised floors and are required to be fastened in place, use two hole inverted “U” straps. No sharp edges or corners will be permitted which may damage PVC jackets or cables.

.24 Runs of conduit and cables, where shown, are indicated only by general location and routing. Install conduits and cables so as to provide maximum head room and to interfere as little as possible with free use of spaces through which they pass. They shall be installed as close to building structure as possible such that, where concealed, necessary furring can be kept to a minimum. Arrange conduits, installed in suspended ceilings, to provide minimum interference with removal of tiles.

3.3 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface channels.

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

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

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA C22.2 No.126.1-09(R2014) 3rd edition, Metal Cable Tray Systems.

.2 CAN/CSA C22.2 No.126.2-02(R2012), Non Metallic Cable Tray Systems.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA VE 1-2009, Metal Cable Tray Systems.

.2 NEMA VE 2-2013, Cable Tray Installation Guidelines.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.

.3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.

.4 Identify types of cabletroughs used.

.5 Show actual cabletrough installation details and suspension system.

Part 2 Products

2.1 CABLETROUGH

.1 Cabletroughs and fittings: to CAN/CSA C22.2 No. 126.1 & 126.2.

.2 Ladder type, Class C1 to CAN/CSA C22.2 No.126.1 & 126.2.

.3 Trays: galvanized steel, 150, 300, 450, 600, 750 mm wide with depth of 40, 75, 100, 150 mm.

.4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.

.1 Radii on fittings: 300 mm minimum.

.5 Barriers where different voltage systems are in same cabletrough.

.6 Ground cable trays with #2 AWG bare copper conductor attached to each tray section in accordance with CEC requirements.

.7 Provide fire stop material at firewall penetrations.

2.2 SUPPORTS

.1 Provide splices, supports for a continuously grounded system as required.

Part 3 Execution

3.1 INSTALLATION

.1 Install complete cabletrough system in accordance with NEMA VE 2.

.2 Support cabletrough on both sides.

.3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

3.2 CABLES IN CABLETROUGH

.1 Install cables individually.

.2 Lay cables into cabletrough. Use rollers when necessary to pull cables.

.3 Use rollers when necessary to pull cables.

.4 Secure cables in tray at 1200 mm centers, with factory made nonferrous cable clamps.

.5 Use aluminum clamps to secure single conductor cables, do not use nylon ties.

.6 Nylon ties may be used for multiconductor cables where acceptable to the Departmental Representative.

.7 Identify cables every 30 m and at each end of the run with size 2 nameplates.

.8 Do not exceed 80% of the load rating of the tray or the support system.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 23 00.01 - Low Voltage Remote Operation Panel.

1.2 REFERENCES

.1 American National Standards Institute (ANSI):

.1 ANSI C12.20-2010, American National Standard for Electricity Meters 0.2 and 0.5 Accuracy Class.

.2 International Electrotechnical Commission (IEC)

.1 IEC 61000-4-30 ed. 3.0 b:2015, Electromagnetic compatibility (EMC) - Part 4-30: Testing and Measurements Techniques - Power Quality Measurements Methods.

.2 IEC 61850, Communication Networks and Systems.

.3 International Organization for Standardization (ISO).

.1 ISO 9001:2015, Quality Management Systems - Requirements.

1.3 ACTION AND INFORMATION SUBMITTALS

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

.2 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Provide updated final wiring diagram l.

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 MAIN BUS POWER QUALITY METERING

.1 The digital power meter instrument base unit must be flush mountable available as a combined front panel and base unit that can be mounted in switchgear cabinet doors.

.1 The panel mounted PM instrument shall have an integral minimum 320 x 240 pixel backlit color graphical LCD display, TFT, 71 mm by 53 mm.

.2 The PM instrument in its standard configuration shall be able to accept voltages up to 347 VLN / 600 VLL (UL) and 400 VLN / 690 VLL (IEC) without using potential transformers.

.3 Current inputs: The digital power meter instrument shall have four current inputs (I1, I2, I3, I4).

.4 Phasor diagram support on web pages and display for troubleshooting and configuration.

.5 Harmonics up to the 63rd Harmonic.

.6 The digital power meter instrument shall be capable of calculating the following information for any reading at 1-second intervals: Sliding Window, Predictive, and Thermal demand calculations for any parameter.

.7 Maximum and Minimum value for any measured parameter.

.8 Derived values for any combination of measured or calculated parameter, using arithmetic, trigonometric, and logic functions (equivalent PLC capabilities).

.9 The PM instrument shall sample continuously at minimum 256 samples per cycle. Waveform recording at 256 s/c on all channels.

.10 The PM Instrument shall be able to perform sag/swell detection of voltage disturbances on a half-cycle basis, providing the duration of the disturbance, the minimum, maximum, and average value of the voltage for each phase during the disturbance. Disturbances less than one cycle in duration can be detected.

.11 The digital power meter instrument shall provide setpoint control of internal recording mechanisms and all digital output relays.

.12 Minimum event recording response time shall be ½ cycle (8.3ms) for high speed events and 1 second for other events.

.13 The digital power meter instrument shall provide extensive Time of Use (TOU) functionality to store and monitor up to 20 years of seasonal rate schedules. The TOU feature shall allow four seasons, four day capability.

.14 The digital power meter instrument shall provide setpoint control of internal recording mechanisms and all digital output relays. Consecutive high speed alarm conditions and triggers shall be supported on a cycle-by-cycle basis with no "dead" time between events.

.15 Without the use of separate software, the PM instrument shall be able to measure power quality statistically in accordance with IEC 61000-4-30, Class S.

.2 Communications: The digital power meter instrument shall support the following:

.1 Ethernet (dual-port, single network).

.2 Ethernet switch with RSTP (Rapid Spanning Tree Protocol).

.3 RS-485 & Ethergate Serial server capability.

.4 Multiple protocols: Modbus RTU, Modbus TCP, Modbus Master, IEC61850, DNP3.0, FTP, HTTP, NTP / SNTP, SMTP, MV90.

.5 Imbedded Web Pages.

.3 I/O: The digital power meter instrument shall include digital I/O and shall be capable of supporting up to four (4) field installable option modules to expand digital and analog I/O capabilities without need for additional control power sources.

.4 Meter shall support alarming with a time-stamped event log.

.1 Support a minimum of 65 setpoint driven alarms evaluated once per second or once every cycle, user configurable.

.2 Support disturbance alarms for detecting voltage and current dips and swells on all monitored phases.

.3 Generate an E-mail on an alarm condition.

.4 Adjust alarm setpoints based on the alarm quantity (alarm setpoint learning).

2.2 FEEDER METERING - FULL FEATURED METER

.1 The Digital Power Instrumentation Package shall be a true RMS, bi-directional, four quadrant meter capable of measuring, calculating and directly displaying on the front panel display the following information in user programmable groups.

.1 Voltage, Current, kW, kVAR, kVA Power Factor, harmonics, demand, minimums and maximums for each phase and totals for all phases. KWh, kVARh, kVAh totals for all phases. Voltage and current unbalance, frequency, k-factor.

.2 The Digital Power Instrumentation Package shall:

.1 Require no PTs on voltage inputs for Delta or Wye (Star) systems up to 600 VAC. Maximum of 480 V L-N / 828 V L-L

.2 Control power input 100-415 VAC L-N or 125-250 VDC

.3 Include minimum four (4) digital (status) dry-contact inputs and two (2) solid state outputs.

.4 Display: power meter display shall be backlit dot-matrix LCD for easy viewing, with a minimum of 128x128 pixels. Meter must include phasor diagram on front display for troubleshooting.

.5 The power meter display shall be capable of allowing the user to view at least four values on one screen at the same time. A summary screen shall also be available to allow the user to view a snapshot of the system.

.6 The power meter display shall allow the user to select a date/time format.

.7 The Instrument shall include minimum 1.1 MB of non-volatile memory (NVRAM) to store a time-stamped event log capable of storing at least 500 events; log 14 values every 15 minutes for 90 days

.8 Two communications shall be independent: (1) One for RS-485 serial communications (2) Dual 100BaseT Ethernet communications port. The dual Ethernet ports shall support network hub or "daisy-chain" capability off one static IP address.

.9 The meter must have an on-board WebMeter functionality that allows a standard Internet browser to point directly to the meter via the Ethernet port for viewing real-time data and set-up information.

.10 The instrument shall provide setpoint control. The power meter shall have a minimum of 29 setpoint driven alarms, 4 digital alarms, 4 unary alarms, 10 Boolean alarms and 5 custom alarms .

.11 Meet the following standards:

.1 Manufactured under ISO 9001 Quality Assurance Standard
.2 Have accuracy specifications that comply with ANSI C12.20 - 0.2 Accuracy Class.

.3 Communications: The digital power meter instrument shall support the following:

.1 Ethernet (dual-port, single network).
.2 Ethernet switch with RSTP (Rapid Spanning Tree Protocol).
.3 RS-485 & Ethergate Serial server capability.
.4 Multiple protocols: Modbus RTU, Modbus TCP, Modbus Master
.5 Imbedded Web Pages.

2.3 INSTRUMENT TRANSFORMERS

.1 Current Transformers (CTs)

.1 All Current Transformers shall be solid core CT (donut) or primary-wound with a 5A secondary unless noted otherwise.
.2 CTs shall have a minimum accuracy of 0.3%.
.3 All CT secondaries shall terminate in CT shorting blocks before being wired to meter.
.4 One CT is required for each phase being metered.

.2 Potential Transformers (PTs).

.1 PTs shall be supplied on each source bus.
.2 PTs shall be wired line-neutral for Wye systems and line-line for delta systems.
.3 PTs shall have a minimum accuracy of 0.3%.
.4 Meters shall not be powered from the PT secondaries.
.5 Voltage inputs shall be fed from a dedicated 15A breaker in distribution panel where practical.
.6 Supply and install appropriate fuses.

2.4 METER ENCLOSURES

.1 The digital meters shall be installed in new remote operation panel as per specification section 26 23 00.01 - Low Voltage Remote Operation Panel.

2.5 COMMUNICATIONS/NETWORKING HARDWARE

.1 To enable the meters to communicate to the central monitoring software, CAT6 - 100BaseT Ethernet shall be run to Remote Operation Control Panel Ethernet Switch.

.2 Provide ethernet cables from networking switch to each generator controller in remote panel. Coordinate with generator controller vendor.

.3 Provide required output and hardware/software to connect to existing B.A.S. network. Coordinate with building controls vendor (VCI). Building controls vendor shall provide interconnection cabling and conduit from remote operation panel to existing network.

2.6 MONITORING AND REPORTING SOFTWARE

.1 A real-time power and energy monitoring software shall be provided that will perform the following functions:

.1 Monitor all devices simultaneously with a graphical interface. User screens will be developed in conjunction with the Departmental Representative. Allow for ten (10) customized user screens.

.2 Store all the data in a MS SQL Server database for open connectivity.

.3 Provide reports to all users based on time-of use or block energy consumption. Reports shall be available using MS Reporting Services. Default reports shall be supplied with the software.

.4 Be a client-server application that will support multiple clients and web-browser clients so that anyone on the network can view meter data in real-time.

.5 Require no proprietary network communication hardware

.6 Support any combination of the following communication protocols directly to devices IONr ; Modbus RTU; Modbus TCP; Serial or TCP/IP; OPC is optional.

.7 Provide setup of represented system single lines on software showing current breaker position status and loads of main bus and feeders.

.8 Provide alarms for annunciation of preset thresholds to alert users of need to shed load/change over generators.

.2 The software shall be capable of being configured and commissioned by local contractors as well as trained factory personnel.

.3 Software system commissioning deliverables shall include, but not be limited to the following:

.1 PRIOR TO STARTUP; A Factory Service Representative shall coordinate with hardware vendors to ensure appropriate scope of work and a checklist of deliverables from all parties.

.2 Server/Software Configuration: The server and clients shall be configured for the metering and remote operations panel and the new generator controllers software. Configuration includes the installation of the software package and service packs, the setup of user accounts, and verification that these packages operate properly.

.3 Communication Configuration and Verification between all devices and the server. This includes configuring communication parameters on the devices and troubleshooting the wiring to ensure proper communications. A LAN network administrator shall be available in order to troubleshoot any network problems that may arise.

.4 Firmware Update: Power logic and meter firmware shall be updated as required to ensure proper SME and system functionality.

.5 Meter Configuration: The appropriate meter templates will be loaded on to the meters that are included in the quoted project. The current transformer (CT) and potential transformer (PT) ratios and the System Type will be programmed into

the devices. The Nominal Voltage and onboard clock will be configured on meters.

.6 The meters will be analyzed to ensure that the CTs and PTs are properly wired to the meter. The manufacture's certified technician will make any changes necessary to ensure that the meters are properly measuring voltage and current from the power system.

.7 Coordinate with building automation vendor to install software on existing B.A.S. server.

2.7 WARRANTY AND SERVICE

.1 The manufacturer warrants the products it supplies for a period of one (1) year from the acceptance date.

.2 Warranty Service may be performed by the manufacturer or authorized representative.

Part 3 Execution

3.1 INSTALLATION

.1 The instrument shall be installed by a manufacturers representative.

.2 All power supply and communications wiring connections shall be performed in accordance with the guidelines set out in the product documentation.

.3 All voltage sensing connections to instrumentation shall be made with 2A fuses.

.4 Where practical, the meters voltage inputs shall be from a dedicated breaker.

.5 Appropriately sized current transformers must be installed on each phase and must be installed with CT shorting blocks. All CTs with 5A secondary shall have CT shorting blocks.

.6 Meters must be powered from an auxiliary power supply, and not powered from the PTs.

.7 The installation must be in accordance with the Ontario and Canadian Electrical codes.

.8 All communications networking including hubs, routers, etc. shall be installed to the satisfaction of the Departmental Representative.

.9 The meters shall be properly configured for the system.

.10 Any power quality settings on the meters shall be configured so the meter's disturbance capture and transient detection is enabled.

.11 The contractor shall ensure all energy and min/max registers have been reset to zero.

.12 Communications networking shall be tested and proved to be working before acceptance by the Departmental Representative.

.13 Provide support to generator controller manufacturer/installer for the installation and communication of their software on server.

.14 The instrument shall be installed as on the drawings and in the following locations:

Location	Function
Buss A main breaker	PQ metering
Feeder Breaker 1	Digital Meter

.15 Provide support to generator controller manufacturer/installer for the installation and communication of their software on server.

.16 Provide testing in accordance with manufacturer's recommendations.

.17 Provide all conduits c/w wiring supports and accessories for complete installation.

3.2 TRAINING

.1 Customer Training: Minimum one day of informal orientation to the software users. The session shall cover how to access the software and view real-time and historical data. The orientation shall be "hands- on" with the site personnel actively using the software. One additional orientation session or follow up, minimum two (2) days, shall be provided within six (6) months of final delivery.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA International

.1 CSA C9-02(R2016), Dry-Type Transformers.

.2 CAN/CSA-C802.2-02, Minimum Efficiency Values for Dry Type Transformers.

.3 CSA C22.2 No.47-13, Air-Cooled Transformers (Dry Type).

.4 CSA C22.1, Canadian Electrical Code, Part 1 (23rd edition), Safety Standard for Electrical Installations.

.2 National Electrical Manufacturers Association (NEMA)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for transformers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Indicate on drawings:

.1 Dimensions showing enclosure, mounting devices, terminals, taps, internal and external component layout.

.2 Technical data:

.1 KVA rating.

.2 Primary and secondary voltages.

.3 Frequency.

.4 Three phase.

.5 Polarity or angular displacement.

.6 Full load efficiency.

.7 Regulation at unity pf.

.8 BIL.

.9 Insulation type.

.10 Sound rating.

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

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.

.3 Operation and maintenance instructions to include:

.1 Tap changing.

.2 Recommended environmental conditions.

.3 Recommended periodic inspection and maintenance.

.4 Bushing replacement.

1.4 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect transformers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.5 EXTRA MATERIALS

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

1.6 SOURCE QUALITY CONTROLS

.1 Certified copies of the manufacturer’s standard production tests on each transformer shall be provided to the Departmental Representative for review prior to shipping.

.2 Factory witness testing to include:

.1 Applied potential

.2 Induced potential

.3 Ratio, polarity and phase angle

.4 Resistance

.5 Excitation losses

.6 Iron losses

.7 Impedance

.8 Review of efficiency curves from no load to full load, kW & KVAR.

.9 Verification of tap voltage ratios including voltmeter recording at the various tap positions.

.10 Visual inspection of fan controls and fans

.11 Verification of operation of all alarm and protective devices

.3 All test results and report data to be factory certified and provided to the Departmental Representative in report format. Correct deficiencies noted during factory witness testing prior to shipment.

Part 2 Products

2.1 MATERIALS

.1 Dry-type transformers: to CSA C9.

2.2 TRANSFORMER CHARACTERISTICS

.1 Type: ANN

.2 Rating: 2000 kVA, 3 phase, 60 Hz.

.3 220 insulation system class, 115 degrees C temperature rise.

.4 Impedance: 5.8 % standard.

.5 Primary winding: 13800 V, delta, BIL 95 kV

.6 Secondary winding: 600 V, star, BIL 10 kV, four wire with neutral brought out and effectively.

.7 Transformer full load regulation not more than 5% at 80% power factor.

.8 No load and full load losses to exceed those indicated in CAN/CSA-C802.2.

2.3 ENCLOSURE

.1 Fabricated from sheet steel.

.2 Bolted removable panels for access to tap connections and enclosed terminals.

.3 Conductor entry:

.1 Knockouts.

.2 Potheads.

.3 Junction boxes.

.4 Bushings.

.5 Clamping rings.

.6 Entry for cable.

.4 Designed for floor.

.5 Indoor, ventilated, self-cooled type. Temperature of exposed metal parts not to exceed 65 degrees C rise.

2.4 VOLTAGE TAPS

.1 Transformers to have 4-2½% full capacity primary taps, two above and two below nominal voltage.

2.5 TAP CHANGER

.1 Bolted-link type.

2.6 WINDINGS

.1 Transformer windings and all current carrying parts shall be copper.

.2 Core constructed of high quality non ageing cold rolled grain orientated silicon steel lamination.

.3 Coil to be disc wound construction designed to minimize eddy losses and provide high short circuit strength

.4 For all transformers of 500 kVA and above, transformer core shall either be manufactured with insulated through bolts through laminations or be provided with perimeter external clamping arrangement to support the core and provide strength to withstand stresses due to short circuits. Core shall be fully insulated from the frame and enclosure with high strength, high temperature plastic (NEMA GPO-3 or better) of minimum 3 mm thickness to minimize the possibility of a magnetic short circuit. Ground core in one location only.

.5 Transformer noise level to be as per Table 8 of CSA Standard.

2.7 ACCESSORIES

.1 Winding temperature detector relay and sensing elements with 2 sets of SPDT contacts.

.2 Wiring and terminal box for protective devices.

.3 Dial type winding temperature indicator with alarm contacts required.

.4 Grounding terminal: inside of enclosure.

2.8 EQUIPMENT IDENTIFICATION

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

.2 Equipment labels: nameplate size 7.

Part 3 Execution

3.1 EXAMINATION

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

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Provide dry type transformers as shown and as specified.

.2 Provide a 100 mm reinforced concrete pad with beveled edges for all floor mounted transformers. Seal with paint or concrete sealer to prevent concrete dust from entering equipment. Concrete pads to be provided under this division.

.3 Ensure adequate clearance around transformer for ventilation.

.4 Install transformers in level upright position.

.5 Provide suitable mounting hardware complete with vibration isolation pads.

.6 Remove shipping supports only after transformer is installed and just before putting into service.

.7 Loosen isolation pad bolts until no compression is visible.

.8 Make primary and secondary connections in accordance with wiring diagram.

.9 Ground transformer casing with 3/0 AWG green insulated copper grounding conductor installed in conduit to the grounding system.

.10 Connect transformer primary wye point to the electrical grounding system with minimum 3/0 AWG green insulated copper installed in conduit.

.11 Energize transformers after installation is complete.

.12 Adjust transformer taps as required to achieve suitable secondary voltage at loads.

.13 Touch up small areas marred in transit or during installation with touch up paint. Repaint entire transformer using electrostatic process where large areas of significant damage to factory finish has occurred.

.14 Provide and install new rubber mats 910 mm wide 6 mm thick 17,000 volt rating, American Biltrite Canada Ltd., in front and rear of transformers for a continuous and neat appearance. Do not place mats until work is completed and room has been thoroughly cleaned. Clean or replace any existing mats dirtied or damaged during the installation.

3.3 FIELD QUALITY CONTROL

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

.2 Energize transformers and apply incremental loads:

- .1 No load
- .2 Incremental Load
- .3 Full load.
- .4 At each load change, check temperatures ambient, enclosure and winding.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

- .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by transformers installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA International

.1 CAN/CSA-C22.2 No.47, Air-Cooled Transformers (Dry Type).

.2 CSA C9, Dry-Type Transformers.

.3 CAN/CSA-C802.2, Minimum Efficiency Values for Dry Type Transformers.

.2 National Electrical Manufacturers Association (NEMA)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect dry type transformers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.5 SOURCE QUALITY CONTROL

.1 In addition to the manufacturer's standard production tests the transformers to be subjected to supplementary factory testing to be witnessed by the Departmental Representative and/or the Independent Testing Organization.

.2 Factory witness testing to include:

.1 Heat run.

.2 Applied potential

.3 Induced potential
.4 Ratio, polarity and phase angle
.5 Resistance
.6 Excitation losses
.7 Iron losses
.8 Impedance
.9 Review of efficiency curves from no load to full load, kW & KVAR.
.10 Verification of tap voltage ratios including voltmeter recording at the various tap positions.
.11 Visual inspection of fan controls and fans
.12 Verification of operation of all alarm and protective devices

.3 All test results and report data to be factory certified and provided to the Departmental Representative in report format. Correct deficiencies noted during factory witness testing prior to shipment.

Part 2 Products

2.1 DESIGN DESCRIPTION

.1 Design

.1 Type: ANN.
.2 3 phase, 112.5 KVA, 150 KVA and 225 KVA, 600 V input, 208/120 V output, 60 Hz as indicated in drawing.
.3 Voltage taps: standard.
.4 Insulation: Class 220, 115 degrees C temperature rise.
.5 Basic Impulse Level (BIL): standard.
.6 Hipot: standard.
.7 Transformers rated below 300 KVA to have noise level as per Table 8 of CSA Standard unless otherwise noted.
.8 Impedance:
.1 Per Table 7 of CSA C9, except where indicated otherwise,
.2 Not less than 4% for 112.5kVA,
.3 Not less than 5% for 150kVA and above,
.4 Not to exceed 6%.
.9 Enclosure: CSA, removable metal front panel.
.10 Mounting: floor.
.11 Copper windings.
.12 Winding configuration to be as noted on drawings.
.13 Voltage Regulation to be 4% or better at 80% power factor.

2.2 TRANSFORMERS FORMING PART OF SUBSTATION

.1 Fully coordinated with same and to match BIL of substation.

.2 Have a flexible gasketted connection to prevent vibration transmission to switchboard.

.3 Mimic bus single line diagram on front of transformers, aligned with switchboards.

.1 Bus to show every piece of equipment, using industry standard symbols for each device.

.2 Mimic bus to be white lamicoid fastened securely with screws or rivets.

.3 Mimic to be complete with detailed descriptive lamicoid nameplates to indicate origin or destination of all incoming and outgoing feeders and bus ducts.

2.3 MONITORING ALARMS

.1 Transformers rated 300 kVA and larger to be equipped with an external dial type thermometer, indicating average coil temperature, with 2 stage alarm contacts.

.2 Contacts to be wired to a terminal block in a suitable enclosure mounted on transformer.

2.4 SUPPORT AND ISOLATION

.1 Support transformers core and coil assembly on in-shear vibration isolation mounting pads. Installed mountings to provide a uniform deflection underweight and weight distribution of supported equipment. Pads to provide a minimum of 6mm static deflection.

.2 In addition, each transformer is to be set on 2 layers of 9 mm ribbed or waffle pattern neoprene pads of not more than 50 durometer. A stainless steel plate of not less than 16 gauge for full size of each pad to be provided on top of and between pad isolator plates. Pads to be similar to Peabody Noise Control Model "NP". Installed mountings to provide a uniform deflection underweight and weight distribution of supported equipment.

2.5 ENCLOSURE AND FINISH

.1 Enclosure: NEMA Type 1 with drip shield for indoor and NEMA Type 3R for outdoor installations unless otherwise noted.

.2 Transformer enclosure to have primary metal treatment and to be finished with 2 coats of powder coat finishing paint.

.3 Finish equipment as follows:

.1 Basic rust-inhibiting metal process

.2 Interior in white

.4 Exterior shall be finished with paint equal to Sherwin Williams, as follows:

.1 Normal power - ASA 61 Grey

.5 Manufacturer to provide quart of touch-up paint or several pressurized spray cans to touch-up small areas marred during installation.

2.6 EQUIPMENT IDENTIFICATION

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

.2 Label size: 7.

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 dry type transformers installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Mount dry type transformers up to 75 kVA suspended or on floor as indicated.

.2 Mount dry type transformers above 75 kVA on floor.

.3 Provide a 100 mm reinforced concrete pad with beveled edges for all floor mounted transformers. Seal with paint or concrete sealer to prevent concrete dust from entering equipment. Concrete pads to be provided under this division.

.4 Provide suitable mounting hardware complete with external vibration isolation pads for both floor mounted (between enclosure and pad) and suspended (between enclosure and support frame) transformers.

.5 Install transformers in level upright position.

.6 Ensure adequate clearance around transformer for ventilation.

.7 Remove shipping supports only after transformer is installed and just before putting into service.

.8 Loosen isolation pad bolts until no compression is visible.

.9 Make final primary and secondary connections using flexible steel conduits.

.10 Make primary and secondary connections in accordance with wiring diagram.

.11 Provide green insulated copper ground conductor in conduit, sized as follows, from transformer ground bus to the building grounding system, in accordance with Table 17 of the Electrical Code: Below 30 kVA transformer: #8AWG in 13 mm conduit; 30 kVA transformer: #6AWG in 13 mm conduit; Up to 45 kVA transformer:#4 AWG in 19 mm conduit; Up to 75 kVA: #2 AWG in 19 mm conduit: up to 112.5 kVA: #2/0 AWG in 25 mm conduit; over 112.5 kVA: 3/0 AWG in 25 mm conduit.

.12 Provide control wiring from alarm contacts to BAS complete with pilot light, buzzer and silencing switch

.13 Energize transformers after installation is complete.

.14 Adjust transformer taps as required to achieve suitable secondary voltage at loads

3.3 FIELD QUALITY CONTROL

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

.2 Energize transformers and apply incremental loads:

.1 No load

.2 Incremental Load

.3 Full load.

.4 At each load change, check temperatures ambient, enclosure and winding.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by dry type transformers installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Equipment to be designed, factory assembled and tested in accordance with latest applicable EEMAC, NEMA, ANSI, IEC, CSA and IEEE standards, including but not limited to:

.1 EEMAC Standards G8-2, G11-1

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

.3 C22.2 No. 31-14, Switchgear Assemblies

.4 C105, C235-83(R2015), Preferred Voltage Levels for AC Systems (0 to 50,000V)

.5 ANSI Standards C37.04-1999(R2006), IEEE Standard Rating Structure for AC High Voltage Circuit Breakers

.6 C37.20-03(R2013), IEEE Standard for Metal-Enclosed Interrupter Switchgear

.7 NEMA Standards SG4-2009(R2013)

.2 Where requirements of this Specification exceed those of above mentioned standards, this Specification to govern. Equipment must be acceptable to Supply and Inspection Authorities.

.3 Terminals, control and secondary circuits and devices, barriers, shutters, insulating materials for covering buses and connections, interlocks, interchangeability of like devices, mounting of potential transformers and ground bus to conform to ANSI C37.20.

.4 Circuit breakers to carry their rated continuous current without exceeding observable temperature rises specified in Table 6.2 of EEMAC Standard G8-2.

.5 Phase to phase, and phase to ground clearances of bare conductors and other current carrying parts, to be in accordance with requirements of C.S.A. Specifications C22.2 No. 31. Where such conductors and components are fully insulated at factory, these clearances may be reduced if acceptable to Supply Authority.

.6 Equipment to have capability to meet or exceed corona extinction tests as per CEMA Standard G11-1.

.7 Electrical indicating instruments to meet requirements of ASA Specification C39-1-1961.

.8 Phase designations for buses, bus taps, current transformers, ammeters, relays, test blocks and terminal blocks to conform to latest EEMAC Standards.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for indoor unit substation and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Include meter, instrument, outline dimensions, panel drilling dimensions and installation cut-out template.

.3 Shop Drawings:

.1 Physical Construction Drawings, completely dimensioned, showing:

.1 Arrangement.

.2 Plan, front view, and elevation views.

.3 Required clearances for opening doors and for removing breakers.

.4 Conduit or cable trays entrance locations and dimensions for both top and bottom entrance.

.5 Bus bar locations and configurations.

.6 Incoming and outgoing power cable terminator positions.

.7 Field wiring terminal block locations, and all other terminal block locations.

.8 Anchor bolt locations.

.9 Grounding connections.

.10 Weight of equipment.

.2 Three line diagrams, with ANSI device function numbers used throughout, to show all:

.1 Instrument transformers.

.2 Relays.

.3 Meters and meter switches.

.4 Other pertinent devices.

.3 Elementary Diagrams

.1 Elementary (schematic) wiring diagrams to be furnished for the electrically-operated breaker control scheme.

.2 Each elementary diagram to show all control devices and device contact, each of which to be labelled with its proper ANSI device function number.

.3 Each elementary diagram to show device and terminal block terminal numbers.

.4 Control Switches

.1 Provide control switch development tables.

.5 Detailed Connection (Wiring) Diagrams showing:

.1 Approximate physical location of all items in each unit.

.2 All wiring within each unit.

.3 All interconnecting wiring between units.

.4 Identification of all terminals, terminal blocks, and wires.

.5 Clear identification, by some distinguishing method, of all wiring which is to be installed by Purchaser. This to include, but not be limited to, leads from external current transformers, trip circuits from remote devices, auxiliary contacts to remote devices, incoming DC control power, and separate incoming AC power. This to also include spare

auxiliary contacts and relay contacts which to be wired to terminal blocks for future use.

.6 Provide one additional set of drawings shipped with the switchgear for maintenance use, installed in a suitable permanent drawing pocket inside one of the control cubicle doors.

.6 Spare Parts List

.1 Complete spare part list, including parts location diagrams or drawings to be included with the manufacturer's quotation.

.2 List of priced spare parts which manufacturer recommends should be on hand during start-up and the first two year's operation.

.7 Material List

.1 A material list to be furnished listing the quantity, rating, type, and manufacturer's catalogue number of all equipment on each unit.

.4 Test Reports:

.1 Submit production test results.

.1 Do not ship equipment until test results have been accepted by Departmental Representative.

1.3 SHIPPING

.1 If shipped separately, the power circuit breaker to be individually crated and tagged with its proper unit number and the equipment number of the assembly to which it belongs.

.2 Relays to be shipped installed in the stationary structures and to be securely blocked and braced to prevent damage during shipment if required.

.3 Each "shipping section" of stationary structures to be provided with a permanently-attached, readily-visible identification tag bearing the equipment number of the assembly of which it is a part.

.4 Shipping splits must be broken down into single cubicles

1.4 PREPARATION FOR SHIPMENT

.1 Preparation for Shipment to be in accordance with manufacturer's standards, unless otherwise noted. The manufacturer to be solely responsible for the adequacy of the Preparation for Shipment provision employed in respect of materials and application, to provide materials and their destination in ex-works condition when handled by commercial carrier systems.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for unit substation for incorporation into manual.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1.7 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect unit substation from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 The switchgear assembly to be heavy duty weatherproof indoor industrial type, temper-resistant construction 15 kV class, complete with operating mechanism, copper bus bars, bus supports and inserts, instrument transformers, instruments, control devices, barriers and supporting framework, incoming line compartments and any other items required.

.2 Primary switchgear: 15 kV, 600 A, 3 phase, 3 wire, interrupting capacity 300 MVA, BIL 95 kV, grounded.

2.2 ENCLOSURE

.1 Enclosure: metal enclosed free standing, floor mounted, front and rear access, indoor tamperproof CSA enclosure.

.2 The switchgears shall consist of gas tight stainless steel tanks containing Sf-6 gas, load interrupter switches and resettable vacuum interrupters with visible open gaps 152 x 305 mm minimum viewing windows integral cable grounds

.3 The tank shall be 7 gauge type 305 stainless steel and must be shipped with a complete fill of Sf-6 gas ready for immediate use. The tank shall be designed to be submersible in up to 3 m of water.

.4 A gas fill port valve shall be provided along with a temperature compensated pressure gauge c/w contacts for remote indication of low gas pressure.

.5 The padmounted enclosure construction shall be welded 11-gauge steel.

.6 The finish shall consist of ANSI #61 light Gray.

.7 A three line mimic bus and identification nameplate may also be included to ensure all internal components are identified in their proper relationship.

2.3 GROUNDING

.1 Copper ground bus not smaller than 50 x 6 mm extending full width of cubicle and situated at bottom. Lugs at each end for size 2/0 AWG grounding cable.

.2 Bond non-current carrying metal parts, including switchgear framework, enclosure and bases to ground bus.

2.4 FAULT INTERRUPTER AND SWITCH

.1 The interrupters & switches shall be factory aligned and tested before being installed in the switchgear.

.2 The switchgear shall be sealed with Sf-6 insulation, with elbow power connections. All switches shall have 3 position operation (Close / Open / Grounded) and a large 152 X 305 mm viewing window for verification or status.

.3 All interrupters shall have self-powered micro-processor based over-current control. The over-current relay shall be housed in a submersible Polycarbonate box with 9 pin serial port for programming.

.4 Relay set-up shall be via laptop so that tampering with settings is not possible. All switchgear must meet ESA standards.

.5 All elbows shall be 15 KV class 600 amp bolted type with universal bushing interfaces to IEEE386

.6 The switchgear arrangement shall be as shown on then Single Line diagram.

Standard of Acceptance

- S & C Vista SWGR

2.5 INDICATOR LIGHTS

.1 Include 30 mm long life LED indicator lights rated for appropriate control voltage to CSA C22.2 No.14.

.2 Include push to test lights with transparent plastic cover.

2.6 SHOP FABRICATION

.1 Shop assemble and test components of substation.

.2 After completion of factory assembly and high potential test, prepare for shipment to site in sections, complete with hardware for re-assembly and re-connecting.

2.7 FINISHES

.1 Prior to painting, exterior metal surfaces will be cleaned with phosphoric acid and then iron phosphate coated. A prime coat of zinc chromate and iron oxide to be applied followed by two finish coats of oil base alkyd.

.2 Exterior shall be finished with paint equal to Sherwin Williams, as follows:

.1 Normal power - ASA 61 Grey

2.8 EQUIPMENT IDENTIFICATION

.1 Engraved high quality plastic nameplates with black letters suitably inscribed on white background for cubicle and circuit identification to be provided on front and rear sections.

.2 Also provide on all rear doors and removable panels, nameplates with red letters suitably inscribed on white background, reading "DANGER - 13,800 VOLTS", and "DO NOT ENTER" as per Canadian Electrical Code. Engraved letters to be 9.5 mm minimum except "DANGER" which to be 19 mm minimum. 6 mm minimum height may be provided for meters, relays, switches and other similar devices.

.3 The Departmental Representative will provide circuit identification inscription data to the manufacturer as required.

.4 All nameplates to be permanently affixed with rivets or screws. Glue alone is not acceptable.

2.9 PHASE DESIGNATIONS

.1 Coloured phase designations or numbering markings to be readily visible in each bus compartment, current transformer compartment, circuit breaker compartment and line and feeder cable compartment. Refer to Electrical General Requirements: "Equipment Identification".

2.10 ACCESSORIES

.1 Accessories to include necessary devices required for operation and maintenance for the equipment as herein described. These to be comprised of the following:

.1 Instruction and maintenance books for equipment furnished and copies of relay calibration, and final 'as left' settings,

.2 Test plugs to be provided as required for relays.

2.11 SOURCE QUALITY CONTROL

.1 Equipment to be production and quality control tested in accordance with industry standards.

.2 Certified copies of standard production tests to be submitted upon request.

.3 Submit certified copies of successful completion of the factory tests prior to shipment of the equipment.

.4 Notify Departmental Representative in writing 5 days minimum in advance when equipment is ready for inspection.

.5 Ensure unit to be factory assembled.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of exiting floor are acceptable for unit substation installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Provide high voltage switchboards of type, rating and arrangement as shown.

.2 Provide a 100 mm reinforced concrete pad with bevelled edges. Seal with paint or concrete sealer to prevent concrete dust from entering equipment. Pads to be provided under this division.

.3 Grout a minimum of two steel plates with anchor bolts into pad, for levelling purposes, for full length of switchboard.

.4 Assemble all shipping sections and level switchboard on pad.

.5 Provide interconnecting, incoming and outgoing cable, bus duct, and control wiring connections as shown and as required.

.6 Terminate all power cables with two hole long barrel compression connectors equal to Burndy YA-2N.

.7 Provide outgoing cable connections, complete with 3M stress cones.

.8 Provide control power connections from battery charger panel to switchboard.

.9 Provide interconnecting relaying control wiring between the various switchboards, control panels and terminal cabinets.

.10 Provide grounding of each switchboard to perimeter ground bus with two separate runs of a #4/O green insulated copper in conduit. Terminate with Burndy YA-2N lugs.

.11 Touch up small areas marred in transit or during installation with touch up paint. Repaint entire switchboard using electrostatic process where large areas of significant damage to factory finish has occurred.

3.3 FIELD QUALITY CONTROL

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

.2 Conduct an acceptance test in presence of and to satisfaction of Departmental Representative, after completion of installation, but before switchboard is permanently put into service.

.3 Test to include operation of breakers manually and electrically, racking in and out, and checking that meters and relays function properly. Correct defects at no additional cost to Departmental Representative. Replace defective equipment immediately with new factory equipment.

.4 In addition to above, include work associated with field testing, cleaning and calibration of relays and trip devices in Bid cost.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by unit substation installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA International

.1 CSA C22.2 No.31-14, Switchgear Assemblies.

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

.1 EEMAC G8-3.3, Metal Enclosed Interrupter Switchgear Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for low voltage switchgear and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 All drawing and product data provided for the equipment to show equipment as specified and ordered.

.2 Typical drawings are not acceptable. Reproducible drawings for approval to be supplied.

.3 Physical Construction Drawings, completely dimensioned, showing:

.1 Arrangement.

.2 Plan, front view, and elevation views.

.3 Required clearances for opening doors and for removing breakers.

.4 Conduit or cable trays entrance locations and dimensions for both top and bottom entrance.

.5 Bus bar locations and configurations.

.6 Incoming and outgoing power cable terminator positions.

.7 Field wiring terminal block locations, and all other terminal block locations.

.8 Anchor bolt locations.

.9 Grounding connections.

.10 Weight of equipment.

.4 Three line diagrams, with ANSI device function numbers used throughout, to show all:

.1 Instrument transformers.

.2 Relays

.3 Meters and meter switches.

.4 Other pertinent devices.

.5 Elementary Diagrams

.1 Elementary schematic wiring diagrams to be furnished for the electrically-operated breaker control scheme.

.2 Each elementary diagram to show all control devices and device contact, each of which to be labelled with its proper ANSI device function number.

.3 Each elementary diagram to show device and terminal block terminal numbers.

.6 Control Switches

.1 Provide control switch development tables.

.7 Detailed Connection Wiring Diagrams showing:

.1 Detailed Connection Wiring Diagrams showing:

.2 All wiring within each unit.

.3 All interconnecting wiring between units.

.4 Identification of all terminals, terminal blocks, and wires.

.5 Clear identification, by some distinguishing method, of all interface wiring to remote devices. This to include, but not be limited to, leads from external current transformers, trip circuits from remote devices, auxiliary contacts to remote devices, AC control power, and separate incoming AC power. This to also include spare auxiliary contacts and relay contacts which to be wired to terminal blocks for future use.

.8 Provide one additional set of drawings shipped with the switchgear for maintenance use, installed in a suitable permanent drawing pocket inside one of the control cubicle doors.

.9 Provide nameplates in accordance with "Equipment Identification"; submit nameplate designations for approval.

.10 Submit co-ordination curves for review.

.11 Spare Parts List

.1 Complete spare part list, including parts location diagrams or drawings to be included with the manufacturer's quotation.

.2 List of priced spare parts which manufacturer recommends should be on hand during start-up and the two year's operation.

.12 Material List

.1 A material list to be furnished listing the quantity, rating, type, and manufacturer's catalogue number of all equipment on each unit.

.13 Installation, Operating, and Maintenance Instructions

.1 Installation, operating, and maintenance instructions to cover all the equipment furnished including all protective relays, power fuses, auxiliary relays, etc., and to include characteristic curves of each different protective relay and power fuse.

.4 Approvals and Information

.1 Manufacturer to not commence final fabrication or erection of equipment until receipt of:

.1 Reviewed or "Reviewed as Noted" shop drawings from Departmental Representative.

.2 Manufacturer to supply:

.1 Information to install and test equipment for complete installation.

.2 Shop drawings for review, as specified in "Design and Shop Drawings".

.3 Information for Departmental Representative, as specified in "Instruction Manuals".

.5 Provisions for Handling and Field Erection

.1 Each shipping split of stationary structures to be furnished with removable lifting angles and/or plates suitable for crane hooks or slings.

.2 Each shipping split to also be furnished with removable steel channel base plates which permit using pipe rollers or dollies without damaging the frame will steel of the equipment.

.6 Shipping

.1 If shipped separately, the power circuit breaker to be individually crated and tagged with its proper unit number and the equipment number of the assembly to which it belongs.

.2 Relays to be shipped installed in the stationary structures and to be securely blocked and braced to prevent damage during shipment if required.

.3 Each "shipping section" of stationary structures to be provided with a permanently-attached, readily-visible identification tag bearing the equipment number of the assembly of which it is a part.

.7 Preparation for Shipment

.1 Preparation for Shipment to be in accordance with manufacturer's standards, unless otherwise noted. The manufacturer to be solely responsible for the adequacy of the Preparation for Shipment provision employed in respect of materials and application, to provide materials and their destination in ex-works condition when handled by commercial carrier systems.

.8 Certificates:

.1 Submit certified factory test results.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for low voltage switchgear and components for incorporation into manual.

1.4 EXTRA STOCK MATERIALS

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

1.5 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect low voltage switchgear from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Switchgear assembly: to CSA C22.2 No.31, EEMAC G8-3.3.

.2 Low voltage switchboard to be of type, rating and arrangement shown. Rearrangement of components will not be permitted. Equipment to be constructed to fit space allocated and to be a free standing assembly mounted on a concrete pad.

.3 Where future breakers are indicated, bus, stationary element, control and metering wiring to be supplied such that, at a future date, Departmental Representative need buy only draw out element and CT.

.4 Main bus and switchboard to be drilled and plated and have provision for future extension of additional vertical cells at each end of switchboard.

2.2 RATING

.1 Secondary switchgear: indoor, 600 V, 2000 A, 3 phase, 3 wire, 60 Hz, minimum short circuit capacity 65 kA (rms symmetrical).

2.3 ENCLOSURE

.1 Main incoming section to contain:

.1 Insulated case circuit breaker sized as indicated.

.2 Digital metering system

.2 Distribution sections to contain:

.1 Moulded case circuit breaker sized as indicated.

.2 Copper bus, from main section to distribution sections including vertical bussing.

.3 Free standing, rigid, dead-front enclosure

.4 Indoor construction of non-walk-in type to conform with CSA Standard C22.2 No. 94 Type 1.

.5 Completely accessible with all bolted connections, lugs for cable connections, terminations for power and control wiring and any other items requiring torqueing, infra-

red thermal scanning, maintenance, or replacement all visible and accessible from the front or rear, when respective hinged door is opened. It is to be possible to undertake full thermal scanning of each component, bus bar joint and termination while the unit is energized.

.6 The main structure of cubicles to be fabricated of minimum No. 12 gauge steel plate, smooth finished surfaces, and welded together and reinforced where necessary with structural members to provide a rigid and self-supporting structure for heavy-duty industrial use. Vertical sections to be designed for bolting together without misalignment or distortion. Cubicles to be divided into individual compartments extending the full height and depth of its units for effectively isolating equipment and connections.

.7 Each switchgear shipping section base to be of welded 100 mm channel iron or equivalent construction as certified by manufacturer, to provide a rugged assembly. Such construction to prevent distortion during shipment and installation, and maintain level and alignment throughout its life without additional support by the Departmental Representative.

.8 Doors to have rolled or formed edges with reinforced steel as required to form a rigid frame unit. Rear doors to be of the hinged and bolted type, fully gasketted, minimum No 12 gauge steel plate, opening 135E. Hinges to be concealed adjustable type with removable pins. Bolts to be of the captive type and to have large knurled heads for ease of removal. Front cubicle doors to be fabricated of minimum No. 14 gauge steel plate and to be suitably braced for mounting of meters and instrument switches. Front of each cubicle to be equipped with an overall full height hinged and gasketted formed outer door fabricated of minimum No. 12 gauge steel plate. Door to have T-handle 3 point locking system complete with lock and latch. A lexan viewing window, fully gasketted, to be installed in the upper section of the outer door to permit viewing of the upper metering compartment. Ventilation louvres, if required, to be overhanging drip proof and sprinklerproof type with internal splash guard.

.9 Each circuit breaker to be housed behind a separate minimum 14 gauge hinged steel inner door painted to match switchgear. Meters and instruments to be mounted in the upper compartment on a 14 gauge minimum, hinged steel panel, painted white, suitable braced for mounting meters.

.10 Overhanging drip-proof and sprinkler proof louvres to be provided for ventilation of ionized gases from the structure where necessary to maintain a maximum internal air temperature of 15EC. rise above 40EC. ambient temperature.

.11 Individual breaker compartments to be provided with primary and secondary contacts of silver plated copper. Also provide rails, stationary disconnecting mechanism parts and cell interlocks. The draw out mechanism to hold the circuit breaker rigidly in the fully connected, test, and fully disconnected positions. Interlocks to be provided which will prevent moving the circuit breaker from the fully connected, test, and fully disconnected positions, unless the breaker is open. Interlocks to prevent closing the breaker between any of these positions. Provisions to be made for padlocking the breaker open in any of the positions noted above. Mechanisms to be ruggedly constructed and close tolerances maintained to assure interlocks will not fail due to binding, misalignment or susceptibility to distortion. Mechanical designs to be such as to minimize the number of parts requiring lubrication. The entrance to the primary stationary contacts to be automatically covered by a shutter when a breaker is withdrawn to the test/disconnect position or removed from the cubicle.

.12 Provision of vertical fire retardant and non-hygroscopic barriers between vertical sections, from bottom to top of switchboard, and from front face to back of switchboard. Barriers to be sealed to prevent passage of ionized gases between vertical sections.

.13 Each switchgear shipping section base to be of welded 100 mm channel iron or equivalent construction as certified by manufacturer, to provide a rugged assembly. Such construction to prevent distortion during shipment and installation, and maintain level and alignment throughout its life without additional support.

.14 Lifting angles or channels to be provided on each shipping section.

.15 Two channels across bottom of each section, to permit rolling or jacking of board.

.16 Two steel plates or channels, to be grouted into concrete pad, for levelling purposes, for full length of switchboard, for mounting under the base channels noted above

.17 Channel or angle across top of each section for hoisting purposes

.18 Removable top plates

.19 Plated hardware

.20 Shipping splits must be limited to no more than 1250 mm in width, to permit installation through building corridors.

2.4 BUSBARS

.1 Main bus work, 3 phase extending through all sections, rated to match main breaker rating and braced to withstand stresses resulting from short circuit current of maximum system fault equal to interrupting rating of main breaker combination. Bus work to be plated copper throughout.

.2 Buswork ampacity to be based on a current density not to exceed 155 amps per square centimeter of cross sectional area.

.3 Main buswork and other live parts in bus compartment fully insulated by covering throughout with PVC using the heated bar and fluidized bed process or heat shrinkable sleeves to the same CSA requirements as 1000 volt insulated conductors. Bus joints to be covered with moulded snap-on covers with the same insulation level.

.4 Phase collection and provision of necessary bolts, nuts and washers for bus duct connection

.5 Secondary bus work as required

.6 Coloured phase designations for all phases to suit CSA, NEMA and Supply Authority Standards.

.7 Bus connections from the main bus to feeder and the breakers to be fully rated for the maximum frame size breaker which may be inserted. Vertical riser busses to be rated for the total maximum ampacity of the vertical section.

.8 Continuous copper ground bus of adequate cross-sectional area to be provided 6 X 50 mm minimum, extending the full length of the switchgear assembly and securely bolted to the structural members of the enclosure. Equipment requiring ground connections to be connected to this bus using approved pressure indent type solderless connectors. Ground bus to be readily accessible from the rear and to be extended adjacent to cable terminations for grounding of the cable shielding and ground wires. Ground bus to be

continuous without joints except at shipping splits, where joint to require a minimum of two bolts. The frame of each housing to be grounded to this bus.

.9 Joints for busses, interconnections and disconnecting devices to have plating and contact arrangement as per manufacturer's standard unless otherwise noted. Bus connections to be bolted with at least two high strength bolts per lap properly torqued and locked into place.

.10 All busbar connections to be secured by the use of zinc plated high tensile bolts inserted into zinc plated pressure plates having a minimum depth of 10 mm. These pressure plates to provide uniform pressure throughout the joint. All bolts to be tightened with a calibrated torque wrench to a pressure in order of 28 Nm for 10 mm bolts, 45 Nm for 12 mm bolts.

.11 Where the busbars are drilled the cross section through the bars at the point of drilling the cross sectional area to be capable of taking the full rated current. Busbars to be de-burred and cleaned after drilling and coated on the joint face with conducting grease before assembly.

.12 Provision for bus extensions for future units to be drilled and plated.

.13 Bus supports of high strength, flame retardant, track resistant, inorganic, non-hygroscopic Class 130 or better insulation material.

.14 Compression type terminal lugs, cable supports, bus supports and necessary space to be provided in the rear section of the switchgear assembly for the proper termination of outgoing cable or bus. Lugs to be double indent long barrel, Burndy Catalogue No. YA-2N.

2.5 AIR CIRCUIT BREAKER

.1 Air circuit breakers to be designed, assembled, and tested and to comply with the following standards complete with their latest revisions:

- .1 Power circuit breakers in enclosures to comply with ANSI (IEEE C37.13).
- .2 Trip devices to comply with ANSI C37.17.

.2 Type tests of circuit breakers to have been conducted by the manufacturer as specified in the above standards. Proof of same with certification that the equipment meets or exceeds these standards to be supplied upon request.

.3 Short time current ratings of circuit breakers to be as follows:

- .1 Unfused circuit breakers; one half second at the current level equal to the interrupting rating.
- .2 Fused circuit breakers; same as for unfused circuit breakers, exclusive of fuses.

.4 Air circuit breakers to include the following:

- .1 Draw out construction
- .2 Manual operation for breakers up to 600 A frame size, electric operation for breakers 800 A frame size and larger
- .3 Isolation of adjacent breaker compartments by steel panels, top to bottom and front to rear
- .4 Isolation of front breaker section and rear bus section by steel panels

.5 Breakers to have solid state selective trips with long time, short time and ground adjustable characteristics, equal to Cutler Hammer Type Digitrip RMS 1150i.

.6 The digital trip unit to include local operation display and control with capability for remote display and control including energy monitoring and to be capable of transmitting the following data over a compatible two wire local area network to a central computer for storage and/or print out:

.1 Individual phase currents and ground current.

.2 Peak energy demand, present energy demand, energy consumed.

.3 Breaker status: open/closed/tripped

.4 Mode of trip:

.5 Override

.6 Instantaneous pick up with “off” position

.7 Discriminator

.8 Short delay

.9 Ground fault

.10 Long delay

.11 Long delay pick-up

.12 Trip unit status:

.13 Internal trip command

.14 Data memory test

.15 Program memory test failure

.16 Missing or defective rating plug

.17 Reserve power flux

.18 Response to depressing test

.19 Breaker control

.20 Breaker open

.21 Breaker close

.22 Power Quality and harmonics

.23 Manual reset "cause of trip" indicators for overload, short circuit and ground fault.

.7 Integral ground fault protection on all breakers.

.8 Six auxiliary contacts for remote annunciation, two for "open", two for "closed" and two for "tripped".

.9 Individual breakers to be equipped with a visual indication of ground fault indication. The integral ground fault protection specified for each breaker to include three coordinated time settings, with the minimum time setting to be 0.20 - 0.25 seconds. Two other, longer term, settings to be included, identified as intermediate and long term. The associated current and time ratings to be applied to the breakers as shown. Provide an auxiliary contact, with wiring to an accessible terminal block to indicate a "breaker tripped" condition, as initiated by the solid state relay.

.10 Ability to remain closed during power outage on supply.

.11 Breakers to be horizontal draw out type, equipped with a stored energy spring mechanism for quick make, quick break, and trip free operation. The breaker stored-energy spring mechanism to be designed so that the closing speed is independent of both control voltage and the operator. Breakers to be 3 pole, single throw with a continuous current trip rating as specified and shown on drawings, complete with three independent arc quenchers, closing mechanism, mechanical push trip button, interpole barriers and positive position indicator, so that the position of the breaker is indicated at the front of the compartment. Breakers of like rating to be completely interchangeable. A mechanical interlock to allow only the correct rating breaker to be inserted into the cubicle.

.12 Breakers, where required, to have the spring charging device operating at 120 V AC. 120 VAC shunt trip from a power supply internal to the switchboard to be provided for remote tripping applications, on manual and electrically operated breakers. Power supplies for all breakers to be redundant.

.13 The breaker levering mechanism to be arranged to prevent racking the breaker between the Connected - Test - Disconnected positions unless the breaker is in the tripped position.

.14 Breakers to be dead front construction, which provides a steel barrier between the operator and live parts when racking the breaker - between the Connected - Test - Disconnected positions, and to be capable of being padlocked in any of these positions, such that it cannot be closed or moved to any other position.

.15 Breakers to be positively grounded to the enclosure prior to being inserted into the 'Test' and 'Connected' positions. In the 'Test' position the primary breaker disconnect contacts to be separated by a safe distance from the line and load contacts. The primary disconnect contacts to be self-aligning and to be positively and securely engaged in the 'connected' position. The contacts to be silver to silver and accessible for inspection.

.16 The secondary disconnecting contacts, as required, to consist of a rugged self-aligning constant pressure device, with smooth silver plated copper contacts, which supply control circuit connections to the moveable element. It to be fully engaged when the circuit breaker is in the 'connected' and 'test' positions. The contacts to be suitably protected from physical damage and designed so that positive contact pressure is assured during the life of the breaker. Control wiring to be harnessed, protected and kept away from moving parts. Wiring to devices to be provided with sufficient slack to prevent breakage from movement or vibration.

.17 Current limiting fuses, on line or load side of breaker as shown complete with interlocks to prevent fuse withdrawal unless associated breaker is tripped and to prevent breaker from being closed if one or more current limiting fuses or control fuses are blown. Fuses for breakers larger than 2000 A frame size to be contained in a separate draw-out compartment.

.18 Key interlocks, in an arrangement as shown, complete with lamacoid nameplate at key block and on key with key designation inscribed with 12 mm letters.

.19 Cable and/or bus duct terminations as required and as indicated on Drawings.

.20 Each breaker to be equipped with pilot lights: red for breaker closed, green for breaker open. Pilot lights to be heavy duty, oil and water tight, 30.5 mm

diameter, individual push to test type, wired independently of the trip coil circuit, and mounted on the outer door of the switchboard.

.21 Power supplies of suitable capacity for operation of such items as electrically operated breakers and meters, using HRC fuses for protection of small wiring

.22 Redundant power supplies in each switchboard, of suitable capacity complete with transfer control relay to provide 120 VAC power to operator breakers.

.23 Additional redundant power supply in each switchboard, complete with transfer control relay scheme, to provide 120 V control power from each switchboard to a common control bus, to provide redundant back up control power to each switchboard for operation of digital metering systems and communications devices forming part of the Electrical Monitoring system. Wiring is to be terminated at suitable labelled terminal blocks, for field wiring between switchboards by the installing contractor.

2.6 PHASE DESIGNATION

.1 Coloured phase designations or numbering markings to be readily visible in each bus compartment, current transformer compartment, circuit breaker compartment and line and feeder cable compartment.

2.7 MIMIC BUS

.1 A white mimic bus single line diagram to be rivetted on front of switchboard.

.2 Run bus through breaker handles and show every piece of equipment on board.

.3 Symbols used to be industry standards for each device.

2.8 FINISH

.1 Finish equipment as follows:

.1 Basic rust-inhibiting metal process

.2 Interior in white

.2 Exterior to be finished with paint equal to Sherwin Williams, as follows:

.1 Normal power - ASA# 61, Grey.

2.9 CONTROL AND SECONDARY WIRING

.1 Control and secondary wiring to be enclosed in metallic raceway insofar as practical. Wiring to outgoing circuits, at shipping splits and devices mounted in hinged instrument panels, to terminate at terminal blocks.

.2 Terminal blocks to have numbered points for circuit identification. Terminal blocks to be General Electric Type EB or equal. Terminal blocks for current circuits to be shorting block type.

.3 Wiring to be type 'TA', 'TBS', or 'SIS', flame retardant #14 AWG size single conductor minimum, stranded, tinned copper, extra flexible type throughout. Wires to be tagged at both ends with permanent plastic sleeve type markers. Insulation to be 600 V, working and 1500 V test.

.4 Secondary and control wiring within the rear bus compartment to be completely shielded in a protective metal covering as far as practical.

.5 Cable openings between sections to be protected with bushings to prevent abrasion to cable jackets.

.6 Wiring from bus differential and transformer differential CT's to be minimum #10 AWG.

.7 Fuse and terminal blocks to be easily accessible. Fuses of the proper type and rating to be supplied by the switchgear manufacturer. Provisions to be made for the installation of control conduits to the switchboard and connections to be brought to a terminal board furnished and installed by the switchboard manufacturer. Fuses to be Class J HRC. DC fuses (one per pole) to be in dead front enclosure.

.8 Auxiliary wiring checks to be made throughout the manufacture and assembly of the equipment to assure wiring correctness and continuity.

.9 Final checkout of wiring to be made with the complete switchgear lineup assembly to assure wiring correctness and continuity. Polarity of current and potential transformers and devices to be checked to assure proper functioning of all protective devices and instrumentation.

2.10 CONTROL DEVICES

.1 Control and instrument switches to be of the rotary cam-type with dial plates engraved as required

.2 Breaker control switches to have green and red push to test oil tight indicating lamps.

.3 Meter switches to have "knurled knob" handles. Switches to be General Electric Type SB-1 or equal.

.4 All control wiring for tripping, closing and control lights to terminate on terminal blocks for wiring to Departmental Representative's mimic and control panels.

2.11 INSTRUMENT TRANSFORMERS

.1 Potential transformers and current transformers required to operate relays, meters and other devices indicated in the drawings and specifications to be coordinated so that the ratio and accuracy are suitable for each individual application, taking into account the burdens imposed. Construction of transformers to conform to ANSI Standards. All terminals to have permanent polarity designations and to be wired accordingly. All applicable requirements of ANSI Standard C57.13 to apply.

.2 Primary potential bus or cable tap leads to be designed with the same design integrity as the primary bus.

.3 Both current and potential transformers to be wired through test switches to provide quick and easy multi-circuit testing of switchboard relays, meters and instruments.

2.12 POTENTIAL TRANSFORMERS

.1 Potential transformers to be housed in a separate compartment in the circuit breaker cubicle or superstructure.

.2 Potential transformers to be of the 0.3 accuracy class, per ANSI Standards and of sufficient capacity to serve the maximum burden imposed.

.3 Each potential transformer to be protected with current limiting primary fuses, and to be designed to withstand the basic impulse level of the switchboard.

2.13 CURRENT TRANSFORMERS

.1 Current transformers to be easily removable and accessible and of the ring or bar-type.

.2 Ring-type current transformers to be used where burden and accuracy permit. Primary terminals on bar-type current transformers to be silver plated and rigidly (2 bolt minimum) connected to the bus structure.

.3 Secondary connections of all current transformers to have provisions for short circuiting when not connected to instruments and to be solidly grounded.

.4 Current transformers to be capable of carrying at least 125% of CT rating continuously and have a short time rating at least equivalent to that of the switchgear bus. Accuracy class: C100/ 0.6 B-1.

2.14 METERS ON MAIN BREAKERS

.1 All meters to be a maximum of 2 m above floor level with switchboard on 100 mm pad.

.2 Provide metering as follows for main breakers:

.1 3 current transformers and 3 HRC fused potential transformers, metering accuracy, frequency response 10 - 10,000 Hz.

.2 Digital microprocessor based metering system to be as follows:

.1 The digital metering to consist of a single microprocessor based unit capable of monitoring and displaying:

.2 AC amperes, AC voltage, Watts, Vars, Power Factor, Frequency, Watt Demand, Watt Hours, power quality, harmonics, waveform capture

.3 The digital metering to have an accuracy of 0.5% of the read values.

.4 Communications with central electrical monitoring system

.5 The digital meter to have a membrane type display face suitable for CSA Type 3R and CSA Type 12.

.6 The digital meter to be provided with an addressable communication card capable of transmitting all data, including trip data over a compatible two wire local area network to a central personal computer for storage and/or print out.

.7 Include a centralized monitoring unit, Cutler Hammer “Breaker Interface Module”, or Siemens or Square D equivalent in each switchboard, factory connected to monitor the complete status of each breaker in the switchboard.

.8 Digital meters and monitoring units to be completely programmed and made operational by the Switchgear manufacturer.

2.15 METERS ON FEEDER BREAKERS

.1 Provide metering as follows:

.1 Each feeder breaker to be equipped with a 3 phase true RMS digital meter with local LCD display to indicate phase current for each phase, present and peak

demand, and power consumption as part of the circuit breaker protective relay unit. Metering functions to be completely programmed and made operational by the Switchgear manufacturer.

2.16 EQUIPMENT IDENTIFICATION

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

.2 Engraved, high quality plastic nameplates with black letters suitably inscribed on white background for cubicle and circuit identification to be provided on front and rear sections.

.3 Engraved letters to be 12 mm minimum, except 6 mm minimum height may be provided for meters, relays, switches, signal lights, keys and key blocks, and all other devices.

.4 Circuit identification inscription data will be furnished to the Manufacturer as required.

2.17 SOURCE QUALITY CONTROL

.1 Departmental Representative to witness final factory tests.

.2 Notify Departmental Representative in writing 5 days minimum in advance that switchgear assembly is ready for testing.

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 low voltage switchgear installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Provide low voltage switchboards of type, rating and arrangement as shown.

.2 Assemble all shipping sections and level switchboard on existing floor.

.3 Provide interconnecting, incoming and outgoing cable, bus duct, and control wiring connections as shown and as required.

.4 Terminate all power cables with two hole long barrel compression connectors equal to Burndy YA-2N.

.5 Provide grounding of each switchboard to perimeter ground bus with two separate runs of a #4/O green insulated copper in conduit. Terminate with Burndy YA-2N lugs.

.6 Install 2- #10 AWG in 19 mm conduit between normal and emergency switchboards for control power interconnection, for proper operation of centralized metering system devices.

.7 Touch up small areas marred in transit or during installation with touch up paint. Repaint entire switchboard using electrostatic process where large areas of significant damage to factory finish has occurred.

.8 Provide and install new rubber mats 914 mm wide 6 mm thick 17,000 volt rating, American Biltrite Canada Ltd., in front and rear of Switchboards for a continuous and neat appearance. Do not place mats until work is completed and room has been thoroughly cleaned. Clean or replace any existing mats dirtied or damaged during the installation.

3.3 ON-SITE TESTING

.1 Conduct an acceptance test in presence of and to satisfaction of Departmental Representative, after completion of installation, but before switchboard is permanently put into service.

.2 Test to include operation of breakers manually and electrically, racking in and out, and checking that meters and relays function properly. Correct defects at no additional cost to Departmental Representative. Replace defective equipment immediately with new factory equipment.

.3 In addition to above, include work associated with field testing, cleaning and calibration of relays and trip devices in Bid cost.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by low voltage switchgear installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 09 13.11 - Remote Operation Panel Metering and Switchboard Instruments.

.2 Section 26 32 13.01 - Power Generation Diesel.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)

.2 Canadian Electrical Code, 23rd edition (CEC).

.3 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No. 31-14, Switchgear Assemblies.

.4 Ontario Electrical Safety Code, 25th edition (OESC).

.5 National Electrical Manufacturers Association (NEMA)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for low voltage switchgear and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 All drawing and product data provided for the equipment to show equipment as specified and ordered.

.2 Typical drawings are not acceptable. Reproducible drawings for approval to be supplied.

.3 Physical Construction Drawings, completely dimensioned, showing:

.1 Arrangement.

.2 Plan, front view, and elevation views.

.3 Required clearances for opening doors and for removing breakers.

.4 Conduit or cable trays entrance locations and dimensions for both top and bottom entrance.

.5 Bus bar locations and configurations.

.6 Incoming and outgoing power cable terminator positions.

.7 Field wiring terminal block locations, and all other terminal block locations.

.8 Anchor bolt locations.

.9 Grounding connections.

.10 Weight of equipment.

.4 Three line diagrams, with ANSI device function numbers used throughout, to show all:

.1 Instrument transformers.

.2 Relays

.3 Meters and meter switches.

.4 Other pertinent devices.

.5 Elementary Diagrams

.1 Elementary (schematic) wiring diagrams to be furnished for the electrically-operated breaker control scheme.

.2 Each elementary diagram to show all control devices and device contact, each of which to be labelled with its proper ANSI device function number.

.3 Each elementary diagram to show device and terminal block terminal numbers.

.6 Control Switches

.1 Provide control switch development tables.

.7 Detailed Connection (Wiring) Diagrams showing:

.1 Detailed Connection (Wiring) Diagrams showing:

.2 All wiring within each unit.

.3 All interconnecting wiring between units.

.4 Identification of all terminals, terminal blocks, and wires.

.5 Clear identification, by some distinguishing method, of all interface wiring to remote devices. This to include, but not be limited to, leads from external current transformers, trip circuits from remote devices, auxiliary contacts to remote devices, AC control power, and separate incoming AC power. This to also include spare auxiliary contacts and relay contacts which to be wired to terminal blocks for future use.

.8 Provide one additional set of drawings shipped with the switchgear for maintenance use, installed in a suitable permanent drawing pocket inside one of the control cubicle doors.

.9 Provide nameplates in accordance with "Equipment Identification"; submit nameplate designations for approval.

.10 Submit co-ordination curves for review.

.11 Spare Parts List

.1 Complete spare part list, including parts location diagrams or drawings to be included with the manufacturer's quotation.

.2 List of priced spare parts which manufacturer recommends should be on hand during start-up and the two year's operation.

.12 Material List

.1 A material list to be furnished listing the quantity, rating, type, and manufacturer's catalogue number of all equipment on each unit.

.13 Installation, Operating, and Maintenance Instructions

.1 Installation, operating, and maintenance instructions to cover all the equipment furnished including all protective relays, power fuses, auxiliary relays, etc., and to include characteristic curves of each different protective relay and power fuse.

.4 Approvals and Information

.1 Manufacturer to not commence final fabrication or erection of equipment until receipt of:

.1 Reviewed or "Reviewed as Noted" shop drawings from Departmental Representative.

.2 Manufacturer to supply:

.1 Information to install and test equipment for complete installation.

.2 Shop drawings for review, as specified in "Design and Shop Drawings".

.3 Information for Departmental Representative, as specified in "Instruction Manuals".

.5 Provisions for Handling and Field Erection

.1 Each shipping split of stationary structures to be furnished with removable lifting angles and/or plates suitable for crane hooks or slings.

.2 Each shipping split to also be furnished with removable steel channel base plates which permit using pipe rollers or dollies without damaging the frame will steel of the equipment.

.6 Certificates:

.1 Submit certified factory test results.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for low voltage remote operation panel and components for incorporation into manual.

.3 Provide final updated accurate as-built switchgear wiring diagram.

1.5 EXTRA STOCK MATERIALS

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

1.6 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect low voltage switchgear from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.7 DESCRIPTION OF SYSTEM

.1 Remote Operation Panel to include:

.1 Enclosure (Freestanding Sprinkler Protection) and associated meters, controls and ancillary equipment.

.2 Digital Metering Systems

.3 Mimic Bus Layout

.4 Breaker Control Switches with Pilot Lights

.5 Generator Controllers

.2 Existing Air Circuit Breakers & Switchgear.

.3 Potential Transformers.

.4 Current Transformers.

.5 Metering Software & Server.

Part 2 Products

2.1 MATERIALS

.1 Remote Operation Panel with components: fully CSA certified compatible for use with existing Merlin Guerin motorized breakers switches, Generator controllers, and ancilliary hardware..

2.2 REMOTE OPERATION PANEL

.1 Freestanding NEMA 12 Enclosed Panel consisting of Power meters, breaker control.

.2 Panel will consist of:

.1 3 x breaker control switches to remotely operate MTM breakers on existing switchgear

.2 2 x Main Bus Power Quality Meters

.3 4 x Feeder Power Meters

.4 2 x Controller existing Caterpillar Diesel Generator

.5 1 x Ethernet Switch

2.3 REMOTE OPERATION PANEL ENCLOSURE

.1 NEMA 12 Freestanding Cabinet.

.2 Maximum dimensions: 1830 mm high x 1220 mm wide x 460 mm depth.

.3 Seamless door seal.

.4 Three point latching system.

.5 12ga steel material.

.6 Polyester powder paint finish.

.7 Double front door.

.8 Floor mounted.

.9 Door on Door construction. Inner steel door for component mounting. Outer locked glass door to prevent inadvertent or unauthorized operation.

2.4 CONTROL WIRING

.1 All wiring in accordance with air circuit breaker manufacturer's recommendations.

.2 Used in rail style terminal blocks for all interfaces between internal and field wiring.

.3 In accordance with manufacturer's recommendations.

.4 Short circuit protection: Provide integral short circuit protection for bus line voltage taps.

.1 Install in a suitable location in accordance with CEC and OESC, respecting maximum unprotected cable lengths.

.2 Use combined fusing and disconnect means.

2.5 BREAKER CONTROL SWITCHES

.1 Provide one breaker control switch for each Main-Tie-Main breaker (total three). Installed behind outer glass door to prevent inadvertent operation.

.2 Mount breaker control switches with integral pilot lights on panel doors.

.3 Switches to have integral pilot lights:

.1 Status Light: Red Closed/Green Open

.2 Fault Light: Amber

2.6 POWER METERS

.1 Main bus power quality meters mounted on enclosure doors.

.2 Feeder power meters mounted on enclosure doors.

.3 Meters to be remote display type.

.4 Standard of acceptance:

.1 Main Bus PQ Meters: in accordance with Section 26 09 13.11 - Remote Operation Panel Metering and Switchboard Instruments.

.2 Feeder Power Meters: in accordance with Section 26 09 13.11 - Remote Operation Panel Metering and Switchboard Instruments.

2.7 GENERATOR CONTROLS

.1 Mount main controller display on cabinet front.

.2 Standard of acceptance: refer to Section 26 32 13.01 - Power Generation Diesel.

.3 Complete with all interface conduit wiring and accessories.

2.8 OWER FLOW NAMEPLATE

.1 Provide system outline by way of power flow diagram in lamacoid on front of cabinet or wall mounted close by.

2.9 CIRCUIT BREAKER

.1 Supply & install new CD switches on existing Merlin Gerin Type M breakers for integration of electrical interlocks.

.2 Complete maintenance on all existing emergency switchgear Air Circuit Breakers including the following tests:

.1 Perform full clean.

.2 Check mechanism and lubricate in accordance with manufacturer's guidelines.

.3 Perform Insulation resistance test between phases and across contacts.

.4 Perform Contact Resistance test using DLRO, and ensure results meet manufacturer's guidelines. Notify Departmental Representative if action required.

.5 Remove and inspect Arc Chutes. Inspect contact wear.

.6 Perform relay testing including secondary injection using STR test set. Ensure that all relays are set correctly and within parameters.

2.10 SWITCHGEAR ASSEMBLY

.1 Complete maintenance on existing emergency switchgear including but not limited to the following:

.1 Clean all bus and components.

.2 Perform IR scan to ensure proper torqueing of connections.

.3 Perform full visual inspection for any signs of issues.

.4 Perform Dielectric testing to ensure correct insulation ratings.

2.11 COMMUNICATIONS

.1 Provide Ethernet switch for meters and generator controllers to tie into new server.

.2 Retain the services of VCI Controls (Daniel Laforge: 613-226-6712) and provide network connection for remote monitoring of breaker controls and generator controls to new operator server on ground floor of building 201 as indicated.

2.12 WARRANTY AND SERVICE

.1 The manufacturer warrants the products it supplies for a period of twelve (12) months from the acceptance date.

.2 Warranty Service may be performed by the manufacturer or authorized representative.

Part 3 Execution

3.1 INSTALLATION

.1 Set and secure complete Remote Control Panel in place on 101.6 mm high concrete pad in accordance with manufacturer's recommendations and as indicated.

.2 Make field connections in accordance with the air circuit breaker manufacturer's recommendations. manufacturer's recommendations.

.3 Connect ground bus to building system ground.

.4 Render entire assembly rodent and insect proof by means of plates, and screens and sealing.

3.2 FIELD QUALITY CONTROL

.1 Operate circuit breaker closing and tripping mechanisms, to verify correct functioning.

.2 Check full operation sequence in conjunction with manufacturer and generator controls supplier.

.3 Have factory representative commission final installation and certify proper operation and installation.

3.3 DEMONSTRATION AND TRAINING

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

.2 Demonstrate and train operation of all systems to Departmental Representatives. Allow for a minimum two, 4 hour sessions.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA International

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Include on drawings:

.1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

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

1.4 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry locations and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect panelboards from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 250 and 600 V panelboards: bus and breakers rated for 10000 A (symmetrical) interrupting capacity or as indicated.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Minimum of 2 flush locks for each panel board.

.6 Two keys for each panelboard and key panelboards alike.

.7 Copper bus with neutral of same ampere rating of mains.

.8 Mains: suitable for bolt-on breakers.

.9 Trim with concealed front bolts and hinges.

.10 Trim and door finish: as per colour schedule.

.11 Isolated ground bus.

.12 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.

.13 Panels to be freestanding surface mounted type, as shown.

.14 Panels to be dead front type in code gauge steel enclosure.

.15 Each Panel shall be complete with a typewritten directory which shall be mounted inside door with clear plastic cover.

2.2 BREAKERS

.1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

2.3 CONSTRUCTION FEATURES

.1 Free-standing, rigid, dead front enclosure

.2 Hinged and formed front doors

.3 Completely front accessible with all bolted connections, lugs for cable connections, terminations for control wiring and any other items requiring torquing, infra-red scanning

and maintenance and replacement all visible and accessible from the front, when front trim is removed.

.4 Indoor sprinkler proof construction of non-walk-in type conforming to CSA Enclosure 2.

.5 Door(s) shall be gasketted, with overhanging drip shield, with T-handle 2 point locking system complete with lock and latch, protecting breakers and all other components.

.6 Two channels across bottom of each section to permit rolling, jacking and levelling.

.7 Finish basic rust inhibiting metal process

.8 Panels shall be finished with two coats of grey ASA No. 61.

.9 Panel locks shall be common to one key throughout project.

.10 Ground bus extending through all sections complete with copper lugs for number of incoming and outgoing feeders.

.11 Equipment and total assembly shall be CSA approved.

.12 Warning labels indicating live components from 2 sources where required by Hydro Inspection.

.13 Provision for padlocking in "on" or "off" positions

2.4 EQUIPMENT IDENTIFICATION

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

.2 Nameplate for each panelboard size 4 engraved.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

Part 3 Execution

3.1 EXAMINATION

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

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical.

.3 Connect loads to circuits.

.4 Connect neutral conductors to common neutral bus with respective neutral identified.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by panelboards installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA International

.1 CSA C22.2 No. 5.1, Molded-Case Circuit Breakers, Molded-Case Switches

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Include time-current characteristic curves for breakers with interrupting capacity of 22,000 A symmetrical rms and over at system voltage with ampacity of 200A and over.

.4 Certificates:

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

.1 Production certificate of origin must be submitted to Departmental Representative for approval.

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

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

.4 Production certificate of origin must contain:

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

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

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

.4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.

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

.1 Project title:

.2 End user's reference number:

.3 List of circuit breakers:

1.3 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store circuit breakers indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect circuit breakers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers, Circuit breakers, ground-fault circuit-interrupters, fused circuit breakers, accessory high-fault protectors: to CSA C22.2 No. 5

.2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation.

.3 Plug-in moulded case circuit breakers: quick- make, quick-break type, for manual and automatic operation.

.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 5-10 times current rating.

.6 Circuit breakers with interchangeable trips over 150 A.

.7 Minimum 35,000A symmetrical interrupting rating at 600 volts unless otherwise noted.

.8 Minimum 10,000A symmetrical interrupting rating at 208 volts unless otherwise noted.

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 SOLID STATE TRIP BREAKERS

.1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time and instantaneous tripping for phase ground fault short circuit protection.

2.4 OPTIONAL FEATURES

.1 Include:

.1 On-off locking device.

.2 Handle mechanism.

Part 3 Execution

3.1 EXAMINATION

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

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Install circuit breakers as indicated.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

.1 CSA International

.1 CSA C282-15 - Emergency Electrical Power Supply for Buildings.

.2 Canadian Electrical Code, 23rd edition.

.3 National Board of Fire Underwriters.

.4 Ontario Electrical Safety Code, 25th edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings:

.1 Battery: make, type and capacity.

.2 Generator Control System:

.1 Interfaces.

.2 Wiring diagrams.

.3 Software.

.4 Submit CSA certification of generator control system and battery charger for use with existing generator systems.

1.4 GENERAL REQUIREMENTS

.1 The existing generation system supports life safety systems.

.2 All materials and parts comprising the systems described herein shall be new and unused, a standard product of current manufacture and of the highest grade, free from all defects or imperfections affecting performance. Workmanship shall be of the highest grade, in accordance with modern practice.

.3 The generator controls manufacturer and major component manufacturers shall have established workshops, extensive parts departments and servicemen in region of the building. Furthermore, they shall be prepared and able to sign a service contract, if required.

.4 The Electrical Contractor, and his subcontractors, shall install the generator control equipment at the job site. The installation shall include the provision of all material and labour to provide a complete, functioning generator system meeting all specification requirements. It is the responsibility of the Electrical Contractor to check and test all equipment supplied by the generator controls manufacturer to assure that it is suitable for the installation and meets all specification requirements.

.5 The generator controls manufacturer shall be responsible for the design, fabrication, testing, installation, conducting field tests including the provision of all test apparatus and warranty repairs, all as per CSA C282. The generator controls manufacturer shall certify that all equipment is installed in accordance with their requirements before it is started or components are energized.

.6 All work shall be done in accordance with the rules of the Ontario Electrical Safety Code, Canadian Electrical Code and the National Board of Fire Underwriters insofar as they apply. Conform to CSA C282 - currently enforced edition.

1.5 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for diesel generator for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Include in Operation and Maintenance Manual instructions for particular unit supplied and not general description of units manufactured by supplier and:

- .1 Operation and maintenance instructions for control panel, battery charger, to permit effective operation, maintenance and repair.
- .2 Technical data:
  - .1 Spare parts lists with parts catalogue numbers.
  - .2 Schematic diagram of electrical controls.
  - .3 Maintenance instructions and schedules.

1.6 DELIVERY, STORAGE AND HANDLING

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

1.7 MAINTENANCE MATERIAL SUBMITTALS

.1 Provide maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.

.2 Provide two (2) copies of instruction manuals, in English, to include a step- by-step procedure to perform running tests, maintenance schedules and complete electric schematics and wiring diagrams of all equipment and controls. It shall also include a list of parts used in the control panel and a list of tools. The source of all parts shall be stated.

1.8 WARRANTY

.1 The complete diesel generator control system, including battery charger, shall be guaranteed for a period of twelve (12) months, or 2000 hours of operation, from date of acceptance to be free from defects in workmanship and material.

.2 All repairs made under this guarantee shall be done at no expense, including travel time, shift premiums, overtime and expenses, etc.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 This specification relates to the supply and installation of replacement generator controllers and battery charging systems for two existing generator systems.

.2 In total, two generator controllers and their respective controls, and two battery chargers are to be replaced.

2.2 EXISTING DIESEL ENGINE GENERATORS

.1 Two existing diesel engine generator sets: Caterpillar, 1418 kVA, 1135 kW, 0.08 pf, 600V, 1364 Amps, 3 phase, 6 wire.

2.3 STARTING SYSTEM

.1 The starting battery charger shall automatically maintain batteries in a charged condition be sized to recharge a completely discharged battery to 80% of capacity in 4 hours and to full capacity in not more than 12 hours.

.2 Provide an industrial quality heavy duty 20 amp fully automatic charger with voltmeter, ammeter, output circuit breaker and manual equalize switch all in wall mounted enclosure. Output voltage regulation shall be within +/- 1% for line voltage variation +/- 10%.

.3 The signal to start the engine shall be furnished from relays mounted emergency switchboards which sense undervoltage and/or underfrequency of the normal source from each of the automatic transfer switches. This signal so enables the engine generator set to start and arrive at full speed and be ready to accept load within 10 seconds.

2.4 GENERATOR CONTROLLER

.1 The Generator Controller is to be housed in the existing free standing panel and come complete with:

- .1 AVR, governor etc.
- .2 System metering.
- .3 System controls.

.2 System Controls:

- .1 A control panel of splash-proof construction for 24 volt DC operation shall be provided, prewired and mounted in the new remote operation panel enclosure. This panel shall include the following functionality:
  - .1 Selector Buttons - three positions.
  - .2 A manual stop button connected to stop the engine after a time delay regardless of the mode of operation.
  - .3 Alarm silence button.
  - .4 Alarm reset button.

.5 Alarm test button.

.6 Lube oil pressure monitor.

.7 Fuel oil pressure monitor.

.8 Tachometer and hour meter.

.2 The three position selector buttons are to operate as follows:

.1 Off - stop and lock out the engine, or reset safeties, or both. With this button pressed, a signal (DC operated) shall be initiated in the control switchgear indicating "Diesel Not On Automatic".

.2 Automatic - with this button pushed, the system will accept either an automatic emergency start/stop signal or a remote manual start/stop signal should the system be manually initiated for maintenance exercise.

.3 Run - manually start and run the engine.

.3 Alarms and Shutdown System:

.1 Visual indication and audible alarms shall be provided for the functioning of any of the shutdown alarms listed below:

.1 Overcrank.

.2 Low lube oil pressure.

.3 High engine water temperature.

.4 Overspeed.

.5 Emergency stop.

.2 Visual indication and audible alarms shall be provided for the functioning of any of the safety indicators listed below; terminal points shall also be furnished for connection of each function to a remote fault annunciator:

.1 Engine temperature too low for reliable start.

.2 High engine temperature pre-alarm.

.3 Low fuel.

.4 Control switch not in automatic position.

.5 Low voltage in battery.

.6 Low coolant level.

.7 Generator breaker open.

.4 Modify the existing free standing enclosure to be finished in accordance with Section 26 05 00 - Common Work Results for Electrical, required to suit the new control equipment. Paint colour to match existing. Systems shall be suitable for installation in a sprinklered environment. - required to suit the new control equipment. Paint colour to match existing. Systems shall be suitable for installation in a sprinklered environment.

.5 Each engine is to have its own dedicated cubical.

.6 Mount the related synchronizer, AVR's and governor controls in each engine's respective cubical.

.7 On the front of each engine cubical, provide engine controls, metering and alarm/status annunciation.

.8 Each generator is to have the following meters:

.1 volts, amps (3 phase).

.2 kW/KVA/PF.

.3 Frequency.

.4 KVAR.

.5 Elapsed time meter.

.9 Product supplied shall be fully compatible with and fully CSA certified for use as a controller with the existing generator systems include the use of the generator systems to supply power to emergency life safety systems in accordance with CSA C282.

Part 3 Execution

3.1 INSTALLATION

.1 Locate and install as indicated.

.2 Start generating set and test to ensure correct performance of components.

.3 Install monitoring software on computer workstation as directed by Departmental Representative.

.4 Provide all wiring c/w conduits, support and accessories to have fully functional system.

3.2 SITE TESTS

.1 Perform all testing in accordance with manufacturer's recommendations. Submit procedures a minimum of 15 working days in advance for review and approval.

.2 Manufacturer's representative shall be present for all testing and shall supervise and manage testing.

.3 The Electrical Contractor shall be responsible for receiving, placing and connecting and disconnecting the test load banks.

.4 Provide all fuel oil required for field testing purposes and leave fuel tanks full upon completion.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.2 Remove surplus materials, excess materials, rubbish, tools and equipment.

3.4 DEMONSTRATION AND TRAINING

.1 Provide demonstration and training of system and software to satisfaction of Departmental Representative by Factory certified technician.

.2 Allow for two sessions of up to 4 hours each.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-3.6-2000, Amend. 2, Regular Sulphur Diesel Fuel.

.2 CSA International

.1 CSA C-282, Emergency Electrical Power Supply for Buildings.

.3 International Organization for Standardization (ISO)

.1 ISO 3046-1-2002, Reciprocating Internal Combustion Engines - Performance - Part 1: Declarations of Power, Fuel and Lubricating Oil Consumptions, and Test Methods - Additional requirements for engines for general use.

.4 National Electrical Manufacturers Association (NEMA)

.1 NEMA MG 1-2014, Motors and Generators.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and data sheets for power generators and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings, and include:

.1 Engine: make and model, with performance curves.

.2 Alternator: make and model.

.3 Voltage regulator: make, model and type.

.4 Dimensioned drawing showing complete generating set and container.

.5 Continuous full load output of set at 0.8 PF lagging.

.6 Description of set operation including:

.1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit reaches rated voltage and frequency.

.2 Manual starting.

.3 Automatic shut down and alarm on:

.1 Overcranking.

.2 Overspeed.

.3 High engine temp.

.4 Low lube oil pressure.

.5 Short circuit.

.6 Alternator over voltage.

.7 Lube oil high temperature.

.8 Over temperature on alternator.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Two temporary generating systems consists of complete weatherproof containerized diesel engine generator set, controls monitoring connections, all wiring and power connections, etc.

.2 System designed to operate as emergency standby.

.3 Provide maintenance of system during installation period.

.4 Provide all fuel.

2.2 DIESEL ENGINE

.1 Diesel engine: to ISO 3046-1.

.2 Capacity:

.1 Rated continuous power in kW at rated speed, after adjustment for system losses in auxiliary equipment necessary for engine operation; to be calculated as follows: Rated continuous output = Generator kW divided by Generator efficiency at full load.

.1 Under site conditions typical for Ottawa, Ontario, Canada.

.2 Engine overload capability 110% of continuous output for 1 hour within 12 hours period of continuous operation.

.3 Fuel: to CAN/CGSB-3.6, Type A.

.1 Fuel for minimum 12 hours continuous operation at full load.

.4 Governor: mechanical hydraulic with:

.1 Steady state speed band of plus or minus 0.5%.

.2 Speed regulation no load to full load 5% maximum.

.3 Electronic type, electric actuator, speed droop externally adjustable from isochronous to 5%, temperature compensated with steady state speed maintenance capability of plus or minus 0.25%.

.5 Lubrication system:

.1 Pressure lubricated by engine driven pump.

.2 Lube oil filter: replaceable, full flow type, removable without disconnecting piping.

.3 Lube oil cooler.

.4 Engine sump drain valve.

.5 Oil level dip-stick.

.6 Starting system:

.1 Positive shift, gear engaging starter 12 or 24V dc.

.2 Cranking limiter to provide (3) cranking periods of 10s duration, each separated by 5 s rest.

.3 Sufficient capacity to crank engine for 1 min at 0 degrees C without using more than 25% of ampere hour capacity.

.7 Guards to protect personnel from hot and moving parts.

.1 Locate guards so that normal daily maintenance inspections can be undertaken without their removal.

.8 Drip tray.

2.3 ALTERNATOR

.1 Alternator: to NEMA MG1.

.2 Rating: 3 phase, 600 V, 6 wire, 1135 kW, 60 Hz, at 0.8 PF.

.3 Output at 40 degrees C ambient:

.1 100% full load continuously.

.2 110% full load for 1 hour.

.3 150% full load for 1 minute.

.4 Revolving field, brushless, single bearing.

.5 Drip proof.

.6 Amortisseur windings.

.7 Synchronous type.

.8 Voltage regulator: thyristor controlled rectifiers with phase controlled sensing circuit:

.1 Stability: +\-1% maximum voltage variation at any constant load from no load to full load.

.2 Regulation: 4% maximum voltage deviation between no-load steady state and full-load steady state.

.3 Transient: 25% maximum voltage dip on one-step application of 0.8 PF full load.

.4 Transient: 30% maximum voltage rise on one-step removal of 0.8 PF full load.

.5 Transient: 2.5 s maximum voltage recovery time with application or removal of 0.8 PF full load.

.9 Alternator: capable of sustaining 300% rated current for period not less than 10 s permitting selective tripping of down line protective devices when short circuit occurs.

2.4 CONTROLS

.1 In accordance with CSA C-282.

.2 c/w general trouble/alarm connection to fire alarm panel in building.

.3 c/w connection for remote transfer switch ON/OFF and cool down.

Part 3 Execution

3.1 INSTALLATION

.1 Locate generating units and install as indicated.

.2 Complete wiring and interconnections.

.3 Start generating set and test to ensure correct performance of components.

.4 Prior to final connection perform 4 hour full load test to demonstrate running and load carrying capability. Notify Departmental Representative min. 10 working days in advance.

- .1 Provide fuel for testing and leave full tanks on acceptance.
- .2 Demonstrate load carrying ability, stability of voltage and frequency, and satisfactory performance of dampers in ventilating system to provide adequate engine cooling.
- .3 At end of test run, check battery voltage to demonstrate battery charger has returned battery to fully charged state.

.5 Provide bird, dust and debris screen to protect generators.

.6 Provide construction fencing around generators to limit access to construction and authorized personnel only.

.7 Remove generators and all associated materials upon completion of work to satisfaction of Departmental Representative.

.8 Reconnect existing generator systems and confirm and demonstrate operation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No.190 -14, Capacitors for Power Factor Correction.

.2 EEMAC 6G-1 Shunt Capacitors.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, and limitations.

.3 Submit certified test results to Departmental Representative.

Part 2 Products

2.1 CAPACITORS

.1 Capacitor reactor assembly for power factor correction: to CAN3-C155, EEMAC 6G-1.

.2 Capacitor design with individual switching stages of 50/100/150/200 KVAR, complete with current transformers and potential transformers installed in each half of each main switchboard, and connected to capacitor control unit for automatic switching of capacitor stages to maintain power factor within adjustable pre-set limits of 0.90 to 0.99.

.3 Capacitor characteristics:

.1 250 kVAR, as noted, 1000 V insulation class.

.2 600 V, 3 phase, 60 Hz, 3 wire.

.3 Enclosure: indoor enclosed, NEMA/TYPE 1 (indoor).

.4 Non propagating liquid insulated.

.5 Protective fuses: with blown fuse indicators.

.6 Discharge device: to 50 V in 1 min.

.7 Rack mounted complete with bus, connectors, enclosing plates, screens.

.8 Clamp connector Threaded stud terminal.

.9 200,000 A short circuit capacity.

.4 Capacitors shall be low dissipation factor, computer grade polypropylene with internal pressure sensitive interrupters, suitable for high order harmonics, GE Gemfoil 61L series or equal, and be operated at no more than 90% of their voltage rating and shall be of the non-PCB type.

.5 Capacitors shall be rated minimum 690 V nominal and 200% of nominal current.

.6 Capacitor shall be complete with internal discharge resistor and pressure sensitive fault interrupter switch. Internal resistor shall discharge residual capacitor voltages to 50 volts or less within 1 minute or less of de-energization. Internal pressure sensitive interrupter switch shall disconnect fault capacitor when measurable pressure is detected.

.7 Fuses shall be installed in each phase of each capacitor and shall not exceed 250% of capacitor rated current. Fuses shall be the current limiting type with 200,000 Amp interrupting capacity. Fuses shall be equipped with indicating device to indicate blown fuse condition.

.8 Wiring to capacitors or capacitor banks shall be minimum 150% of capacitor rated current. Contactor rating shall be minimum 150% of capacitor rating.

.9 Contactor control system shall be built into the power factor correction system with fused switch section, control transformer, HOA selector switch and push-to-test pilot light on cover.

.10 Wiring to capacitors shall be minimum of 150% of capacitor rated current.

2.2 FINISH

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install and connect capacitors.

3.3 FIELD QUALITY CONTROL

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

.2 Carry out following tests by manufacturer within 24 hours of energizing equipment:

- .1 Voltage and current are balanced and within capacity rating.
- .2 Operating KVAR.
- .3 Terminal to case resistance is greater than 1000 MΩ for two bushing capacitors.
  - .1 For one bushing capacitor check by measuring discharge time constant.
  - .2 This should be less than 60 seconds and residual capacitor voltage should be reduced from crest value of nominal rated voltage to less than 50 V.

.3 Provide certified test results to Departmental Representative.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA International

.1 CSA C22.2 No.5-13, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

.2 CSA C22.2 No.178.1-14, Automatic Transfer Switches.

.3 CSA C282-15, Emergency Electrical Power Supply for Buildings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for transfer switches and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.1 Indicate on drawings:

.1 Make, model and type.

.2 Single line diagram showing controls and relays.

.3 Description of equipment operation including:

.1 Automatic starting and transfer to standby unit and back to normal power.

.2 Test control.

.3 Manual control.

.4 Automatic shutdown.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for transfer switches for incorporation into manual.

.3 Detailed instructions to permit effective operation, maintenance and repair.

.4 Technical data:

.1 Schematic diagram of components, controls and relays.

.2 Illustrated parts lists with parts catalogue numbers.

.3 Certified copy of factory test results.

1.4 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect transfer switches from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Automatic transfer switches shown connected to continuously energize preferred and alternative sources:

.1 Controls to prevent transfer to the alternative source unless:

.1 The preferred source fails.

.2 Selector switch to allow selection of the preferred source.

.3 Engine start contact is not required.

2.2 MATERIALS

.1 Instrument transformers: to CAN/CSA C60044-1.

.2 Contactors: to NEMA ICS2.

2.3 CONTACTOR TYPE TRANSFER EQUIPMENT

.1 Contact Type Transfer Equipment: to CSA C22.2 No.178.1.

.2 To provide a break before make switching operation in each direction.

.3 Preferred source and alternative source contacts mounted to a common shaft.

.4 Single operator to provide a high speed switching operation with no intentional delay in a neutral position.

.5 Two 3 pole contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked, open type with CSA enclosure solenoid operated.

.6 Rated: 600 V, 60Hz, 225 A, 3-Phase, 4 wire.

.7 Main contacts: silver surfaced, protected by arc disruption means.

.8 Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.

.9 Auxiliary contact: silver plated, to initiate emergency generator start-up on failure of normal power.

.10 Fault withstand rating: 28 kA symmetrical for 3 cycles with maximum peak value of 40 kA.

.11 Lever to operate switch manually when switch is isolated.

.12 Neutral bar, solid

2.4 CONTROLS

.1 Selector switch - 4 position "Test", "Auto", "Manual", "Engine start".

.1 Test position - normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.

.2 Auto position - normal operation of transfer switch on failure of normal power; retransfers on return of normal voltage and shuts down engine.

.3 Manual position - transfer switch may be operated by manual handle but transfer switch will not operate automatically and engine will not start.

.4 Engine start position - engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine.

.2 Solid state electronic in-phase monitor.

.3 In phase monitor:

.1 To operate in both directions,

.2 To inhibit a transfer between live sources until the phase angle between the sources is at the selected angle and is decreasing,

.3 Phase angle transfer initiation point to be adjustable from 5^{o} to $60^{o,}$

.4 Factory set the phase angle at 15^{o} except where indicated otherwise,

.5 Reset the phase angle on site to suit the characteristics of the load,

.6 To permit transfer when both sources are synchronized and in phase,

.7 To permit transfer when one source is not energized.

2.5 ACCESSORIES

.1 A microprocessor-based control panel with field accessible adjustments to such items as voltage pick-up and drop-out and timing controls,

.2 Three phase true RMS over and under voltage sensing of both the preferred and alternative sources with programmable set points,

.3 Over and under frequency sensing of both the preferred and alternative sources with programmable set points,

.4 Time Delays

.1 On preferred source fails, adjustable from .5 to 6 seconds, set at 2 seconds,

.2 On transfer to alternative source, adjustable 0-300 seconds, set as indicated,

.3 On alternative source failure, adjustable from .5 to 6 seconds, set at 6 seconds,

.4 On transfer to preferred source after restoration of preferred source, adjustable 0-30 minutes, set as indicated,

.5 On transfer to preferred source following a test of the alternative source, adjustable 0-30 minutes, set at 30 seconds,

.5 Pilot lights

.1 To indicate transfer switch is in preferred source position,

.2 To indicate transfer switch is in alternative source position,

.3 To indicate preferred source power is available,

.4 To indicate alternative source is available,

.6 Auxiliary Contacts

.1 Contact to close when preferred source fails,

.2 Four on main shaft, closed when on preferred source,

.3 Four on main shaft, closed when on alternative source,

.7 Remote test circuitry

2.6 EQUIPMENT IDENTIFICATION

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

.2 Control panel:

.1 For selector switch and manual switches

.2 For meters, indicating lights, minor controls

2.7 SOURCE QUALITY CONTROL

.1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested in presence of Departmental Representative.

.2 Notify Departmental Representative a minimum of 5 days in advance of the date of the factory test.

.3 Tests:

.1 Operate equipment both mechanically and electrically to ensure proper performance.

.2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.

.3 Check voltage sensing and time delay relay settings.

.4 Check:

.1 Automatic starting and transfer of load on failure of normal power.

.2 Retransfer of load when normal power supply resumed.

.3 Automatic shutdown.

.4 In-phase monitor operation.

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 transfer switches installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Locate, install and connect transfer equipment.

.2 Check solid state monitors and adjust as required to ensure correct operation.

3.3 FIELD QUALITY CONTROL

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

.2 Energize transfer equipment from normal power supply.

.3 Set selector switch in "Test" position to ensure proper transfer, retransfer.

.4 Set selector switch in "Manual" position and check to ensure proper performance.

.5 Set selector switch in "Auto" position and open preferred power supply disconnect. Transfer to Alternate source. Allow to operate for 10 minutes, then close preferred source power supply disconnect. Load should transfer back to preferred power supply and standby should shutdown.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION