GENERAL

1.1 GENERAL

.1 This Section covers items common to Sections of Division 26, 28 and all associated sections. These sections supplement requirements of Division 1.

1.2 CODES AND STANDARDS

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

.2 While not identified and specified by number in these Divisions, comply with CSA Electrical Bulletins in force at time of tender submission. Comply with the requirements of all provincial and local laws, rules, ordinances and codes.

.3 Electrical installation shall be in accordance with current edition of the Canadian Electrical Code, Provincial and other codes, rules and regulations. It is not the intention of the drawings and specifications to reiterate the Code. It is expected that the Contractor will be responsible for access panels, ground fault receptacles, wire sizes and methods, conduit sizes, fire rating of cables, coordination of circuit protection components, fire alarm ancillary devices, exit and emergency lighting requirements, specialty ratings for cable for elevators etc. Notify the Departmental Representative of any detected code deficiencies prior to submission of tender. In the absence of such notifications, it will be assumed that the Contractor has accepted responsibility for a complete code-compliant installation, and no additional compensation will be provided for code-related items.

.4 Supply materials and labour required to meet requirements of codes, rules and regulations, whether or not such work is indicated on the drawings or in specifications.

.5 Where Divisions 26 and 28 specifies better quality of construction (or materials) than minimum code requirements, the more expensive of the two will be provided.

.6 Electrical installation shall be in accordance with the requirements of the electrical supply authority and local inspections authority.

.7 Do underground systems in accordance with CSA C22.3 except where specified otherwise.

1.3 CARE, OPERATION AND START-UP

.1 Instruct operating personnel in the operation, care and maintenance of systems, system equipment and components. Arrange care and instructional sessions to be provided at a time convenient to the Departmental Representative.

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

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

1.4 VOLTAGE RATINGS

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

1.5 PERMITS, FEES AND INSPECTION

.1 Submit to Electrical Inspection Department and Supply Authority necessary number of latest drawings and specifications for examination and approval prior to commencement of work.

.2 Pay all fees for permits and inspections as required for the electrical installation.

.3 Departmental Representative will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost.

.4 Notify Departmental Representative of changes required by Electrical Inspection Department prior to rough-in and making any deviation changes; from originally issued drawings, specifications.

.5 Notify Departmental Representative of any changes on estimated electrical loads; from originally issued and shown on electrical drawings; before rough-in and commencement of construction work.

.6 Furnish Certificates of Acceptance from Electrical Inspection Department on completion of work to Departmental Representative. Include copies of certificate in maintenance manuals.

1.6 MATERIALS AND EQUIPMENT

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

.2 Electrical equipment shall be new and of the type and quality specified.

.3 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department and pay required associated service fee as required..

.4 Provide labour, materials, transportation, equipment and facilities, etc. required for the complete electrical installation as indicated or can be reasonably implied from the drawings and specifications.

.5 Provide factory assembled control panels and component assemblies.

.6 Provide minimum 1500mm (59") clearance and access/working space at all equipment access doors/panels, breakers, switches, transformers, controls, etc. that is rated 1200A or more or rated over 750V and minimum 1000mm (39.4”) clearance in all other areas.

.7 Equipment shall not be located near pipe shafts or fluid piping.

.8 Equipment, conduits and cables shall not restrict or interfere with necessary access space required to safely service mechanical equipment (ventilation fans, filters, etc.) which are existing and/or to be installed under this contract.

1.7 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 volts, related to control systems, are specified in Division 25.

.3 All electrical connections, terminations, power requirements related to electrical work shown on architectural or mechanical drawings are to be included by this Division.

1.8 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into operation and maintenance manuals. Operation and maintenance manuals shall be submitted to Departmental Representative in time to be used in the commissioning of the project.

.2 Include detail of design elements, construction features, components function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

.3 Include technical data, product data; supplement by bulletins, component illustration, exploded views, technical description of items, and parts lists. Advertising or sales literature will not be accepted.

.4 Include wiring, schematic diagrams and performance curves.

.5 Include name and addresses of local suppliers for items included in maintenance manuals.

.6 Maintenance manuals shall be submitted to Departmental Representative for review. Manuals that are incomplete shall be returned to electrical subcontractor for completion. Completed manuals must be submitted, to the satisfaction of the Departmental Representative, before final payment may be considered to be due.

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1.9 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

.1 Submit shop drawings, product data and samples for review by Departmental Representative. Manufacture of equipment must not commence until shop drawings have been reviewed.

.2 Indicate detail construction, dimension, capacities, weights and electrical performance characteristics of equipment or material.

.3 Where applicable, include wiring, single line and schematic diagrams.

.4 Include wiring drawings or diagrams showing interconnection with work of other sections.

.5 Submit samples in accordance with General Conditions. Deliver samples to Departmental Representative's office. Pay all transportation costs to ship samples to Departmental Representative's office including return costs. Approved samples will be retained until after tender closing, then all samples will be returned except for the samples submitted by successful Contractor in tender documents. This sample will be used for comparison with the actual production run of successful manufacturer.

.6 Shop drawing submissions shall include a photocopy of all applicable specification sections showing a complete compliance/non-compliance listing.

.7 Each drawing submission to bare following signed stamp, and include name of project, equipment supplier and clause number equipment is specified under.

CONTRACTORS CERTIFICATION

This drawing has been reviewed by

firm name, person reviewed, contact information.

All dimensions have been checked and found compatible with the contract drawings and all capacities, quantities, sizes and other data contained in the contract documents have been listed by the supplier on this drawing and have been checked by the undersigned and found correct.

Date

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.8 Clearly show division of responsibility. No item, equipment or description of work shall be indicated to be supplied or work to be done `By Others' or `By Purchaser'. Any item, equipment or description of work shown on shop drawings shall form part of the contract, unless specifically noted to the contrary.

.9 Provide field dimensions required by electrical supplier and sub-subcontractors. In cases where fabrication is required prior to field dimensions being available, check all related drawings and obtain clarification from Departmental Representative if necessary.

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.10 All main service power, service entrance equipment, power poles, utility metering facility, compartment, PT's, CT's, associated ancillary devices, mounting structures and location, panels, etc. shall bear the approval stamp of the electric utility prior to submission for Departmental Representative's review.

.11 Division 26 shall check all shop drawings and make necessary changes, prior to submission to the Departmental Representative. They will be reviewed by the Departmental Representative and, if re-submission is required, Division 26 shall ensure that the supplier's drawings have been changed to comply before returning them to the Departmental Representative for another review. If the drawings still do not comply, and require additional review by the Departmental Representative, the Departmental Representative shall be reimbursed by Division 26 for the time required for such additional reviews.

.12 Review of the shop drawings by the Departmental Representative shall not relieve the Contractor from responsibility for errors and omissions therein.

.13 Shop drawings reflecting additional design or change in design shall be reviewed by the Departmental Representative.

.14 Provide shop drawings for all electrical components, including but not limited to wiring devices, lamps, starters, luminaires, etc.

1.10 STRUCTURAL ENGINEERING SERVICES FOR CONCRETE PADS, PILES, BOLLARDS, CABLETRAYS, DUCTBANKS, MANHOLES AND EQUIPMENT PEDESTALS

.1 Electrical Contractor to be responsible to include in base bid costs for contracting, payment of services and management of structural Engineering design services and all structural requirements for structural work to accommodate electrical equipment concrete pads, piles, bollards, etc. design and structures supporting electrical equipment and components such as cable trays, cable struts, panels, pumps, conduits, starters, etc.

.2 Installation to be satisfactory to current Codes and Standards, Authorities Having Jurisdiction, Departmental Representative.

.3 Provide design and stamped documents sealed and signed by a Professional Engineer Registered in the Province of Newfoundland and Labrador. Submit to Departmental Representative and HDK consulting as shop drawings.

.4 Electrical Contractor to include all costs in base bid related to Structural Engineering services for successful design of piles, bollards, concrete bases, ductbanks, manholes, cable trays/Cable Struts/conduit supports, racks and supports ready for installation of equipment and electrical components.

.5 Electrical Contractor to provide shop drawings of equipment to structural engineer containing information regarding weight, dimensions and manufacturer's requirements for installation, such as anchors, gasketing, etc.

1.11 FIELD QUALITY CONTROL

.1 All electrical work to be carried out by qualified licensed electricians or apprentices as per conditions of the Provincial Act respecting manpower vocational training and qualifications. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.

.2 The work of this Division to be carried out by a Contractor who holds a valid Master Electrical Contractor license as issued by the Province that the work is being constructed.

.3 Conduct and pay for all tests as indicated in Section 26 08 01 “Electrical Testing Requirements”.

1.12 FINISHES

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

.1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1-1955.

.2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1-1958.

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

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

1.13 WIRING TERMINATIONS

.1 Lugs, terminals,15kV utility terminations, 15kV Load break EBLOWS, inserts/bushing, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

1.14 MANUFACTURERS AND CSA LABELS

.1 Visible and legible, after equipment is installed.

1.15 WARNING SIGNS

.1 Provide warning signs on equipment, as required, to meet the requirements of the Inspection Authorities and Departmental Representative.

1.16 SINGLE LINE ELECTRICAL DIAGRAMS

.1 Provide single line electrical diagrams under plexiglass in glazed frames as follows:

.1 Electrical distribution system: locate in main electrical room and outdoor switchgear.

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.2 Drawings: 600 x 600 mm minimum size.

1.17 LOCATION OF OUTLETS

.1 Locate outlets as indicated.

.2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm (10'-0"), and information is provided before installation.

.3 Locate light switches on latch side of doors.

.4 Drawings are schematic only, co-ordinate mounting height and location of all equipment with architectural, mechanical and structural drawings prior to installation.

.5 Vertically align outlets of different systems when shown in close proximity to each other and occur at different mounting heights.

1.18 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.Install electrical equipment at following heights unless indicated on electrical drawings, architectural elevations, or instructed otherwise:

- .1 Local switches: 1200 mm.
- .2 Wall receptacles:
  - .1 General: 450 mm.
  - .2 Above top of continuous baseboard heater: 200 mm.
  - .3 Above top of counters: 150 mm.
  - .4 Above top of counter splash backs: 100 mm.
  - .5 In mechanical rooms: 1400 mm.
- .3 Panelboards: 2000 to top.
- .4 Fire alarm strobe/speakers: 2300 mm.

1.19 LOAD BALANCE

.1 Measure phase current to panelboards with normal loads 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 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. Record hour and date on which each load was measured, including voltage at time of test.

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1.20 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete. 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 to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

1.21 CUTTING AND PATCHING

.1 Pay the costs of all cutting and patching required for the installation of electrical work. Payment for cutting and patching shall be made through the GC.

.2 Cutting and patching required for the installation of electrical work shall be done by the particular trade whose work is involved.

.3 Obtain the approval of the Architect and/or Departmental Representative before arranging for any cutting. Patching shall restore the affected area to the original condition; material used for patching shall be compatible with existing condition.

.4 Cutting or patching shall be carried out by the tradesmen of the subcontractor who normally works with materials involved, with the cost being the responsibility of Division 26 or 28 Sub-Contractors.

1.22 CONDUIT, SLEEVES AND HOLES

.1 Make necessary arrangement for cutting of chases, drilling of holes and other structural work required to install electrical conduits, cables, pull boxes and outlet boxes. In existing facilities - Do Not core without Departmental Representative's permission or without x-ray or scanning of floors.

.2 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete to be sized for free passage of conduit.

.3 Flash and weatherproof any penetrations or holes through exterior walls and roof.

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

.5 All sleeves and access conduits shall protrude through the floor 25mm above finished floor surface.

.6 Provide fire-stop all floor and wall penetrations.

.7 Provide approved fire stopping systems and smoke seals for all electrical penetrations at all fire rated walls and floors to maintain the integrity of wall/floor fire rating being penetrated.

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1.23 ACCESS DOORS

.1 Access doors to be a minimum #12 gauge prime coat painted bonderized steel. Each to be complete with a heavy flush frame and anchor, concealed hinges, positive locking screwdriver lock, and mounting and finishing provisions to suit the finish material for which they are supplied. Access doors in fire rated ceilings, walls, partitions, structures, etc. shall be U.L.C. listed and labelled and of a rating to maintain the fire separation integrity.

.2 Where access doors are located in surfaces where special finishes are required, they shall be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the final building surface appearance throughout.

.3 Supply access doors in inaccessible construction to give access to all concealed junction boxes, pull boxes, conductor joints and other similar electrical work, which may require maintenance or repair. Before commencing installation of electrical work, submit to the Architect for approval a list of required access doors showing the exact sizes and locations of such access doors. Locate access doors in walls and partitions to the Architect's approval, and arrange electrical work to suit. Access doors shall be, wherever possible, of a standard size for all applications. Confirm exact dimensions with the Architect, prior to ordering.

.4 Access doors will be installed by the Division responsible for the particular type of construction in which access doors are required. Supply the access doors to the Division installing same at the proper time to avoid construction delays.

1.24 CO-ORDINATION OF PROTECTIVE DEVICES

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

1.25 PROTECTION

.1 Protect exposed live equipment during construction for personnel safety.

.2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage in English.

.3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

1.26 RECORD DOCUMENTS

.1 Submit project documents in accordance with Division 01 - General Conditions.

.2 The Contractor shall keep a set of white prints on the job site at all times on which he shall record all additions or deviations from the contract documents including all changes covered by addenda, change orders, field changes, job conditions, etc. A set of drawings shall be utilized for each system and the contractor shall obtain prints as required. Drawings to include locations of all junction and pull boxes, routing of feeders and conduits, and changes to circuit numbers.

.3 All principle below grade or inaccessible conduits, systems, etc. shall be dimensioned at each change in direction. All conduit routes not shown on original drawing shall be shown including circuit wiring, junction boxes, zoned conduit runs, etc.

.4 Allowance for electronic record documents, refer to Section 01 78 00.

.5 The Contractor shall provide one set of clean marked-up drawings for approval and a final set with changes as may be requested by the Departmental Representative.

.6 If corrections are required after the second Departmental Representative review, due to missing information, the Electrical Subcontractor shall be responsible for the Departmental Representative's time to indicate the required corrective measures and all courier and printing costs.

.7 Departmental Representative will invoice the Contractor for the total cost of mylars, and white prints taken from mylars.

.8 Corrected, revised "Mylars", white prints, electronic files, etc. will be forwarded to the Departmental Representative by the Departmental Representative. Final payment on the contract will not be made until correct mylars, and files are prepared and submitted to the Departmental Representative.

1.27 EQUIVALENT MATERIALS AND EQUIPMENT

.1 Bidder shall submit a tender based on the specified materials and equipment only.

.2 Bidders may submit a tender based on equivalent material and equipment, only if such items have been approved as equal by the Departmental Representative.

.3 Request for equal submissions shall include a photocopy of all applicable specification sections showing a complete compliance/non-compliance listing in the left hand margin. Every clause of the applicable specification section must be individually marked indicating details of how compliance is met or, how the non-compliance items should be considered equal.

.4 Submittal list will be returned by facsimile machine, where number is shown, or may be picked up at the Departmental Representative's office when directed by the Departmental Representative. Where submissions are not returned by the Departmental Representative before tender or forty (40) working hours before close of tender, they are considered not approved.

.5 The approval of equivalent products will be granted on the basis of general design only. Such approvals will not relieve the electrical trade from providing all necessary components and functions required in the specifications or on the drawings.

.6 Clearly show division of responsibility. No item, equipment or description of work shall be indicated to be supplied or work to be done `By Others' or `By Purchaser'. Any item, equipment or description of work shown on shop drawings shall form part of the contract, unless specifically noted to the contrary.

1.28 CO-ORDINATION WITH OTHER TRADES

.1 Refer to architectural, structural and mechanical design drawings and specification for electrical work in connection with other divisions. The most stringent or restrictive requirement of specifications or drawings from any Division shall apply and be included in the tender price. This will be applicable even after the work was installed with the lesser requirement. Provide all required work to the full satisfaction of the Departmental Representative.

.2 Co-ordinate electrical work with work of other trades to avoid conflict with pipes, air ducts and other equipment. Provide additional supports, wiring, etc. to all relocated equipment as required where relocation is necessary to avoid interferences.

1.29 EXAMINATION OF SITE

.1 Prior to submitting a tender, examine site and local conditions, which may affect work. Claims for extra payment resulting from conditions, which may have been foreseen during examination of the site, will not be recognized.

.2 Ensure that all equipment designated as “existing to remain” or “existing to be relocated” is suitable for its intended re-use, including panelboards and circuits. Report any discrepancies to the Departmental Representative before tender close.

1.30 PROCEDURE SCHEDULE

.1 All electrical work shall be coordinated with Departmental Representative and sub-trades involved. Manner and areas of work shall be pre-arranged prior to proceeding.

.2 Procedure schedule will be prepared by the Contractor in conjunction with the Departmental Representative to ensure continuity of work can be maintained with minimal interruption to occupant routine within the existing facilities. Electrical sub-contractor to coordinate his/her proposed schedule with the GC in a manner satisfactory to all parties involved.

1.31 WORKMANSHIP

.1 Install equipment, conduits and cables in a workmanlike manner to present a neat appearance to the satisfaction of the Departmental Representative. Install conduit and cable runs parallel and perpendicular to building lines, in chases, behind furring or above ceilings, where such concealment is possible. In areas where systems are to be exposed, install neatly and group in a tidy appearance.

.2 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement, with adequate clearance and accessibility for same.

.3 Include in the work all requirements shown on the shop drawings or manufacturer's installation instructions.

.4 Replace work unsatisfactory to the Departmental Representative without extra cost.

1.32 SUPERVISION

.1 Supervise the work at all times through a responsible and competent supervisor.

.2 Employ the same supervisor on the project from the start to the finish to ensure continuity of the work.

.3 Employ experienced, qualified journeymen and apprentices.

1.33 CLEANUP

.1 The electrical trade and his/her sub-trades shall at all times during construction, keep the site free of all debris, boxes, packing, etc., resulting from work of this trade.

.2 At the completion of the work, the electrical installation shall be left in a clean, finished condition to the satisfaction of the building Departmental Representative.

1.34 DELIVERY, STORAGE AND HANDLING

.1 Deliver all materials to the site in an orderly fashion.

.2 Store all materials in a clean and dry place, secure from vandalism or theft. All materials to be left in shipping containers until required for use.

.3 Provide additional protection such as tarps, padding, wood skids, etc., where such is required to ensure protection of equipment and as directed by the Architect.

1.35 GUARANTEE/WARRANTY

.1 All unsatisfactory work and any equipment that does not perform satisfactorily within the guarantee period shall immediately be repaired or replaced at no cost to the Departmental Representative, providing such failure is not due to improper usage by the Departmental Representative. The warranty on any replacement equipment or components shall be one year from the date of their installation.

.2 Any equipment that has been placed in use for any reason prior to the beginning of the guarantee period, such as for heating during construction, shall be cleaned and provided with whatever maintenance and repair is required so that its condition is equal to that of new equipment, or it shall be replaced, at no cost to the Departmental Representative.

.3 Equipment that fails as a result of its use prior to the beginning of its one-year guarantee period shall be repaired or replaced at no cost to the Departmental Representative, even after the normal one-year guarantee period has expired.

.4 All details of warranty repairs shall be documented in letters to the Departmental Representative.

.5 No certificate given, payment made, or the use of the equipment by the Departmental Representative, shall be construed as acceptance of defective work or of improper materials.

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.6 This guarantee shall not act as a waiver for products that are warranted by the manufacturer for longer than one year.

1.36 CASH ALLOWANCES

.1 Refer to General Conditions for further requirements under this section.

1.37 PRICING OF CHANGES AFTER TENDER

.1 Within a week of contract award, the Electrical Contractor shall submit an itemized cost breakdown for labour, including an hourly rate for foreman (or journeyman) for all work to be performed on changes of the Contract (PCNS). Refer to General Conditions for further requirements under this section.

1.38 DEFINITIONS

.1 The following are definitions of terms and expressions used in the Specification:

.1 Departmental Representative means:

.2 Inspection Authority means agent of any authority having jurisdiction over construction standards associated with any part of the electrical work on site.

.3 Supply Authority means electrical power utility company responsible for delivery of electrical power to project.

.4 Electrical Code means Canadian Electrical Code or Local Code in force at Project location.

.5 Indicated means as shown on contract drawings or noted in contract documents.

.6 Type Tested means that each piece of equipment produced by manufacturer is not fully tested. An original piece with similar arrangement has been fully tested and results of that test are available.

.7 Provide means to supply, install and leave in working order all materials and necessary wiring, supports, access panels, etc., as necessary for equipment indicated.

PART 2 PRODUCTS

.1 Not used.

PART 3 EXECUTION

.1 Not used.

END OF SECTION

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PART 1 GENERAL

1.1 RELATED WORK

.1 Refer to all sections of the specification for related work.

1.2 COORDINATION

.1 The existing buildings and parking lot shall remain open and remain in normal operation during entire construction period.

.2 Contractor shall allow for off-hours work as required.

.3 Where existing services or systems, such as electrical power, telephone system, data systems, equipment alarm system, fire alarm system, etc. are required to be disrupted and/or shut-down, coordinate the shut-downs with the Departmental Representative and carry out the work at a time and in a manner acceptable to them. Carefully schedule all disruptions and/or shutdowns and ensure the duration of same is kept to the absolute minimum. Submit for approval, a written concise schedule of each disruption at least 120 hours in advance of performing work and obtain written consent prior to implementing.

.4 Should any temporary connections be required to maintain services or systems during work in the existing building, supply and install all necessary material and equipment and provide all labour at no extra cost. Should any existing equipment or system be damaged, make full repairs without extra cost, and to the satisfaction of the Departmental Representative.

.5 Refer to General Requirements and buildings needs for phasing and staging of work and adhere to that schedule. Comply with instructions regarding working hours necessary to maintain the building in operation.

.6 Coordinate complete installation of relocated utility services, if required, with utilities to ensure minimum interruption of service. Coordinate the disconnection and re-connection of the existing electrical circuits in order to keep power interruptions to a minimum.

.7 The drawings indicate major items of equipment to be deleted or relocated but may not indicate every item of equipment or conduit to be deleted or relocated. Contractor shall be responsible for determining which existing equipment is to be deleted or relocated by examining all site conditions and all construction documents.

.8 No drilling in concrete floors shall take place unless the floor has been scanned (or x-rayed) to confirm exactly what is in the floor. The Contractor shall notify the Departmental Representative's Construction Officer before drilling. The Contractor assumes complete responsibility for any and all damages or work stoppages occurring from unforeseen problems. The Departmental Representative does not want any facility disruptions.

1.3 EXISTING DEVICES IN NEW CONSTRUCTION

.1 Disconnect and remove existing electrical equipment made obsolete due to renovations. Remove associated wiring and conduits back to source panel.

.2 Where existing devices (receptacles, switches, etc.) are presently mounted on a wall which will be covered with a new finish, provide an extension ring, coverplate, etc., as required, to mount device to new wall finish.

.3 All existing electrical equipment to remain, which is located in or on portions of existing walls being demolished, shall be relocated to nearest wall. This equipment shall include cabinets, panels, switches, receptacles, etc.

.4 Where existing conduits, which are in use, pass vertically through a wall being demolished, relocate those conduits and conceal in a new wall or surface mount in a service area. Extend conduit, wiring, etc. as required.

.5 Where new ceilings are to be installed, relocate all existing ceiling mounted devices down to new ceiling. This equipment shall include but not be limited to smoke detectors, heat detectors, speakers, luminaires, etc. Extend existing conduit and wiring as required.

.6 All existing junction boxes in walls and ceiling spaces required to maintain existing circuits shall remain accessible.

.7 Include all costs to x-ray existing floors to be drilled or sleeved to ensure no existing services are severed or damaged. Damages could be very serious. Any damages resulting from failure to x-ray (or scan) is the Contractor’s responsibility.

.8 Redundant existing circuit breakers shall be left and labelled as spares.

.9 Field-check all existing fire alarm work on site including existing terminal boxes on each floor before submitting tender. Include all required work and re-work as may be required for a completely finished working system. No compensation will be given to the Contractors for work that should have been foreseen before submitting tenders.

.10 Some new outlets may require shallow boxes to fit into existing walls with shielding. Contractor shall confirm site conditions prior to submitting bid.

1.4 REMEDIAL WORK

.1 It is the Electrical Contractor’s responsibility to ensure that any coring of holes through decks or floor slab’s, will not penetrate existing conduits, cables or mechanical equipment in walls, ceilings or floor slabs. The Contractor, at his cost, is responsible to take all actions required and as may be deemed necessary by the Departmental Representative to correct any damage. No coring shall be undertaken unless permission is given by the building the Departmental Representative’s Construction Officer.

1.5 RELOCATE EXISTING CABLING IN NEW CONSTRUCTION

.1 Include allowance to relocate existing cabling that may exist in ceiling spaces. Allowance includes replacing entire lengths of cables, testing and commissioning.

1.6 SCHEDULE OF WORK

.1 Carefully note and refer to Division 01 Section 01 11 00 Summary of Work for general schedule of work and include for all requirements to conform to it.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Provide all materials required for the complete interface and reconnection installation as herein described and as indicated on the drawings.

.2 New wiring required to interconnect new devices to existing systems shall be provided to suit the manufacturer's requirements and instructions.

.3 Add new grounding materials as required to make existing grounding systems good in renovated areas only. Confirm existing on site.

.4 Add modules, switches, etc., in existing control panels, as required, to extend existing systems to the new or renovated areas only. Confirm existing on site.

.5 Where an existing panelboard requires to be relocated, provide as many junction and/or pull boxes in accessible ceiling space as necessary to properly extend all conductors. Provide permanent compression connections or, appropriate terminal blocks. Provide permanent identification on all related junction and pull boxes.

.6 New system devices, speakers, starters, panelboards, breakers, etc. that are required to be tied into existing systems, quality of new materials to match or exceed existing. Confirm existing on site.

.7 Add modules, switches, etc. in existing control panels, as required, to extend existing systems to new or renovated areas.

.8 It is the intent of these specifications to not re-use any existing wiring.

.9 Provide all controls and communications wiring from building to new switchgear for metering and monitoring.

2.2 LOAD BANK

.1 Supply one load bank 300 kW, 600 V, 3 phases,

.2 Stainless steel, horizontal air output, including:

.1 Heavy Duty Stainless steel base (Frame), 14 gauge;

.2 Nema 3R Housing in Stainless steel, 16 gauge;

.3 Elements cases in Stainless steel, 18 gauge;
.4 Air inlet and outlet with louver and bird screen protection;
.5 Heater and thermostat for the control section;
.6 Power block terminal for conductors;
.7 3 wire connection system;
.8 CSA approved.
.9 Step load
  .1 2X 25KW
  .2 1X50KW
  .3 2X100KW
.10 Nema 1 remote control panel for manual operations.
.11 Mounting stand – 30'' - stainless

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install boxes, conduit and wiring through existing areas as required for the new installation.

.2 Patch and repair walls and ceilings in existing building that have been damaged or cut open due to the new electrical installation.

.3 Patch and make good existing walls which are to remain where existing electrical devices have been removed.

.4 Where new cables or conduits have been installed through existing fire rated walls, seal opening around cables and conduit to maintain fire rating.

.5 Test and confirm all existing grounding systems are effective and in good condition. Include work and materials required to change wiring and make good existing.

.6 Electrical Contractor shall confirm the exact position and mounting height of each outlet prior to commencement of work. Special efforts are required to coordinate outlets, conduit routes, etc. with architectural, mechanical and other related work.

3.2 LOAD BANK INSTALLATION

.1 Install load bank as per manufacturer guidelines and recommendations.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

.1 CSA Group (CSA)

.1 CSA-C22.2 No. 131-07, Type TECK 90 Cable.

.2 CAN/CSA-C61089-2003, Round Wire Concentric Lay Overhead Electrical Stranded Conductors.

.2 National Electrical Manufacturers' Association (NEMA)/Insulated Cable Engineers Association (ICEA)

.1 ICEA S-93-639/NEMA WC74-06, 5-46 KV Shielded Power Cable for Use in the Transmission and Distribution of Electrical Energy.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

.1 Provide manufacturer's printed product literature, specifications, data sheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 RUBBER INSULATED CABLES (1001 - 15000 V)

.1 Conductors: copper, Type and size as indicated on drawings.

.2 Multi conductor, stranded copper,

.3 Uninsulated class B Stranded Grounding Conductor

.4 Insulation: cross-linked polyethylene compound rated RW90.

.5 XLPE Insulated, color code 4/c Red, Black, Blue, White.

.6 Insulation Shielding: Semi-conducting non-metallic tape over insulation, and served wire shield over tape.

.7 Cable Jacket: thermosetting with separator tape between shield and jacket.

2.2 TECK POWER CABLE (1001 - 15000 V)

.1 Cable: to CSA-C22.2 No. 131 in accordance with Section 26 05 00 - Common Work Results for Electrical

.2 Bare copper grounding conductor, size as indicated.

.3 Aluminum circuit conductors, size and number as indicated.

.4 Strand shielding.

.5 Insulation: chemically cross-linked thermosetting polyethylene rated RW90 to ICEA S-93-639/NEMA WC74.

.6 XLPE INSULATED COLOR CODE 4/C, Red, Black, Blue, White.

.7 Insulation shielding: semi-conducting non-metallic tape over insulation and served wire shield over tape to ICEA S-93-639/NEMA WC74.

.8 Separator tape over conductor assembly.

.9 Inner jacket of PVC.

.10 Interlocked steel armour.

.11 Overall PVC jacket rated minus 40 degrees C.

.12 15KV Matching Load Break Elbows, Bushing Insert and compressed lugs for15KV load interrupter metal enclosed switchgear and 15KV Transformer primary cables connection. CSA approved, per Newfoundland Hydro cable termination, Manufacturer recommendation and local authority having jurisdiction.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install power cable in concrete encased duct banks and manholes as indicated and in accordance with manufacturer's instructions and local authority having jurisdiction. Trenching and backfilling to property line; including providing concrete encase duct banks for all New and Modified Under Ground power feeder cables.

.2 Contractor is required to coordinate with Newfoundland Hydro Service provider for inspection of all new and modified Under Ground Power cables runs; before backfilling of underground cables and pay all associated service fee as required for material, Labor and for any instigated equipment rental as required.

.3 Install power cable in trenches as indicated.

.4 Provide supports and accessories for installation of high voltage power cable.

.5 Install stress cones, terminations and splices in accordance with manufacturer's instructions.

.6 Install grounding in accordance with local inspection authority having jurisdiction.

.7 Provide cable identification tags and identify each phase conductor of power cable.

.8 Elbow fitting and conduits for LV interior building power cable runs.

.9 Power cable transition 200A, 347/600V, 3phase,4w splitter box, sprinkler proof/drip hoods, Min IC=50KA, CSA approved.

3.2 FIELD QUALITY CONTROL

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

.2 Use of qualified tradespersons for installation, splicing, termination and testing of high voltage power cables.

.3 Engage an independent testing agent to test high voltage power cable. Submit test result and inspection certificate.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

.1 Refer to all Sections of the specification for related work.

1.2 REFERENCES

.1 CSA C22.2 No. 0.3 Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No. 131.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 00 Common Work Results - Electrical.

1.4 FIRE RATING

.1 Fire ratings shown are minimum required. Provide cable of fire rating as required by authority having jurisdiction.

.2 Fire rate entire cable support system. This shall include but not be limited to cable racks, support rods, anchors, etc.

PART 2 PRODUCTS

2.1 CABLE IDENTIFICATION

.1 Cables to be identified with wire markers.

.2 Machine printed self laminating label type.

.3 Thermal transfer type with printable area and translucent vinyl film.

2.2 BUILDING WIRES

.1 Conductors in conduit:

- .1 Type: RW90, RWU90
- .2 Conductors for panel and branch circuits:
  - .1 Solid copper #10 AWG and smaller
  - .2 Stranded copper #8 AWG and larger.
  - .3 Sized as required (minimum #12 AWG).

.3 Insulation:
.1 Cross link polyethylene (XLPE), 90°C.
.4 Configuration:
.1 Single conductor.
.5 Voltage Rating: 1000V.
.6 Certification:
.1 CSA C22.22 No. 38 or latest revision.

2.3 ARMOURED CABLE

.1 Type: AC90 (BX).

.2 Conductors:
.1 Solid copper #10 AWG and smaller.
.2 Stranded copper #8 AWG and larger.
.3 Sized as required (minimum #12 AWG).

.3 Insulation:
.1 Cross link polyethylene (XLPE), 90°C.

.4 Configuration:
.1 Multi-conductor, as required, complete with a separate bare CU ground wire.

.5 Voltage Rating: 600V.

.6 Armour: Bare inter-locked aluminum.

.7 Certification:
.1 CSA C22.22 No. 51 or latest revision.

2.4 ARMOURED CABLE (TECK)

.1 Type: TECK 90

.2 Conductors for panel and branch circuits:
.1 Solid copper #10 AWG and smaller.
.2 Stranded copper #8 AWG and larger.
.3 Sized as required (minimum #12 AWG).

.3 Insulation:
.1 Cross link polyethylene (XLPE), 90°C.

.4 Configuration:

.1 Single or multi-conductor, as required.

.5 Colour Code:

.1 Black, red, blue and white in 4/C cable. Cables of more than 4/C to be number coded.

.6 Voltage Rating: 1000V.

.7 Inner Jacket:

.1 Black polyvinyl chloride (PVC).

.2 Low flame spread (LFS).

.3 Low gas emission (LGE).

.8 Armour:

.1 Inter-locked aluminum.

.9 Outer Jacket:

.1 Black polyvinyl chloride (PVC), -40°C.

.2 Low flame spread (LFS).

.3 Low gas emission (LGE).

.10 Fire Rating: FT4, AG14.

.11 Certification:

.1 CSA C22.22 No. 131 or latest revision.

2.5 ALUMINUM SHEATHED CABLE

.1 Type: RA-90 (Corflex)

.2 Conductors:

.1 Solid copper #10 AWG and smaller.

.2 Stranded copper #8 AWG and larger.

.3 Sized as required (minimum #12 AWG).

.3 Insulation:

.1 Cross link polyethylene (XLPE), 90°C. (194°F).

.4 Configuration:

.1 Single or multi-conductor as required.

.5 Voltage Rating: 600V.

.6 Aluminum Sheath:

.1 Liquid and vapour tight solid corrugation.

.7 Outer Jacket:

.1 Polyvinyl chloride (PVC), -40°C (-40°F).

.2 Low flame spread (LFS).

.3 Low gas emission (LGE).

.8 Fire Rating: FT4, AG14.

.9 Certification:

.1 CSA C22.22 No. 123 or latest revision.

2.6 ELECTRONIC CABLES

.1 Conductors:

.1 #18 AWG - STC solid copper.

.2 Insulation:

.1 Polyvinyl chloride (PVC).

.3 Configuration:

.1 Twisted pairs (number as required).

.4 Shielding:

.1 Copper braid.

.5 Voltage Rating: 300V.

.6 Certification:

.1 CSA.

2.7 FIRE ALARM CABLES

.1 Conductor:

.1 Solid copper minimum #18 AWG.

.2 Minimum #12 AWG for signaling circuits, in accordance with Manufacturer's recommendations.

.2 Insulation:

.1 105°C. (221°F) flame retardant PVC.

.3 Configuration:

.1 Multi-conductor (minimum 4 conductors per cable).

.4 Voltage Rating: 300V.

.5 Conductor Identification:

.1 Colour coded.

.6 Shielding:

.1 Aluminum mylar foil.

.7 Outer Jacket:

.1 105°C. (221°F) red PVC jacket.

.8 Certification:

.1 CSA Class #5851-01 File #LR41741.

.2 UL subject 1424 File #E-83163.

2.8 LOW VOLTAGE CONTROL CABLES

.1 Type: LVT.

.2 Conductors:

.1 Solid copper #18 AWG.

.3 Insulation:

.1 Thermoplastic, colour coded.

.4 Configuration:

.1 Single, two conductors – parallel.

.2 Three or more conductors – twisted.

.5 Voltage Rating: 30V.

.6 Outer Jacket:

.1 Thermoplastic.

.7 Certification:

.1 CSA C22.22 No. 35.

2.9 INSTRUMENTATION CABLES

.1 Type: Instrumentation cable.

.2 Conductors:

.1 7-wire, concentric lay, Class B tinned copper, #18 or #14 AWG as required.

.3 Voltage Rating: 300V or 600V as required.

.4 Insulation:

.1 Fire retardant - cross link polyethylene (XLPE), 90ºC.

.5 Configuration:

.1 Single or multi pairs or triads, as required.

.6 Shielding:

.1 Aluminum/mylar shield with drain wire for each pair triad.

.2 Overall aluminum/mylar shield with drain wire.

.7 Drain Wires:
- .1 7-wire, concentric lay, Class B tinned copper.
- .2 Individual shields to be one size smaller than conductor size.
- .3 Overall shields to be the same as conductor size.

.8 Colour Codes:
- .1 300V Pairs:
  - .1 black, white and number code.
- .2 300V Triads:
  - .1 black, white and number code.
- .3 600V Pairs:
  - .1 black, red and number code.
- .4 600V Triads:
  - .1 black, red, yellow and number code.

.9 Armour:
- .1 Inter-locked aluminum.

.10 Outer Jacket:
- .1 Grey polyvinyl chloride (PVC).
- .2 Low flame spread (LFS).
- .3 Low gas emission (LGE).

.11 Fire Rating: FT4.

.12 Certification:
- .1 CSA C21.1 or latest revision.
- .2 CSA C22.2 No. 174 or latest revision.

2.10 MEDIUM VOLTAGE

.1 Type: 15 kV rated 133% insulation and shielded multi conductors.

.2 Conductors: #1/0 AWG, 19 wires compressed Class B strand bare copper.

.3 Voltage rating: 15 kV.

.4 Conductor shield: Extruded semi-conducting thermoset polymer.

.5 Insulation: Extruded tree retardant crosslinked polyethylene.

.6 Insulation shield: Extruded semi-conducting thermoset polymer.

.7 26 x #14 AWG bare copper concentric neutral wires helically applied.

.8 Outer jacket: extruded PVC -40°C.

.9 Refer to single line distribution drawing.

.10 Cable shall be as manufactured by General Cable or approved equal.

2.11 CONNECTORS

.1 Pressure type connectors, fixture type splicing connectors, cable clamps and lugs, as required.

.2 15KV Matching Load Break Elbows and Bushing Insert for15KV load break switchgear and Transformer 15kVprimary cables connection. CSA approved, per Newfoundland Hydro cable termination requirement and local authority having jurisdiction.

.3 Refer to Section 26 05 21 Wire and Box Connectors and 26 05 22 Connectors and Terminations.

PART 3 EXECUTION

3.1 CABLE INSTALLATION & WORKMANSHIP

.1 Install cables for feeders or branch circuits in raceways, cable trays, wireways or trenches as required.

.2 Prevent over-heating by induction in accordance with rule 12-3024(7) and 12-3024(8) and Appendix B Canadian Electric Code, Part 1 where single conductor cables connect to boxes and cabinets.

.3 Install sleeves where cables pass through poured concrete or masonry.

.4 Provide mechanical protection for cables where cables are turned up above the floor through sleeves or slots. Provide channels, angle sills or rigid conduit sleeves which protrude at least 150 mm above the finished floor.

.5 Where cables are grouped and not run in tray, support on channels.

.6 Run cables parallel to the lines of the building.

.7 Bends to be concentric.

.8 Seal cables which penetrate air barrier and vapour boxes to barrier and boxes.

3.2 PHASE BALANCING

.1 Connect single phase equipment to minimize imbalance on feeders. Adjust branch circuiting for optimum balancing.

.2 Record all changes on “as-built” drawings.

.3 Phase rotation to match existing

3.3 MINIMUM CABLE SIZE

.1 Minimum wire size to be #12 gauge throughout except where indicated otherwise.

.2 Be responsible for providing the minimum wire size to meet the code where the wire size shown on the drawing is inadequate to serve the load.

.3 Minimum size of panelboard and motor feeders is to be in accordance with CEC.

3.4 VOLTAGE DROP

.1 Size wiring for branch circuits to achieve a maximum 3% voltage drop.

.2 Base on distance from overcurrent device to furthest wiring device/load.

.3 Provide cable size for entire length of circuit.

.4 Submit voltage drop calculations when requested.

3.5 NEUTRAL CONDUCTORS

.1 Reduced neutrals not permitted.

.2 Provide separate neutrals for all dimmers, laser printers or as otherwise indicated.

3.6 GROUND CONDUCTORS

.1 Provide a green insulated ground conductor equal in size to current carrying conductors within all raceways.

3.7 FIRE SEPARATIONS

.1 Submit drawings showing proposed method of sealing fire separations.

3.8 INSTALLATION OF BUILDING WIRES

.1 Install wiring in conduit system in accordance with Section 26 05 34 Conduits, Conduit Fastenings and Conduit Fittings.

.2 Ensure conduits are dry and free of debris before pulling cables.

.3 Provide colour coding and identification as per this Section.

.4 Wires in outlet, junction and switch boxes, not having a connection within the box shall not be spliced, but shall continue unbroken through the box.

3.9 INSTALLATION OF ARMOURED CABLES (BX)

.1 Group cables wherever possible.

.2 Terminate cables in accordance with Section 26 05 21 - Wire and Box Connectors.

.3 Type AC90 armoured cable (Bx) with screw type connectors shall be used for connections from conduit systems to luminaires in accessible ceilings only.

.4 Type Bx cable shall not be used for any other application.

.5 Maximum length of AC90 armoured cable for connections to luminaires mounted in stud partitions shall be 1.5 metres. Cable drops for luminaires in accessible ceilings shall be of sufficient length to allow the luminaire to be relocated to any location within a 3m radius.

.6 Cable shall be clamped before entering the lighting fixture and shall be clipped before entering the conduit system junction box.

3.10 INSTALLATION OF ARMOURED CABLES (TECK)

.1 Group cables wherever possible on channels, spaced one (1) cable diameter apart.

.2 Do not splice cables.

.3 Terminate cables in accordance with Section 26 05 21 - Wire and Box Connectors. Terminate cables using non-magnetic connectors. Cable armour shall be grounded via an aluminum plate at the supply end and isolated via an insulating plate at the load end of the cable.

.4 Cable bending radius shall be at least twelve (12) times the overall cable diameter and bend shall not damage or distort the outer sheath.

.5 Do not install PVC jacketed cables in circulating air plenums.

3.11 INSTALLATION OF ALUMINUM SHEATHED CABLES

.1 Group cables wherever possible.

.2 Terminate cables in accordance with Section 26 05 21 - Wire and Box Connectors.

.3 Do not use aluminum sheathed cable in cast concrete or masonry construction.

3.12 INSTALLATION OF LOW VOLTAGE CONTROL CABLES

.1 Install low voltage control cables in conduit.

.2 Ground control cable shield.

3.13 INSTALLATION OF INSTRUMENTATION CABLES

.1 Install instrumentation cables in conduit.

.2 Ground cable shield.

3.14 INSTALLATION OF MEDIUM VOLTAGE CABLES

.1 Refer to primary cable detail on drawings for installation method.

.2 Do not splice cables.

.3 Provide 3M cold shrink stress relief termination kit.

.4 Cable bending radius shall be as per manufactures recommendations.

3.15 INSTALLATION IN EQUIPMENT

.1 Group and lace-in neatly, wire and cable installed in switchboards, panel boards, cabinets, wireways and other such enclosures.

3.16 TERMINATIONS

.1 Terminate wires and cables with appropriate connectors in an approved manner.

3.17 IDENTIFICATION

.1 Provide cable identification on all cables.

.2 Wire in conduit #2 AWG and smaller shall have solid coloured insulation, colour coded as listed below.

.3 Wire in conduit #1/0 AWG and larger and single conductor cables shall be identified at each outlet box and termination with a 150mm band of coloured vinyl tape of the appropriate colour. Neutral and ground conductors shall be identified. Paint or other means of colouring the insulation shall not be used.

.4 Colour code wire in conduit and single conductor cables as follows unless otherwise shown on the drawings:

Three Phase Systems:			Single Phase Systems:		
Phase A	-	red	Phase A	-	red
Phase B	-	black	Phase B	-	black
Phase C	-	blue	Neutral	-	white
Neutral	-	white	Ground	-	green
Ground	-	green			

.5 Maintain phase sequence and colour coding throughout project.

.6 Phasing to match existing buildings phasing as approved by Departmental Representative.

.7 Use colour-coded wires in communication cables, matched throughout the system.

.8 Identify control conductors in motor control equipment, contactors, fire alarm panels, etc. with mylar/cloth wire markers.

.9 Identification text to include panel name, wire number and wire type (A, B, C, N or G). Identification to be independent of circuit numbers to allow phase balancing.

.10 Provide identification on cables at:

.1 Inside distributions/panelboards.

.2 Inside device boxes or at terminations.

.3 Wide junction boxes where joints are made.

.11 Distribution feeders to be identified as follows:

.1 Color code of feeder phase shall appear on every cable in two locations at any distribution; once inside the distribution enclosure near the cable termination and once outside the distribution enclosure, in a visible location near the enclosure.

.12 Color code all feeders at all terminations, at all points where taps are made, and at all panelboards, switchboards, motor control centres, etc., by means of colored insulation or markers. Use markers of a type not subject to aging or deterioration through heating, drying or easy erasure. Color code in accordance with Rule 4-036 of the CEC. Phasing to be ABC, left, centre, right respectively.

.13 Demonstrate to the Departmental Representative that each wire has been clearly identified with wire markers where requested.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

.1 Refer to all sections of the specifications for related work.

1.2 REFERENCES

.1 CSA C22.2 No. 65 Wire Connectors.

.2 CSA C22.2 No. 0.3 Test Methods for Electrical Wires and Cables.

.3 CSA C22.2 No. 131 Type Teck 90 Cable.

PART 2 PRODUCTS

2.1 WIRE CONNECTORS

.1 Copper long barrel compression connectors sized for conductors. Use two-hole long barrel compression connectors for feeder conductors.

.2 Solderless, self-insulated connectors for hand twist wire joints for lighting, small power, and associated control devices, with nylon insulator. Standard of acceptance: Thomas & Betts Marette Type II Winged or Ideal Cantwist.

.3 Solderless, self-insulated connectors for hand twist wire joints for solid to stranded connections (e.g. heater thermostats), nylon insulator. Standard of acceptance: Thomas & Betts Marette ACS.

.4 Terminate conductors #8 AWG and larger with Thomas & Betts Color-Keyed compression connectors 54000 Series, or on lugs provided with equipment. Use Thomas & Betts "KOPR-SHIELD" compound Series CP8-TB on all terminations for compression connectors.

2.2 CABLE CONNECTORS

.1 Provide rain-tight connector fittings, complete with O-rings, for use on surface mounted weatherproof or sprinkler-proof enclosures. Side entrances to enclosures are preferred however when top entries are necessary rain-tight connectors must be used for all panels, contactors, motor control centres, etc.

2.3 RAIN-TITE COUPLINGS

.1 Rain-tight couplings shall be used for surface mounted conduits exposed to moisture or sprinkler heads.

PART 3 EXECUTION

3.1 CABLE INSTALLATION

.1 Install cables for feeders or branch circuits in raceways, cable trays, wireways or trenches.

.2 Prevent over-heating by induction in accordance with rule 12-3024(7) and 12-3024(8) and Appendix B Canadian Electric Code, Part 1 where single conductor cables connect to boxes and cabinets.

.3 Provide mechanical protection for cables where cables are turned up above the floor through sleeves or slots. Provide channels, angle sills or rigid conduit sleeves which protrude at least 150 mm above the finished floor.

.4 Support on channels where cables are grouped and not run in tray.

.5 Run cables parallel to the lines of the building.

.6 Bends to be concentric.

.7 Seal cables which penetrate air barrier and vapour boxes to barrier and boxes.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

.1 Refer to all sections of the specification for related work.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 00 Common Work Results - Electrical.

PART 2 PRODUCTS

2.1 CONNECTORS AND TERMINATIONS

.1 Copper, long barrel or short barrel compression connectors as required, sized for conductors.

.2 Provide compression lugs for feeder cables. Set screw connectors not allowed.

.3 15KV Load Break ELBOWS, Bushing Insert and Compressed Lugs for 15KV Load Interruptor Metal Enclosed Switchgear and 15KV Primary Padmount Transformer, Dead Front

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install terminations and splices in accordance with manufacturer's instructions.

.2 Bond and ground as required.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

.1 Refer to all sections of the specification for related work.

1.2 REFERENCES

.1 Latest issue of C22.1 as amended by Provincial Requirements or Inspection Authorities, specifically Section 10 – Grounding.

.2 ANSI/IEEE837 – Qualifying Permanent Connections Used in Substation Grounding.

1.3 STATION GROUND

.1 Establish a station ground at the new pad-mounted switchgear & transformer location consisting of four ground electrodes installed a minimum of 3m apart.

.2 All ground electrodes shall be connected together with a common #3/0 copper ground wire. Two ground wires are required to each new main distribution.

.3 Provide inspection cans at all ground rods.

PART 2 PRODUCTS

2.1 ELECTRODES

.1 Ground rods: copper clad steel, minimum 3m long, 19mm diameter.

2.2 INSPECTION CANS

.1 Refer to drawings.

2.3 GROUND CONDUCTORS

.1 Bare, stranded, un-tinned, soft annealed wire, sized as per the Canadian Electrical Code. Minimum size to be #4/0.

.2 Refer to Table 17, Canadian Electrical Code.

PART 3 EXECUTION

3.1 INSTALLATION – GENERAL

.1 Make buried connections using copper welding by thermit process.

3.2 GROUND RESISTANCE TESTING

.1 Measure ground resistance using fall of potential method (4 point method) before installation of ground rods and advise Departmental Representative of readings.

.2 Measure ground resistance after installation of station ground using clamp on meter and advise Departmental Representative. Perform measurements in accordance with meter manufacturer's requirements (i.e. supply disconnected, etc.).

3.3 WORKMANSHIP

.1 Ensure that all components make good contact at connections to form a continuous metallic ground through the system. Torque bolts in accordance with manufacturer's recommendations.

.2 Ensure that contact surfaces are free of grease, oil, paint, primer and similar surface coverings. Clean all conductor contact surfaces thoroughly before installation by scratch brushing until bright and shiny.

.3 For welding type connections, follow manufacturer's instructions.

.4 Size conductors in accordance with code requirements if size is not specifically shown.

3.4 FIELD QUALITY CONTROL

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

.2 Separately test the resistance to ground of each ground rod of the station ground. Drive ground rods deeper to get an acceptable reading or provided additional ground rods if readings are not acceptable.

.3 Ground rod resistance levels shall be in accordance with requirements of the local authority having jurisdiction.

.4 A report shall be submitted to the Departmental Representative from the Testing Agency indicating the soil conditions at the time of the test, the measuring equipment used for the test and the actual resistance value to ground measured during the test.

.5 Perform tests before energizing electrical system.

.6 Copy of report to be included in the maintenance manuals.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

.1 Refer to all Sections of the specification for related work.

1.2 SECTION INCLUDES

.1 Provision of low voltage and extra low voltage grounding/bonding system for the facility.

.2 Includes but is not limited to grounding/bonding for:

- .1 Electrical service.
- .2 Transformer neutral.
- .3 Water/gas/sewer pipe grounding.
- .4 Equipment.
- .5 Lightning protection system.

1.3 REFERENCES

.1 Canadian Standards Association:

- .1 CAN/CSA C22.2 No. 41 Grounding and Bonding Equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

.1 Acceptable manufacturers:

- .1 Recognized within industry meeting all quality controls and Canadian certifications.

2.2 EQUIPMENT

.1 Ground equipment: to CAN/CSA C22.2 No. 41

.2 Clamps for grounding of conductor: size as required to electrically bond to underground water piping.

.3 Grounding conductor system, circuit and equipment, grounding to be bare standard copper, sized in accordance with the Canadian Electrical Code.

.4 Ground bus: copper; minimum 300mm long, 25mm high and 6mm thick with pre drilled holes, complete with appropriate insulated supports sized to suit, fastenings, connectors.

.5 Compression fittings to ground conductors to existing electrical system grounding.

.6 Insulated grounding conductors: green, insulated.

□

2.3 ACCESSORIES

.1 Non-corroding, necessary for complete grounding system, type, size, material as required, including:

- .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

.2 Copper alloy castings with silicon bronze bolts, nuts and washers for connecting pipe, tube, cable, flat bar and special bus shapes.

.3 Wire connectors and terminations: to Section 26 05 22 – Connectors and Terminations.

PART 3 EXECUTION

3.1 INSTALLATION GENERAL

.1 Ensure that all components make good contact at connections to form a continuous metallic ground through the system. Torque bolts in accordance with manufacturer’s recommendations.

.2 Ensure that contact surfaces are free of grease, oil, paint, primer and similar surface coverings. Clean all conductor contact surfaces thoroughly before installation by scratch brushing until bright and shiny.

.3 Install complete permanent, continuous system and circuit grounding systems including electrodes, conductors, connectors and accessories to conform to requirements of local authority having jurisdiction over installation. Where EMT is used, run ground wire in conduit.

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

.5 For welding type connections, follow manufacturer’s instructions.

.6 Protect exposed grounding conductors from mechanical injury.

.7 Make buried connections and connections to conductive water main and electrodes using copper welding by thermit process or permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837 as required.

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

.9 Soldered joints not permitted.

.10 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.

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

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

.13 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end as necessary and run separate ground conductor.

3.2 PIPING SYSTEMS

.1 Provide a #6 ground to service entrances of all electrically conductive piping systems in the building. Connect on street side of meters.

.2 These are to include, but not be limited to:

- .1 Domestic water system.
- .2 Building heating and cooling systems.
- .3 Gas system.

.3 Install meter ground shunts.

.4 Utilize permanent mechanical connectors or wrought copper compression connectors to connect to pipe. Connectors are to be inspectable.

.5 Interconnect the grounding system with the main building ground.

3.3 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of low voltage system(s).

.2 In addition to grounding achieved through conduit grounds and cable ground wires, provide a #1/0 ground conductor from each derived ground back to the main electrical room ground bus. Route to be identical to route used for main feeder.

.3 Where not specified otherwise, size of bonding and grounding conductors to be in accordance with Tables 16 and 17 of the Canadian Electrical Code.

3.4 EQUIPMENT GROUNDING

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

3.5 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall of the main electrical room.

.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size #1/0 AWG.

3.6 COMMUNICATION SYSTEMS

.1 Refer to existing building standards for requirements.

3.7 FIELD QUALITY CONTROL

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

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation. Record readings and place copy in maintenance manual.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

3.8 GROUND RESISTANCE TESTING

.1 Provide ground resistance testing as required by the Departmental Representative.

END OF SECTION

□

PART 1 GENERAL

1.1 RELATED WORK

.1 Refer to all Sections of the specification for related work.

PART 2 PRODUCTS

2.1 SUPPORT CHANNELS

.1 U shape, galvanized steel, size 41mm x 41 mm, 2.5mm thick, surface mounted, suspended or set in poured concrete walls and ceilings as required.

.2 Acceptable manufacturers: Burndy, Electrovert, Unistrut, Pilgrim, Pursley.

.3 Support equipment to be of type and size required to withstand the fire rating where used (rack hangers, rods, anchors).

PART 3 EXECUTION

3.1 INSTALLATION

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

.2 Secure equipment to poured concrete with cast in or expandable inserts.

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

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

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

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

- .1 One-hole steel straps to secure surface conduits and cables 32mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 32mm.
- .3 Beam clamps to secure conduit to exposed steel work.

□

.7 Suspended support systems.

.1 Support individual cable or conduit runs with 6mm diameter threaded rods and spring clips.

.2 Support two or more cables or conduits on channels supported by 10mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use U-channels at 1500mm on centre spacing.

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

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

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

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

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

.14 Provide a separate fire rated system of supports where required (e.g. mineral insulated cables).

.15 Install continuous vertical channel supports for conduits in utility service rooms and mechanical room.

.16 Where conduit and cable runs are installed on support systems, they shall run so as to be as inconspicuous as possible. Coordinate support system with equipment of other trades to ensure proper installation of equipment. Run support system paths perpendicular or parallel to building lines.

END OF SECTION

□

PART 1 GENERAL

1.1 RELATED WORK

.1 Refer to all Sections of the specification for related work.

1.2 REFERENCES

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

.2 CAN/CSA C22.2 No. 75 Splitters.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data for splitters and cabinets in accordance with Section 26 05 00 Common Work Results - Electrical.

PART 2 PRODUCTS

2.1 SPLITTERS, JUNCTION BOXES, PULL BOXES AND CABINETS - GENERAL

.1 ANSI 61 grey polyester powder coat finish inside and out over phosphatized steel.

.2 Gasketed and waterproof for wet and damp locations.

.3 Locate splitters, junction and pull boxes as needed for each system.

2.2 SPLITTERS

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters less than 400A, two spare terminals in all other splitters.

2.3 JUNCTION AND PULL BOXES

.1 Code gauge sheet steel, welded construction.

.2 Screw-on hinged flat covers.

.3 For flush mounting, covers to overlap box by 25mm minimum all round with flush head cover retaining screws.

2.4 CABINETS

.1 Cabinets: code gauge sheet steel, welded construction, suitable for field painting with handle lock and catch.

.2 Locks: to match panelboards, complete with two keys.

.3 Backboards: 19mm GIS fir painted plywood, one piece per cabinet, covering entire cabinet interior.

.1 Type E: with hinged door and return flange overlapping sides, for surface mounting ,size as indicated or to suit.

.2 Type T: surface, or flush with trim, and hinged door.

PART 3 EXECUTION

3.1 SPLITTER INSTALLATION

.1 Install splitters and mount plumb, true and square to the building lines.

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

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Supply all pull boxes and junction boxes shown on the drawings and as required for the installation.

.2 Install in inconspicuous but accessible locations, above removable ceiling or in electrical rooms, utility rooms, or storage areas. Advise Departmental Representative of locations prior to installation.

.3 Size in accordance with Rule 12-3038, Canadian Electrical Code, as a minimum. Sizes shown on the drawings may be adjusted to suit available space. Review with Departmental Representative where necessary.

.4 Mount cabinets with top not greater than 2000mm above finished floor, coordinated with masonry, panelboards, fire hose cabinets and similar items. Securely fasten backboards to cabinet interiors.

.5 Install terminal block as Type T cabinets.

.6 Where junction and pull boxes are not indicated, install pull boxes so as not to exceed 30m of conduit run between pull boxes.

.7 Install junction and pull boxes clear of all mechanical duct work and piping.

3.3 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 53 - Identification for Electrical Systems.

.2 Install size 2 identification labels indicating system name and system voltage (where voltage is applicable).

END OF SECTION

□

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Refer to all Sections of the specification for related work.

1.2 REFERENCES

.1 CAN/CSA C22.2 No. 18.1 Metallic Outlet Boxes.

.2 UL 514C Non-Metallic Outlet Boxes, Flush Device Boxes and Covers.

.3 Latest issue of CSA C22.1 Canadian Electrical Code, Part 1.

PART 2 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES - GENERAL

.1 Minimum size of boxes to be in accordance with Canadian Electrical Code, Section 12.

.2 Boxes to be hot dip galvanized to ASTM a924(M), designation zinc coating Z180 (G60).

.3 102mm square or larger outlet boxes as required for special devices.

.4 Provide multi-gang boxes where wiring devices are grouped.

.5 Provide blank cover plates for boxes without wiring devices.

.6 Provide barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

.1 Hot dipped galvanized steel device boxes for flush installation, minimum size 102mm (4”) square with extension and plaster rings as required.

.2 Hot dipped galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit.

.3 102mm (4”) square or octagonal outlet boxes for lighting fixture outlets.

.4 102mm (4”) square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

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2.3 MASONRY BOXES

.1 Hot dipped galvanized steel masonry single and multi-gang boxes, 89mm (3½") deep, for devices flush mounted in block walls.

.2 Provide 64mm (2½") deep boxes only when wall thickness does not allow 89mm (3½") box to be used.

2.4 CONCRETE BOXES

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

2.5 CONDUIT BOXES

.1 Cast feraloy boxes, 64mm (2½") deep, with factory-threaded hubs and mounting feet for surface mounting of wiring devices and for use in electrical or mechanical rooms.

.1 Provide 43mm (1 11/16") deep boxes only when installation does not allow 64mm (2½") boxes to be used.

.2 Not approved for telecommunications use.

2.6 SECTIONAL BOXES

.1 Sectional boxes shall not be utilized.

2.7 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install all outlets flush, plumb and square with building lines.

.2 Surface mount above suspended ceilings and in mechanical and electrical rooms.

.3 Adjust position of outlets in finished masonry walls to suit course lines. Coordinate cutting of masonry wall to achieve net openings for all boxes.

.4 Where a two gang box is required for single gang device, provide special plate with device opening in one gang and blank second gang.

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.5 Do not distort boxes during installation. If boxes are distorted, replace with new boxes.

.6 Use plaster rings to correct depth. Use 32mm on concrete block.

.7 Installation to be in accordance with Rules 12-3000 to 12-3038, Canadian Electrical Code, “Installation of Boxes, Cabinets, Outlets and Terminal Fittings”. Minimum box size to be in accordance with Rule 12-3038 and Table 23, Canadian Electrical Code, “Number of Conductors in Boxes”. Use more than one outlet box where the number of joints exceeds the requirements for the boxes specified.

.8 Support boxes independently of connecting conduits.

.9 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.10 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.11 Provide correct size of openings in boxes for conduit and cable connections. Reducing washers are not allowed.

.12 Align outlets that are installed in the same general location so that they are centered.

END OF SECTION

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PART 1 GENERAL

1.1 RELATED WORK

.1 Refer to all Sections of the specification for related work.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

- .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
- .2 CAN/CSA C22.2 No. 45, Rigid Metal Conduit.
- .3 CAN/CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CAN/CSA C22.2 No. 83, Electrical Metallic Tubing.
- .5 CAN/CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.

1.3 PRODUCT DATA

.1 Submit product data for non-metallic raceways in accordance with Section 26 05 00 Common Work Results - Electrical.

1.4 LOCATION OF CONDUIT

.1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.

.2 Electrical Subcontractor shall produce layout sketches of conduit runs through mechanical and electrical service areas to avoid any conflict with other construction elements and to determine the most efficient route to run conduit.

1.5 FIRE RATING

.1 Fire rating of combustible conduits shown are minimum required. Provide conduit of fire rating as required by authority having jurisdiction.

PART 2 PRODUCTS

2.1 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 32mm and smaller. Two hole steel straps for conduits larger than 32mm.

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

.3 U-channel type supports for two or more conduits at no more than 2m o.c. spaced as per code and manufacturer’s recommendations, whichever is closer.

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.4 Threaded rods, 6mm diameter, to support suspended channels.

.5 Perforated metal and field fabricated hangers and supports not acceptable.

2.2 CONDUIT FITTINGS

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

.2 Factory "ells" where 90º bends are required for 27mm and larger conduits.

.3 Steel set screw connectors and couplings. Insulated throat liners on connectors.

.4 Raintight connector fittings complete with O-rings for use on weatherproof or sprinkler proof enclosures. Raintight couplings to be used for surface conduit installations exposed to moisture. Raintight connectors shall be used for all top entries to panels, contactors, motor control starters and centres, transformers, etc.

2.3 EXPANSION FITTINGS FOR RIGID METAL AND PVC CONDUIT

.1 Weatherproof expansion fittings suitable for 200mm linear expansion.

.2 Watertight expansion fittings suitable for linear expansion and 19mm deflection in all directions.

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

.4 With internal bonding assembly for metallic conduits.

2.4 FISH CORD

.1 Polypropylene, minimum 200 kg strength, UV resistant.

2.5 CONDUIT - GENERAL

.1 Minimum conduit size shall be 21mm unless otherwise indicated.

2.6 ELECTRICAL METALLIC TUBING (EMT)

.1 Conduit: electrical metallic tubing with wall thickness less than rigid conduit, hot dipped galvanized with corrosion resistant and friction reducing coating on inside, to CAN/CSA C22.2 No. 83.

.2 Connectors and fittings: in dry locations, steel or malleable iron wet concrete tight, set-screw fasteners with insulated throats complete with expansion joints as required. Die cast connectors are not permitted.

2.7 FIRE ALARM EMT

.1 Characteristics same as for EMT for any relocation of devices.

.2 Provide sample of labelling to Departmental Representative/Departmental Representative for final approval prior to installation.

2.8 RIGID METAL CONDUIT

.1 Conduit: rigid galvanized steel, heavy wall, with threaded joints and connections to CAN/CSA C22.2 No. 45.

.2 Connectors: in dry locations steel or malleable iron, insulated throat type bushings inside, enclosures, lock nuts outside enclosures. In locations subjected to moisture interior and exterior: liquid and dust tight with insulated throat.

.3 Rigid conduit fittings: outlet boxes, junction boxes, LB's and other fittings cast metal with factory applied epoxy paint.

.4 Expansion joints: rigid conduit type with external bonding jumper.

.5 Ground bushing: threaded type with insulated throat.

2.9 RIGID PVC CONDUIT

.1 Conduit: rigid non-metallic conduit of unplasticized polyvinyl chloride to CAN/CSA C22.2 No. 211.1.

.2 Fittings: threaded male or female solvent weld connectors and solvent weld couplings, as supplied and recommended by conduit manufacturer.

.3 Fire rating: FT4.

.4 Expansion joints: as supplied and recommended by conduit manufacturer, complete with two O-rings.

2.10 FLEXIBLE CONDUIT

.1 Conduit: flexible metal conduit, spirally wound, interlocked zinc coated steel strip which may be easily bent without use of tools to CAN/CSA C22.2 No. 56.

.2 Connectors: steel slip-proof, complete with insulated throat.

2.11 LIQUID TIGHT FLEXIBLE CONDUIT

.1 Conduit: construction same as flexible conduit, with liquid-tight PVC outer jacket to CAN/CSA C22.2 No. 56.

.2 Connector: type providing seal to conduit jacket and positive ground to interior of conduit, with high pull-out resistance and insulated throat, straight or angles.

PART 3 EXECUTION

3.1 CONDUIT INSTALLATION

.1 Provide a separate raceway for each electrical system.

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

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

.4 Do not surface mount conduits in other areas unless specifically indicated.

.5 Wiring homeruns to panel boards and main branch circuit wiring runs in ceiling space to be run using TECK or in conduit. Wiring drops from conduit systems to light fixtures shall not run horizontally more than 1.8m from conduit system junction boxes in ceiling space.

.6 Type AC90 armoured cable (Bx) with screw type connectors shall be used for connections from conduit systems to luminaires in accessible ceilings and stud partitions or to magnetic door holders. Maximum length of AC90 armoured cable for connections to luminaires mounted in stud partitions shall be 1.5m. Type BX cable shall not be used for any other application.

.7 Armour of TECK cable shall be grounded via an aluminum plate at the supply end and isolated via an insulating plate at the load end of the cable.

.8 Use electrical metallic tubing (EMT) above 2.4m and in areas where it will not be subjected to physical damage.

.9 Rigid galvanized steel conduit shall be used where exposed to damage, in wet or hazardous locations or under floor slabs where shown on the drawings.

.10 Use Rigid PVC Conduit in poured concrete, in duct banks, in areas subject to intermittent or continuous moisture (i.e. coolers, etc.). These areas may not necessarily be shown on the drawings.

.11 Use flexible metal conduit in dry locations for connection to motors movable partitions not served by a solid (wiremold type) raceway, recessed luminaires in T-bar ceilings, suspended fixtures, transformers and equipment subject to movement or vibration, A Motor connections and connections to transformers in damp locations to be liquid-tight.

.12 All flush mounted branch circuit panelboards shall have two 27mm spare conduits stubbed out and extended into accessible ceiling space so that future circuits can be installed without damaging walls or finishes surrounding the panel.

.13 The length of any conduit run shall not exceed 30m and no conduit run shall have more than four 90º bends before a pull box is required. Pull boxes to be installed in accessible ceiling space. Conduits shall be supported within 300mm of entering any junction box, pull box, cabinet or panel board.

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.14 Conduit to be sized as per Canadian Electrical Code. Note that the sizes of branch circuit conductors scheduled and/or specified on the drawings are minimum sizes and must be increased as required to suit length of run and voltage drop in accordance with Canadian Electrical Code. Where conductor sizes are increased to suit voltage drop requirements, increase the conduit size to suit at no extra cost.

.15 Seal around all conduit penetrations through floors to ensure penetrations are watertight.

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

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

.18 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter. Radius of bend shall be not less than 600mm.

.19 Mechanically bend steel conduit over 21mm diameter.

.20 Install fish cord in empty conduits.

.21 Install expansion joints where conduits cross building expansion joints.

.22 Ream conduit ends to remove all burrs.

.23 Seal to air barriers conduits which penetrate barrier.

.24 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.25 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

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

.3 Run conduits in flanged portion of structural steel.

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

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

.6 Do not locate conduits within 300mm of flues. steam or hot water lines.

.7 When a conduit can be run surface, it shall be primed and painted with two coats to match the wall.

3.3 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

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.3 Do not install conduits in terrazzo or concrete toppings unless otherwise indicated.

3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

.1 Installation of conduits in concrete floor slabs is acceptable for feeding free-standing equipment only. Installation of conduits in concrete floor slabs shall not be permitted for any other application.

.2 Obtain approval from Departmental Representative:

.1 Where conduits are spaced closer than 3 diameters.

.2 For conduits greater than 53mm diameter.

.3 Where conduits must be run less than 8 diameters from columns.

.3 Locate to suit reinforcing steel. Install in centre one third of slab. Do not strap directly to parallel reinforcing steel (and reduce concrete bond). Strap to reinforcing steel perpendicular to conduit.

.4 Protect conduits from damage where they stub out of concrete.

.5 Install sleeves where conduits pass through slab or wall.

.6 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

.7 Do not place conduits is slabs in which slab thickness is less than 4 times conduit diameter.

.8 Encase conduits completely in concrete with minimum 50mm concrete cover.

.9 Organize conduits in slab to minimize crossovers.

3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

.1 Installation of conduits in cast-in-place slabs on grade is acceptable for feeding free-standing equipment only. Installation of conduits in cast-in-place slabs on grade shall not be permitted for any other application.

3.6 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.7 GROUNDING

.1 Where current carrying conductors are installed in raceway, provide ground wire of equal size.

.2 Where non-current carrying/telecommunication conductors are installed minimum ground wire size #6 AWG.

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.3 Ensure raceways are large enough to accommodate additional (ground) wire.

3.8 INSTALLATION OF EMT CONDUIT

.1 Use EMT strictly in accordance with Rules 12-1400 to 12-1412 inclusive of CEC.

3.9 INSTALLATION OF FIRE ALARM EMT

.1 Installation to be as for EMT.

3.10 INSTALLATION OF RIGID METAL CONDUIT

.1 Touch up damage to epoxy finish on rigid conduit fittings with touch-up paint supplied by manufacturer. Paint exposed threads on rigid conduit with epoxy paint.

3.11 INSTALLATION OF RIGID PVC CONDUIT

.1 Use strictly in accordance with Rules 12-1100 inclusive of CEC.

.2 When not encased in concrete:

.1 Provide expansion joints and follow manufacturer's recommendations and code requirements with respect to expansion/contraction, particularly where temperature variations are anticipated.

.2 Install conduits loosely with straps and clamps to allow movement.

3.12 INSTALLATION OF LIQUID TIGHT FLEXIBLE CONDUIT

.1 Provide a separate ground conductor within flexible conduit, bonded to motor frames and system ground.

.2 Install conduit to prevent liquids draining to connectors.

3.13 CONDUIT AND CABLE IDENTIFICATION

.1 Refer to Section 26 05 53 "Identification For Electrical Systems" for scope of work.

3.14 WORKMANSHIP

.1 Install all conduit and wiring concealed, except where specifically noted otherwise. Install conduit in furred spaces or recessed in block or masonry walls. Do not recess conduits in columns or concrete walls, except as noted, without permission. Where conduit is necessary to be run exposed, run parallel to building lines.

.2 Where metal conduit is placed in concrete, screw up joints tight and paint joints with sealant paint. Before concrete is poured, tightly pack outlet boxes with paper and cap open ends of conduit to prevent concrete intrusion. At junction between exposed conduit and concrete, paint conduit before concrete is poured.

.3 Take extreme care and ream the ends of all conduits to ensure a smooth interior finish that will not damage the insulation of the wires. Ensure electrical continuity in all conduit systems.

END OF SECTION

□

PART 1 GENERAL

1.1 RELATED WORK

.1 Refer to all Sections of the specification for related work.

1.2 REFERENCES

.1 CAN/CSA C22.2 No. 126-1, Metal Cable Tray Systems (Bi-National Standard with NEMA VE 1).

.2 CAN/CSA C22.2 No. 126 – Cable Tray Systems.

.3 EEMAC F5-1 – Cabletrough Systems and Accessories.

1.3 SECTION INCLUDES

.1 Contains specification for cable trays used to carry power conductors.

.2 Refer to Section 27 05 28 for cable trays for communication systems.

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 26 05 00 Common Work Results - Electrical.

.2 Identify types of cable trays used.

.3 Show actual cable tray installation details and suspension system.

.4 Submit shop drawing for fire/smoke stopping assembly to be used when cable tray penetrates fire/smoke rated walls or floor.

PART 2 PRODUCTS

2.1 MANUFACTURERS

.1 Cable trays and fittings: to EEMAC F5-1.

.2 Ventilated type, Class C1 to CAN/CSA C22. No. 126.

.3 Trays: galvanized steel, minimum 305mm wide with depth of 150mm.

.4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cable tray supplied. Radii on fittings: 300mm minimum.

.5 Barriers where different voltage systems are run in the same cable tray.

.6 Cable tray support:

.1 Utilize trapeze style supports and wall mounted cantilevered supports as indicated.

.2 Space supports at a minimum of 3m (10'), closer support spacing as required for load.

.7 Expansion joints required throughout complete run according to manufacturer recommendations for type of atmosphere.

2.2 GROUNDING

.1 Provide No. 6 green insulated copper ground wire throughout length of cable tray. Fasten ground cable on the outside of tray.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install complete cable tray system.

.2 Installation to be in accordance with manufacturer's recommendations.

.3 Support cable tray on both sides with trapeze mounting supports.

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

.5 Keep number of elbows, offsets and connections to minimum.

.6 Coordinate with other trades and provide vertical clearance above the trays and raceways of 450mm. This clearance can be reduced at duct crossovers but shall not be less than 150mm.

.7 Maintain a minimum separation of 150mm from luminaires.

.8 Maintain fire separations with approved products.

3.2 CABLES IN CABLE TRAY

.1 Install cables individually.

.2 Lay cables into cable tray. Use rollers when necessary to pull cables.

.3 Secure cables in cable tray at 6m centres, with nylon ties.

.4 Identify cables every 30m with size 2 nameplates in accordance with Section 26 05 00.

3.3 GROUNDING

.1 Bond cable tray at 3m centres, using approved ground clamps.

END OF SECTION

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PART 1 GENERAL

1.1 RELATED WORK

.1 Refer to all Sections of the specification for related work.

PART 2 PRODUCTS

2.1 CABLE PROTECTION

.1 38mm x 140mm planks pressure treated with coloured ACQ (Alkaline Copper Quartenary) preservative.

2.2 CABLE HORIZONTAL SPACER

.1 50mm x 25mm (2” x 1”) planks pressure treated with coloured ACQ (Alkaline Copper Quartenary) preservative.

.2 Ty-rap cable ties.

2.3 MARKERS

.1 Concrete type cable markers: 600mm x 600mm x 100mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

.2 Brass nameplate with words “Buried Electrical Cable” and arrow.

2.4 CABLE SAND BED

.1 Sand used for bedding around cables shall be clean from rocks and debris. Sieve to remove foreign objects.

PART 3 EXECUTION

3.1 DIRECT BURIAL OF CABLES

.1 Provide offsets for thermal action and minor earth movements. Offset cables 150mm for each 60m run, maintaining minimum cable separation and bending radius requirements.

.2 Underground cable splices not acceptable.

.3 Minimum permitted radius at cable bends for rubber or plastic, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.

.4 Spacing of feeder cables:

.1 Provide horizontal space to maintain separation distance between individual cables of underground feeders.

.1 Attach cables to spacer with “Ty-rap” cable ties.

.2 Backfill and compact each layer of feeder to maintain vertical spacing between cables.

.3 Demonstrate to Departmental Representative that cables have been installed in accordance to diagrams before backfilling of trench.

.5 Separation of feeders and circuit:

.1 Maintain 75mm minimum separation between cables of different circuits.

.2 Maintain 300mm horizontal separation between low and high voltage cables.

.3 When low voltage cables cross high voltage cables maintain 300mm vertical separation with low voltage cables in upper position.

.4 When cables crossover, maintain 75mm minimum vertical separation between low voltage cables and 150mm between high voltage cables.

.5 Maintain 300mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.

.6 Install treated planks on lower cables 0.6m in each direction at crossings.

.6 After sand protective cover is in place, install continuous rows of pressure treated planks to cover length of run.

3.2 CABLE INSTALLATION IN DUCTS

.1 Install cables in ducts.

.2 Do not pull spliced cables inside ducts.

.3 Install multiple cables in duct simultaneously.

.4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.5 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.

.6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

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

3.3 MARKERS

.1 Mark cable every 150m along cable and duct runs and changes in direction.

.2 Mark underground splices.

.3 Where markers are removed to permit installation of additional cables, reinstall existing markers.

.4 Lay concrete markers flat and centred over cable with top flush with finish grade.

.5 Affix brass nameplate to building or walls where cables are routed below.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 08 01 Electrical Testing Requests.

.2 Perform tests using qualified personnel. Provide necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Acceptance Tests (medium voltage cables)

- .1 Ensure that terminations and accessory equipment are disconnected.
- .2 Ground shields, ground wires, metallic armour and conductors not under test.
- .3 High Potential (Hipot) Testing.
  - .1 Conduct hipot testing at 80% of original factory test voltage in accordance with manufacturer's recommendations.
- .4 Leakage Current Testing.
  - .1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.
  - .2 Hold maximum voltage for 15 minutes. If leakage current quickly stabilizes, duration may be reduced to 10 minutes.
  - .3 Record leakage current at each step.

.6 Provide Departmental Representative with list of test results showing location at where each test was made, circuit tested and result of each test. Include copies of test results in Maintenance Manuals.

.7 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

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PART 1 GENERAL

1.1 REFERENCE STANDARDS

.1 CSA Group (CSA)

.1 CAN/CSA-Z809-08, Sustainable Forest Management.

.2 Forest Stewardship Council (FSC)

.1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.

.3 Insulated Cable Engineers Association, Inc. (ICEA)

.4 Sustainable Forestry Initiative (SFI)

.1 SFI-2015-2019 Standard.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.3 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan and Waste Reduction Workplan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75 % of construction wastes were recycled or salvaged.

.2 Wood Certification: submit vendor's and manufacturer's Chain-of-Custody Certificate number for CAN/CSA-Z809 or FSC or SFI certified wood.

1.3 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.

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

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

.3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 CABLE PROTECTION

.1 38 x 140 mm planks pressure treated, copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.

2.2 DB-2/ SCHEDULE 20 PVC CONDUIT

.1 All Conduit fittings and spacers shall be of the same manufacturer

.2 Crush resistance 90kg @23c

.3 Impact strength 61J @23c

.4 Joint tightness 35kPa

.5 The Conduit shall meet CSAC22-2 No. 211.1

2.3 MARKERS

.1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

.2 Cedar post type markers: to CAN/CSA-Z809 or FSC or SFI 89 x 89 mm, 1.5 m long, pressure treated with clear coloured, or copper napthenate or 5% pentachlorophenol solution, water repellent preservative, with nameplate fastened near post top, on side facing cable or conduit to indicate depth and direction of duct and cable runs.

.1 Nameplate: aluminum anodized 89 x 125 mm, 1.5 mm thick mounted on cedar post with mylar label 0.125 mm thick with words Cable, Joint or Conduit with arrows to indicate change in direction.

2.4 UNDERGROUND WARNING TAPE

.1 150mm wide

.2 Red in Colour

.3 Lettering “CAUTION BURIED ELECTRICAL CABLE BELOW”

2.5 REINFORCING ROD

.1 12mm rebar

PART 3 EXECUTION

3.1 EXAMINATION

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

.1 Visually inspect substrate in presence of Departmental Representative.

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

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

3.2 GENERAL INSTALLATION REQUIREMENTS

.1 Install all underground pathways as per CEC. And manufacturers recommended installation procedures.

.2 The contractor will arrange for all permits for digging, cable locates and confined space entry from the authority having jurisdiction. The contractor will ensure 72 hours notice is given prior to any excavation activities.

.3 Duct bank Separation from other systems.

- .1 Power or other systems:
  - .1 75mm when encased in concrete
  - .2 100mm when encased in masonry
  - .3 300mm of well tamped earth
- .2 Pipes(Gas, Water, Oil)
  - .1 150mm when crossing
  - .2 300mm when parallel
  - .3 Cross Power and other systems at 90 degrees.
- .3 Utility Poles/ Horizontal/ Vertical
  - .1 1800mm/ N/A
  - .2 Utility Pole Anchor
    - .1 Gas line between pole 1500mm
    - .2 Gas Line above angled anchor 3000mm
    - .3 Utility Power Ductbank 1500mm
    - .4 Utility Transformer Pad 1500mm
    - .5 Utility Ductbank (Contract) 300mm
    - .6 Utility Ductbank Electrical Cable 300mm
    - .7 Utility Direct Bury Communications Cable (300mm)

.4 A continuous run of Red underground magnetically detectible marking tape shall be run directly above the duct bank 300mm below finished grade. Rigid bend radius for 103mm conduits shall be a minimum radius's as follows:

Angle	Radius	Length
7 degrees	4.6m	.71m
30 degrees	4.6m	2.54m
45 degrees	2.7m	2.31m
90 degrees	.9m	1.6m

.5 Manufactured fittings and couplings shall be used at all times.

.6 There shall be no more than the equivalent of 2- 90 degree bends between pull points, including offsets and kicks.

.7 Duct shall extend 1 metre beyond road surface on either side. Proper manufactured couplings will be used at all times.

.8 Monolithic duct spaces shall be used for all concrete encased duct banks

.9 A stable 200mm deep compacted sand bed shall be placed underneath the duct bank before placement of concrete. The entire length of the duct bank shall be exposed. Should obstacles be encountered, the Departmental Representative will be contacted to determine alternate routing; this will be at no cost to the Departmental Representative.

.10 Should water be found in trench when excavated, remove unsuitably wet sub-grade material and replace with approved compacted fill at no cost to the Departmental Representative.

.11 Damage to incurred existing conduits and services is the responsibility of the party involved. Report any damage immediately to ensure timely repair to service.

.12 Ensure duct bank has been inspected by the Departmental Representative prior to pouring any concrete. Ensure the duct bank is stable and secure before pouring concrete, Secure by looping the entire duct bank with tie wire by securing the duct spacers and reinforcing bars. Use a diverting mechanism to avoid harsh pours to ensure the duct bank assembly is not disturbed.

.13 Install ductbanks 1830mm minimum distance away from roadways when parallel.

.14 Monolithic Duct spacers shall be installed 1/5 duct length section from each end and the second and third course is installed 150mm offset, at a maximum distance of 1524mm.

.15 Install 12mm rebar in all monolithic duct spacers rebar slots continuous between the maintenance holes. Tie courses together with metal tie wire.

.16 Under grass areas compact backfill in 150mm lifts, place minimum 150mm new topsoil over entire excavated area. Roll Sod to achieve even coverage.

.17 Under roadways backfill excavated in 150mm lifts, place minimum 150mm of 20mm down crushed “A” Base Road material. Place and compact two 50mm lifts of HMAC. Match adjacent and existing grades. Compact Backfill and Base material to 98% max dry density. Prime Base material with asphalt prime coat prior to placement of HMAC. Each lift of HMAC to 98% of Marshall density.

.18 Concrete to be 30 MPA

.19 Backfilling to occur once concrete has been cured for a minimum of 7 days.

3.3 DIRECT BURIAL OF CABLES

.1 After sand bed is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable.

.1 Do not pull cable into trench.

.2 Include offsets for thermal action and minor earth movements.

.1 Offset cables 150 mm minimum for each 60 m run, maintaining minimum cable separation and bending radius requirements.

.3 Make termination and splice only as indicated leaving 0.6 m minimum of surplus cable in each direction.

.1 Make splices and terminations in accordance with manufacturer's written recommendations using approved splicing kits.

.4 Underground cable splices not acceptable.

.5 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable or in accordance with manufacturer's written recommendations; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.

.6 Cable separation:

.1 Maintain 75 mm minimum separation between cables of different circuits.

.2 Maintain 300 mm minimum horizontal separation between low and high voltage cables.

.3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.

.4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.

.5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.

.6 Install treated planks on lower cables 0.6 m minimum in each direction at crossings.

.7 After sand protective cover is in place, install continuous row of interlocking cable blocks, overlapping, pressure 38 x 140 treated planks as indicated to cover length of run.

3.4 CABLE INSTALLATION IN DUCTS

.1 Install cables as indicated in ducts.

.2 Do not pull spliced cables inside ducts.

.3 Install multiple cables in duct simultaneously.

.4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

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

3.5 MARKERS

.1 Mark cable every 150 m along duct, cable runs and changes in direction.

.2 Mark underground splices.

.3 Where markers are removed to permit installation of additional cables, reinstall existing markers.

.4 Install concrete cable markers within 180 m from each side of runway centreline; 45 m from each side of taxi way centreline; 50 m from edge of taxi ramps or aprons.

.5 Install cedar post type markers.

.6 Lay concrete markers flat and centred over cable with top flush with finish grade.

3.6 FIELD QUALITY CONTROL

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

.2 Perform tests using qualified personnel.

.1 Include necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds.

.1 Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance tests:

.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests:

.1 Ensure that terminations and accessory equipment are disconnected.

.2 Ground shields, ground wires, metallic armour and conductors not under test.

.3 High Potential (Hipot) Testing.

.1 Conduct hipot testing in accordance with manufacturer's recommendations.

.4 Leakage Current Testing:

.1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.

.2 Hold maximum voltage for specified time period by manufacturer’s indication.

.3 Record leakage current at each step.

.7 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.

.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 19 – Waste Management and Disposal.

.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 19– Waste Management and Disposal.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

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

3.8 PROTECTION

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

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Refer to Section 26 05 00 - Common Work Results - Electrical for related Sections applicable to this Project.

1.2 REFERENCES

.1 Refer to Section 26 05 00 - Common Work Results - Electrical for references applicable to this project.

1.3 SECTION INCLUDES

.1 Seismic restraints for electrical systems including, but not limited to lighting, distribution, transformers, fire alarm, main distribution switches, uninterruptible power supply (UPS), exit lighting, cabletrays, etc.

1.4 SYSTEM DESCRIPTION

.1 This Section of the Specification defines the seismic bracing requirements of electrical equipment and ancillaries. The bracing of these systems must be independent of other operational and functional components of the building.

1.5 SUBMITTALS

.1 Provide certified professionally sealed shop and placement drawings for all electrical equipment and equipment assemblies, including runs of cable trays and conduit/cable racks showing the methods of attachment to the particular structure for each piece of equipment and assembly and provide anchorage/attachment details approved and sealed by a Newfoundland and Labrador Registered Professional Engineer for review by the Departmental Representative. Submit samples of materials required to complete the seismic restraint work for review if and when required. Arrange and pay for the Professional Engineer who designed all anchorage/attachments to inspect same on site (note that multiple inspections will be required as the work progresses) and to provide typewritten Inspection Reports to the Departmental Representative throughout construction and to provide “Letters of Assurance and Conformance” with the specified Codes, Standards and Bylaws.

.2 Calculations sealed by a Professional Engineer registered in Newfoundland and Labrador shall be provided for the seismic restraint design shown on the shop drawings. Shop drawings shall show the equipment type, manufacturer’s name, model number and weight of equipment to be restrained.

1.6 GENERAL

.1 All equipment installed throughout the building shall meet the Seismic requirements for the Province of Newfoundland and Labrador, the Municipality of Wabush and as outlined.

.2 Requirements for seismic restraint outlined in Section 26 05 48 shall be the minimum accepted.

.3 Supply all labour, material and equipment required and necessary to isolate (noise/vibration) and seismically restrain electrical equipment as specified herein and guarantee the function of the materials and equipment supplied.

.4 All electrical connections to vibration isolated equipment shall be made with flexible conduit or other flexible means acceptable to the Departmental Representative so as not to restrict the maximum anticipated movement of the equipment under seismic excitation movement.

.5 Seismic restraining devices shall be provided to restrain all electrical and related equipment.

.6 Use of the manufacturer's isolation package is acceptable provided it meets the requirements of this Specification.

.7 Provide vibration isolation for equipment or parts connected rigidly to the isolated equipment of this section.

.8 In the event that inadequate isolation is provided by the manufacturer's isolation package, the supplier shall be responsible for improving the isolation to an acceptable standard at no additional cost to the Departmental Representative.

PART 2 MATERIALS

2.1 SEISMIC RESTRAINTS

.1 The seismic restraints shall restrain the equipment in all directions and shall be sized to meet the appropriate Sp factor defined in Table 4.1.9.D of the current National Building Code and Commentary J of the Supplement to the current Code. Calculations bearing the seal of a qualified Professional Engineer must be submitted with the shop drawings to justify the stated seismic restraint requirements.

.2 All attachment points and fasteners shall be capable of withstanding a load of three (3) times the sized capacity of the restraint. The equipment suppliers shall provide proof of conformance with this clause by means of shop drawings certified by a qualified Professional Engineer.

.3 All neoprene isolators shall be bridge bearing rated type.

.4 Test data shall be provided to the Departmental Representative, showing the load deflection curves up to 1.5 times the rated capacity of the restraint and certifying that neither the neoprene elements nor the restraint body sustained any deformation after release of load.

.5 All restraints shall be adjusted to have clearances between 3mm and 6mm under normal operating conditions of the equipment.

PART 3 EXECUTION

3.1 GENERAL

.1 Cable trays, conduit, raceways or other connections shall be with flexibly connected to vibration isolated equipment or vibration isolated per above for a minimum of 9.1m from the equipment. If a flexible connection is used, it must accommodate without strain, the full range of movement of the isolated equipment.

.2 Perforated pipe hangers shall not be used for any seismic supports.

.3 Explosive type fasteners shall not be used. Rawl plugs and 6.3mm and 9.5mm inserts are acceptable.

.4 The following is a list of electrical equipment and systems requiring seismic protection, however not limited to:

- .1 Lighting and exit lighting
- .2 Normal distribution system including dry-type transformers, sub-distributions, branch circuit panelboards, conduits and pull boxes, cabletray
- .3 UPS power supply, conduits and pull boxes, cabletray
- .4 Low voltage lighting control relay panels

3.2 LIGHTING

.1 Recessed luminaires shall be secured to the building structure (independent of ceiling tiles or gypsum board) via 12 Ga. hanger wires. Recessed fluorescent luminaires shall have four hangers located at corners.

.2 All luminaire lenses shall be secured via Municipality of Wabush approved retaining clips.

.3 All recessed downlights shall be secured to the building structure via one 12 gauge hanger wire.

3.3 DISTRIBUTION TRANSFORMERS

.1 Distribution transformers shall only be floor-mounted, never suspended from ceilings or walls.

.2 Transformers shall be secured to the floor at all four corners with bolts (nuts, lock washers) cast into the concrete floor. Bolts shall be sufficient in length to penetrate housekeeping pads minimum 75mm into structural slab.

.3 Provide vibration isolation for all transformers by means of bridge bearing neoprene isolators or open steel spring isolators.

.4 The static deflection of vibration isolators for electrical transformers is 12mm. All isolators requiring a static deflection greater than 12mm (0.50 in.) shall be open spring isolators unless otherwise specified.

3.4 DISTRIBUTION CENTRES

.1 All distribution centres shall be securely mounted to room walls. All walls shall have 19mm plywood backing installed behind drywall for mounting screws.

3.5 CABLETRAY

.1 Wall mounted cabletray supported by brackets shall have two (2) 12 Ga. steel hangers installed to the building structure per tray section.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Suitably identify with nameplates all pieces of electrical equipment such as power and distribution panels, switchgear, switchboards, contactors, control devices, pull boxes, splitters, system panels and all equipment connected direct to the power supply.

.2 Revise and update all existing electrical identification plates (lamacoids) and panel directories affected by room number and distribution changes made in this project. This shall include all electrical distribution components which are fed from or which feed equipment located in areas where room number and distribution changes have been made.

1.2 NAMEPLATES AND PANELS DIRECTORIES

.1 Laminated phenolic nameplates with engraved white letters on:

.1 Black for normal power.

.2 Unless specifically indicated otherwise lettering size to be as follows:

.1 Lamacoid nameplates: 3mm (1/8") thick plastic engraving sheet, black or red faced, white core, mechanically attached with shelf-tapping screws or split rivets, unless otherwise specified. 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 Label outlet box coverplates: 5 mm minimum height (.76 mm inscription width).

.3 Motor control centre identification lamacoid (top one), large sub-distribution panel identification lamacoid (top one), all main distribution identification lamacoids: 100 mm minimum height (1.52 mm inscription width).

.4 Breakers:

.1 Sub-distribution panels: 7 mm minimum height. May be reduced to 5 mm if there are space restrictions.

.2 Panelboards: 5 mm minimum height. May be reduced to 3 mm if there are space restrictions.

.5 Others: 7 mm minimum height (1.02 mm inscription width) when less than 2500 mm (100”) above floor; 10 mm minimum height (1.52 mm inscription width) when more than 2500 mm (100”) above floor.

□

.3 Prior to nameplate fabrication, submit to the Departmental Representative for approval a copy of all panel directories with a list stating exact wording and fabrication details for all nameplates.
- .1 Submit one complete package, including details for all equipment and devices connected to or part of the electrical distribution.
- .2 Submission to be received by Departmental Representative a minimum of 7 weeks prior to schedule completion of the work.

.4 Submit panel directories in electronic format to accommodate future revisions.
- .1 Submit copies of all 'as-built' panel directories for all new and existing panelboards worked on.
- .2 Do not destroy old directories. For existing panels, insert old directory behind the new one where possible, otherwise turn them over to Departmental Representative's on site.

.5 Use Departmental Representative's building and location codes to provide permanent equipment identification. Architectural room numbers on drawings are not acceptable. Confirm permanent building and location codes with Departmental Representative and Departmental Representative prior to making name plates and directories.

.6 In each maintenance/operating manual, include a copy of all panel directories and nameplate listings which were reviewed by Departmental Representative, including any changes or corrections prior to lamacoid fabrication. Nameplate listing schedule shall have exact description of what appears on installed lamacoid, for all lamacoids installed by Division 26.

.7 Co-ordinate names of equipment and systems with mechanical to ensure consistency.

.8 All nameplates and panel directories to be installed and 100% complete prior to commissioning.

1.3 PANELBOARD AND DISTRIBUTION CENTRE IDENTIFICATION

.1 Provide nameplates to identify the following:
- .1 Panelboard or distribution centre title and code number and voltage characteristics.
- .2 Supply feeder panelboard or distribution centre title and code number, slot number and location (Departmental Representative's building and location code).
- .3 Slots on distribution centres stating either "spare" or location (Departmental Representative's building and location code) of panelboard being fed, and panelboard title and code number.

.2 Rivet nameplate to top, exterior on cabinet door.

.3 Provide a typewritten data card enclosed in a clear plastic pouch attached inside the door of each panelboard or distribution centre. Information listed on the data card shall include the following:
- .1 Panelboard or distribution centre title and code number.
- .2 Supply feeder panelboard or distribution centre title and code number, slot number and location (Departmental Representative's building and location code).
- .3 The following information for each circuit:
  - .1 Circuit # and location(s) (Departmental Representative's building and location code).
  - .2 Circuit function i.e. lighting, receptacles, equipment (state equipment name), spare, etc.

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.4 When a panelboard sub-feeds other panelboards, supply and install a lamacoid on supply feeder panelboard door (inside) below directory. Information on lamacoid shall identify the following:

.1 Circuit # and location(s) (Departmental Representative's building and location code).

.2 Panelboard identification of panel being sub-fed. This lamacoid identification and directory shall be identical. Rivet or screw lamacoid to panelboard door. Letter size shall be minimum 5 mm high.

.5 Insert a copy of each data card into each maintenance/operating manual.

.6 All existing panelboards or distribution centres affected by this project shall have their directories neatly updated. A copy of updated directories shall be included in each maintenance/operating manual.

.7 Panel and circuit identification (examples provided):

.1 Panel directory identification:

.1 Near the top of the directory, provide the following information: PANEL: ON-A (panel identification code no.) 120/208V/3PH/4W (panel voltage, # of phases and wires) FED FROM ON-SD-2A IN ON-B-005 (origin of feeder).

.2 Sample panel directory:

Panel: ON-A

120/208V/3PH/4W

Fed from ON-SD-2A in ON-B-005

Circuit		Three Phase		Circuit
	Heaters ON-609	1A	22A	Heaters ON-609
	Heaters ON-615,	2B	23B	Heaters ON-615A
615A				
	Heaters ON-615A	3C	24C	Heaters ON-604A
	Heaters ON-609A	4A	25A	Heaters ON-604B
	Heaters ON-609	5B	26B	Heaters ON-604C
	Heaters ON-615	6C	27C	Heaters ON-604A, B
	Heaters ON-615,	7A	28A	Heaters ON-604C
615A				
	Heaters ON-609	8B	29B	Heaters ON-604C
	Heaters ON-604A,	9C	30C	Spare
	Heaters ON-604A	10A	31A	Spare
	Heaters ON-604B	11B	32B	Spare
	Heaters ON-602	12C	33C	Spare
	Heaters ON-602, 604	13A	34A	Spare
	Heaters ON-604A, B,	14B	35B	Spare
C				
	Fan F-19	16A	37A	Spare
	Fan F-18	17B	38B	Spare
	Space	18C	39C	Spare
	Space	19A	40A	Space
	Space	20B	41B	Space
	Space	21C	42C	Space

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The contractor is to supply a sample of the proposed panel designations to the Departmental Representative for approval, prior to all labeling.

1.4 OTHER EQUIPMENT IDENTIFIED BY NAMEPLATE

.1 Panels and terminal cabinets for low voltage systems: Indicate panel designation, system, and load, system or load location and area served. Provide directories to identify equipment and locations of equipment connected to each circuit. Insert a copy of directory in clear plastic pouch attached inside panel door and in maintenance operating manuals.

.2 Splitters and pullboxes: Indicate their function and characteristics (equipment description and location where fed from and what it feeds). ON-401-D/38

.3 Miscellaneous equipment and exit lights: All equipment, including equipment supplied by others, wired directly to the power source such as line voltage thermostats, control panels, alarm panels, power supplies, fans, heaters and other equipment, shall have lamacoid mechanically fastened onto the piece of equipment, in a conspicuous location, stating: e.g. POWER FROM PANEL ON-401-A/22, 23 IN ON-498. Letter size on lamacoids shall be 5 mm high.

.1 Dyno markers maybe used for labeling small devices and use of the dyno markers must be pre-approved by the Departmental Representative.

.2 Division 26 to site check space available on equipment to determine lamacoid dimensions. Lamacoid shall be flush mounted and shall not project over equipment edges nor conceal other information or elements on surface of equipment. The installation shall have a neat appearance.

.4 Computer equipment lamacoids are not to be mechanically fastened. . Discuss method of labeling with Departmental Representative prior to labeling of equipment.

.5 Panel Breakers:

.1 Sub-distribution panels: All breakers to have lamacoid identification with 7 mm high letters. Examples are:

.1 For mechanical equipment:

CONDENSING UNIT CU-4 (equipment description)

ON ON-2RF Roof (equipment location)

.2 For electrical distribution equipment:

FEEDS TR-ON-2 (equipment description)

IN ON-015 (equipment location)

.2 Panelboards: Provide lamacoid identification with 5 mm high lettering for breakers which control sub-fed panels. If there is insufficient space available adjacent to breakers, lamacoids to be mechanically fastened to the interior of panel door, either above or below the directory. If lamacoids are fastened adjacent to individual breakers, circuit numbers may be omitted from lamacoids.

EXAMPLE: CCT. #14, 15, 16

PANEL: ON-199-X IN ON-199

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.6 By-Pass Switches:

.1 Indicate designation, characteristics, normal supply feeder and panel, generator supply feeder and panel, essential load feeder and panel. Identify each breaker and each position of the interlocking. See drawings as well.

1.5 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code of feeder phase (Refer to Section 26 05 34 “Conduits” for colour coding.) shall appear on every cable in two locations at any distribution; once inside distribution enclosure near cable termination and once outside distribution enclosure, in visible location near enclosure.

.2 Junction boxes with power wiring, all circuits inside the box shall be identified on the inside of the cover plate with permanent marker.

.3 Provide ARISTO-Print (Len Friesen: 786-6728) or STANCO (ALRO Enterprises Limited) or Thomas and Betts stick-on conduit markers for the following systems. Markers to be:

.1 Style B 28.6 mm x 114.3 mm for 25 mm conduit and larger.

.2 Style C 12.7 mm x 57.2 mm for conduit under 25 mm.

.4 Space markers 10 metres on centres maximum for exposed conduits and conduits in accessible ceiling spaces and, in addition, attach markers before and after all barriers, where conduits pass through closets, cupboards, stairwells, etc., and adjacent to all panels, cabinets, pullboxes and access fittings. Markers to be laminated mylar with orange background and black letters. Identify systems as follows:

NORMAL POWER	FIRE ALARM
CONTROL WIRING	GROUND CONDUCTOR

Others: Check with Departmental Representative. All conduit systems shall be identified.

.5 All stick-on conduit markers must be installed during installation of related conduit systems, not after installation of complete conduit systems.

.6 Do not apply stick-on conduit markers onto exposed wiremold raceways.

1.6 FIRE ALARM IDENTIFICATION

.1 Identification Plates:

.1 Provide engraved laminated phenolic identification plates to identify various components of the fire alarm system, as specified. All identification plates shall be mechanically fastened with either rivets or screws.

.2 Prior to identification plate fabrication, submit to the Departmental Representative for approval a complete list stating exact wording and fabrication details for all identification plates. Submission to be one complete package for all Section 28 31 01 identification plates. Submission to be received by Departmental Representative a minimum of 6 weeks prior to scheduled completion of work.

.3 Colour of lamacoid identification plates:

.1 For zone modules:

.1 Pre-action initiating zones: red background with white letters.

.2 All other zone modules: white background with black letters.
.3 For identification of power supply:
.1 As described in Section 26 05 31.

.2 For smoke control system panel:
.1 White background with black letters.

.3 For all other fire alarm components:
.1 Red background with white letters for all other components including, but not limited to, the following:
.1 Tubs, cabinets, enclosures.
.2 End-of-line devices.
.3 Pre-action detector identification plates.
.4 Remote alarm lamp (RAL) identification.
.5 Duct detector identification.

.2 Terminal, Wire and Cable Identification:
.1 Identification:
.1 Use permanent markers to identify all cables, terminals and corresponding wires at all termination points and junctions stating the identification code of the circuit alarm module in the fire alarm panel (e.g. CS-120-A-1).
.2 Coding system shall be consistent throughout the entire alarm system, corresponding exactly to the designations used at the main panel. As-built drawings and directories shall list colour coding by circuit.
.3 Colour scheme for cable and wiring shall be consistent throughout the entire alarm system installation. Refer to Section 26 05 53.

.2 Directory: Provide a typewritten directory in a clear plastic pouch inside all tub and master terminal cabinet covers describing the following:
.1 Enclosure nameplate code number and location code (e.g. FAP-8/GG-041).
.2 The following for each terminal point in each enclosure:
.1 Terminal code number and/or colour.
.2 Areas served (state locations).
.3 Zone number.
.4 Function (i.e. equipment name and location, etc.).
.3 Cable codes and corresponding wire colour codes and/or code numbers. State cable function. Insert a copy of each tub or cabinet directory into each maintenance/operating manual.

.3 Changes to existing: Whenever changes are made to existing wiring, panels, annunciators, etc., re-label as required and update corresponding directories and drawings, to reflect as-built conditions.

.4 All identification and labeling shall be approved by the Departmental Representative prior to installation.

.5 All system identification (nameplates, directories, cable, wire, etc.) to be installed and 100% complete prior to system verification.

□

PART 2 PRODUCTS

.1 Not used.

PART 3 EXECUTION

.1 Not used.

END OF SECTION

□

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Provide Protective devices Coordination Study for newly added, modified power sources and affected existing power distribution system as required, shall be prepared and include all time current characteristic curves plotted on log paper.

.2 Provide Short Circuit and Arc Flash Studies for newly added, modified power sources and affected existing power distribution system as required, to suitable to the site condition.

.3 The Short Circuit, Protective devices Coordination and Arc Flash Hazard Studies shall reflect the new and existing affected power distribution systems and all associated building protection devices.

.4 The Shor Circuit, Protective Devices Coordination and Arc Flash Hazard Studies shall include a professional electrical engineer's stamp registered in the Province of Newfoundland and Labrador and statement which clearly confirming the selective and fully coordinated system permits maximum service continuity. Include all costs in contract.

1.2 REFERENCES

.1 Institute of Electrical and Electronics Engineers, Inc. (IEEE)

- .1 IEEE 141 - Recommended Practice for Electrical Power Distribution and Coordination of Industrial and Commercial Power Systems.
- .2 IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
- .3 IEEE 399 - Recommended Practice for Industrial and Commercial Power System Analysis.
- .4 IEEE 241 - Recommended Practice for Electric Power Systems in Commercial Buildings.
- .5 IEEE 1015 - Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
- .6 IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations.

.2 The National Fire Protection Association (NFPA)

- .1 NFPA 70 - National Electrical Code, latest edition.
- .2 NFPA 70E - Standard for Electrical Safety in the Workplace.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit Coordination Study at the same time as the Switchboard, Transformer & Distribution Equipment shop drawings are submitted.

.2 Submit Short Circuit and Arc Flash Hazard Study shop drawings at the same time as the Switchgear, transformer & Distribution Equipment shop drawings are submitted.

1.4 WORK INCLUDED

.1 The information required to be plotted and part of the studies includes:

.1 Main feeder cables thermal damage curves including associated lengths.

.2 Symmetrical and asymmetrical fault current calculations verifying protection of various elements of the system.

.3 A summation chart showing all ratings and settings with reference to the appropriate curves.

.4 Recommendations and comments on the effectiveness of the coordination study.

.5 Protective devices associated with the largest motor.

.6 A system single line diagram indicating circuit identification, device numbers and equipment ratings.

.7 Drawings generated by a computer aided drafting system.

.8 New transformer thermal damage curves including impedance.

.9 All main feeders protective devices for coordination with Hydro Utility fuse to medium voltage feeder breakers and fuses.

.10 Arc Flash Studies, Recommendation Arc Flash mitigation comment and providing Arc flash Stickers on newly added and modified power distribution system.

1.5 THE CO-ORDINATION OF PROTECTIVE DEVICES

.1 Submit a complete Short Circuit and Time-Current Coordination Study for the breakers and fuses provided under this contract.

.1 Include all upstream overcurrent protection up to Newfoundland Hydro service (NLH) and including the main breaker in the normal main distribution switchgear and up to and including the main breaker in the emergency main distributions.

.2 Curves shall be plotted on a standard log-log scale as time versus current values on a common 600 Volt base. It shall be the responsibility of the Division 26 contractor to provide time-current curves of all breakers, fuses, etc.

.3 The study shall:

.1 Select settings and characteristics for the protective devices in order to achieve maximum selectivity between devices during fault conditions (ie. the device nearest the fault will operate first, thus minimizing the interruption) and to provide proper protection for all distribution equipment, transformers, cable, etc.

.2 Determine the fault currents at critical points in the power system under the worst case conditions in order to ensure the adequacy of the electrical equipment and protective devices. Motor contribution is to be taken into account.

.3 Include all breakers in CDP type panelboards. Breaker settings shall be listed in the study for all breakers with adjustable trips.

.4 In addition to the curves for the protective devices, each drawing shall show and include proper protection and coordination for:

.1 Transformers inrush points.

.2 Transformers full load currents.

.3 Transformers damage curves (single phase and three phase).

.4 Cable damage curves.

.5 The largest motor or motors likely to present coordination problems.

.5 All required breaker settings shall be listed in table form including breaker details such as breaker type, trip rating, etc. All breakers with adjustable trips shall be included in this list.

.6 Maximum available short circuit currents shall be listed for each bus. This listing shall also include the interrupting rating of the protective devices actually supplied in the contract.

.7 In all cases use actual values for transformer impedance, cable types, cable sizes, cable lengths, available utility fault current, etc.

.8 Identification names and numbers for breakers and distribution in the study shall match the identification shown on the contract documents.

.9 The short circuit and coordination study shall be done by a Professional Engineer licensed in the Province of Newfoundland and Labrador and the study shall be signed and sealed by the Professional Engineer.

.10 Ground fault curves shall be plotted on the same drawings as overcurrent curves to ensure proper coordination.

.11 Where there is a generator set, the study shall include the generator breakers.

.12 Where there is equipment such as power factor correction panels with incoming breakers include these breakers in the study.

.13 As a minimum, the study shall be bound in a 3-ring loose leaf binder and shall include:

.1 A title sheet listing the study name, project name, project number, date, engineering company that prepared the study (including address and phone number), the engineers seal and signature, etc.

.2 Table of Contents.

.3 Purpose of the study.

.4 The criteria for determining proper selective coordination, protection, adequacy, etc. (eg. describe when coordination is achieved, minimum/maximum tripping times and current values, separation between curves, safety margins, damage curves, etc.).

.5 Summary stating that proper selective coordination, proper protection, adequacy of the equipment for the maximum available short circuit currents, etc. was achieved and listing any areas of compromise, potential problems, marginal adequacies, etc.

.6 Drawings of the breaker curves showing proper selective coordination, protection, adequacies, etc. On each drawing, include a single line diagram of the distribution for the curves shown on the drawing, breaker settings, etc.

.7 Maximum available short circuit currents at each bus.

.14 The study shall be started immediately on award of contract and shall be submitted as a shop drawing for review in advance of distribution shop drawings.

.15 All breakers shall be set per the curves in the coordination study.

.16 The Short Circuit and Time-Current Coordination Study (revised to as-built conditions) shall be included in the Operating and Maintenance Manuals.

.17 A summation chart showing all ratings and settings with reference to the appropriate curves.

.18 Recommendations and comments on the effectiveness of the coordination study.

.19 A system single line diagram indicating circuit identification, device numbers and equipment ratings.

.20 Drawings generated by a computer aided drafting system. Drawings to be provided on departmental representative approved AutoCAD system and version.

.2 Contractor Responsibilities:

.1 In the event that the studies indicate necessary changes to provide proper coordination, the distribution equipment Supplier and Contractor shall include cost for the changes and replacement of panelboards, circuit breaker sizes, trip settings, wire sizes, etc., to enable coordination with downstream devices. Include all costs in the contract price.

.2 The studies shall be completed and reviewed by the General Contractor and the electrical contractor prior to equipment being ordered, include revisions and then submit to the departmental representative for review along with the shop drawings.

.3 Visit the site and commission the equipment settings with test instruments. Submit verification test results to the Departmental Representative.

1.6 ARC FLASH HAZARD ANALYSIS

.1 Scope

.1 The scope of the studies shall include all new distribution equipment supplied by the equipment Manufacturer under this contract.

.2 Submittals For Construction

.1 Arc flash labels shall be provided in hard copy only and affixed to the relevant equipment.

.3 Qualifications

.1 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 analysis it has performed in the past year.

.4 Studies

.1 The contractor shall furnish an Arc Flash Hazard Analysis Study report and schematics (including calculations) per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

.5 Arc Flash Hazard Analysis

.1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, 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 significant locations in 600 volt systems fed from transformers equal to or greater than 125kVA where work could be performed on energized parts.

.4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.

.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 locations. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculations 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 calculation 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 e 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 (as required per above), the line side and load side contributions must be included in the fault calculations.

.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 computer 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 1584-2002 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 arch flash event, a maximum clearing time based on the specific location shall be utilized.

.12 Incident energy and flash protection boundary calculations

.1 Arcing fault magnitude

.2 Protective device clearing time

.3 Duration of arc

.4 Arc flash boundary

.5 Working distance

.6 Incident energy

.7 Hazard Risk Category

.8 Recommendations for arc flash energy reduction

.6 Field Adjustment

.1 Arc Flash Warning Labels

.1 The contractor of the Arc Flash Hazard Analysis shall provide a 3.5in. x 3.5in. 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 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

.5 Incident energy

.6 Working distance

.7 Engineering report number, revision number and issue date

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

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

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

.2 For each motor control centre, one arc flash label shall be provided.

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

.4 For each switchgear, one flash label shall be provided.

.5 For medium voltage switches one arc flash label shall be provided.

.6 Labels shall be field installed by Electrical Contractor.

PART 2 PRODUCTS

.1 Not used.

PART 3 EXECUTION

.1 Not used.

END OF SECTION

PART 1 GENERAL

1.1 INCLUDED SYSTEMS AND EQUIPMENT

.1 The following is a partial list of equipment and system test requirements included in this section:

- .1 New distribution systems including phasing, voltage, grounding, load balancing hipot and/or megger testing.
- .2 New circuits originating from central distribution and branch distribution panels.
- .3 Grounding systems.
- .4 Automatic Transfer Switches.
- .5 Distribution Transformers
- .6 Emergency power systems.
- .7 12kV equipment, power feeders and systems downstream of new switchgear.

1.2 DESCRIPTION

.1 This section specifies the functional testing and commissioning requirements for electrical systems and equipment as performed by the electrical contractor. The test requirements for each piece of equipment or system shall contain the following:

- .1 A list of the integral components being tested.
- .2 Pre-functional checklists associated with the components.
- .3 Functions and modes to be tested.
- .4 Required conditions of the test for each mode.
- .5 Special procedures.
- .6 Required methods of testing.
- .7 Required monitoring.
- .8 Acceptance criteria.

.2 Include the cost of testing in the contract price.

.3 In each purchase order or subcontract written, include requirements for submittal data, O&M data and training.

.4 Provide a copy of the O&M manual submittals of tested equipment, through normal channels, to the Departmental Representative for review and approval.

.5 Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure technicians are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests and adjustments.

.6 Prepare O&M manuals according to the Contract Documents. Include clarifying and updating the original sequences of operation to as-built conditions.

.7 Provide training of the Departmental Representative's operating personnel.

.8 Immediately upon completion, test the entire electrical system by performing a loss and return of utility power test.

1.3 TEST EQUIPMENT

.1 Electrical Contractor shall provide all test equipment necessary to fulfill the testing requirements of this Division.

PART 2 PRODUCTS

.1 Not used

PART 3 EXECUTION

3.1 GENERAL

.1 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.2 Carry out tests in presence of the Departmental Representative's representative.

.3 Give advance notice of proposed time of tests so that the Departmental Representative can be represented at the tests.

.4 Submit test results for review by the Departmental Representative. Complete deficiencies within construction schedule.

.5 Include copy of test results in maintenance manuals.

.6 Testing methods and test results: in accordance with CSA, CEC and regulations of the supply authority, other authorities having jurisdiction and manufactures recommendations.

.7 Conduct dielectric tests, megger tests, insulation resistance tests and ground continuity tests as required by the nature of the various systems and equipment.

3.2 EQUIPMENT TESTING

.1 With the systems completely connected and lamped, conduct the following tests on the power system:

.1 Control and Switching: test all new circuits for the correct operation of devices, switches and controls.

.2 Polarity Tests: test all new circuits for correct operation of devices, switches and controls.

.3 Phase Balance: measure the load on each phase at each switchboard. Report results in writing to the Departmental Representative. Re-arrange phase connections as necessary to balance the load on each phase as instructed by the Departmental Representative with the re-arrangement being restricted to the exchanging of connections at the distribution points mentioned in this paragraph. After marking any such changes, make available to the Departmental Representative, drawings or marked prints showing the modified connections.

.4 Supply Voltage: measure the line voltage of each phase at the load terminals of the main breakers and report the results in writing to the Departmental Representative. Perform this test with the majority of electrical equipment in use.

.2 When tests are performed, the Departmental Representative may require that equipment be opened and removed from their housings to examine interior of equipment, terminations and connections. Provide all required labour and tools.

.3 General Component Starting and Testing:

.1 Prior to energizing:

.1 Confirm components nameplate data with characteristics of power supply.

.2 Verify supply voltage and phase rotation.

.3 Ensure all testing as specified has been completed and deficiencies have been corrected.

.4 Close and open all new devices to ensure proper mechanical operation.

.5 Megger all modified feeders and record results on approved verification forms.

.4 Load balancing:

.1 At time of acceptance carry out the following work at peak load hours:

.1 Measure load balance on all modified feeders at distribution centres. If load unbalance exceeds 15%, reconnect circuits to obtain the best possible balance of current between phases. Revise directories and wiring identification accordingly.

.2 Measure phase voltages at distribution centres. Adjust transformer taps, where required, to within 2% of rated voltage of components.

.5 Insulation Resistance Testing:

.1 After installing cable and terminating reform insulation resistance test with megger on each phase conductor.

.2 Megger all new circuits, feeders and components up to 350 V with a 500 V instrument.

.3 Megger all new 350-600 V circuits, feeders and components with a 1000 V instrument.

.4 Check insulation resistance to ground before energizing.

.5 Megger cables for one minute, graph results at 10 second intervals. Submit graphs to Departmental Representative and include graphs in O & M manuals.

.6 Minimum insulation resistance to earth or between phases: 100.

.7 Instrument to have minimum of 100 Megaohm resolution in the 0 to 500 Megaohm range.

.8 Check insulation resistance after each termination to ensure that cable system is ready for acceptance testing.

.6 Ground Resistance Testing:

.1 Measure ground resistance with earth test megger to verify compliance with CSA C22.2 No. 0.4 and Canadian Electrical Code.

.7 Coordination of Protective Devices:

.1 Ensure new circuit protective devices such as overcurrent trip relays, fuses are installed to values and settings determined by the Coordination Study.

.8 Arc Flash Protection:

.1 Ensure new circuit protective devices such as overcurrent trip relays, fuses are installed to values and settings determined by the Arc Flash Study.

.9 L.V. Power Distribution:

.1 Completely isolate from all sources of power, the switchgear, switchboard enclosure to be tested and inspected.

.2 Remove necessary access panels, doors and cover plates.

.3 Cleaning:

.1 Check for accumulations of dirt especially on insulating surfaces and clean all interiors of compartments thoroughly using a vacuum or blower.

.2 Use only clean, lint free cloth.

.3 Remove all filings caused by burnishing of contact.

.4 Visual and Mechanical Inspection:

.1 Check physical, electrical and mechanical condition.

.2 Compare equipment nameplate data with latest contractual documents/requirements.

.3 Check for proper anchorage, required clearances, physical damage and proper alignment.

.4 Check physical appearance of all doors, panels, and sections for paint, dents, scratches, fit and missing hardware. Lubricate in accordance with manufacturer's instructions.

.5 Inspect all insulators and insulating surfaces for evidence of physical damage, cracks, chips and tracking or contaminated surfaces.

.6 Check condition of all bussing for moisture or other contamination, proper torque using calibrated torque wrench, and clearance to ground. Seal all bolted connections with red lacquer.

.7 Check all mechanical devices for proper operation. Exercise all active components.

.8 Check and verify that circuit breakers comply with latest contractual documents/requirements:

.5 Check condition of all contacts.

.6 Check and report all discovered unsafe conditions.

.7 Check cable and wiring condition, appearance, termination. Perform electrical tests as required.

.8 Inspect for proper grounding of components.

.9 Molded case circuit breakers 150 amp frame and larger:

- .1 Visual and Mechanical Inspection:
  - .1 Check physical, electrical and mechanical condition. Inspect for cracks or other defects.
  - .2 Compare equipment nameplate data with latest contractual documents/requirements. Check for proper mounting. Ensure correct protection elements.
  - .3 Operate circuit breaker to ensure smooth operation.
  - .4 Check tightness of connections using calibrated torque wrench
- .2 Electrical Tests:
  - .1 Megger test.
  - .2 Mechanical function test
  - .3 Set all units with adjustable magnetic trip units.
- .3 Where solid state protection is provided with large breakers, test units as follows:
  - .1 Inspect and test in accordance with manufacturer's most recent installation and maintenance brochure.
  - .2 Perform tests using manufacturer's relay test unit as applicable, with corresponding test instruction
  - .3 Proof test each relay in its control circuit by simulated trip tests to ensure total and proper operation of breaker and relay trip circuit by injection of the relay circuit to test the trip operation.
  - .4 Check C/T and P/T ratios and compare to coordination data.
  - .5 Record all observations, data and test results.

.10 Molded case circuit breakers to150 amp:

- .1 Visual and mechanical inspection as for the larger moulded case breakers.
- .2 Mechanical function test.
- .3 Set all units with adjustable magnetic trip units.
- .4 Record all observations, data and test results.

.11 Protective Relaying:

- .1 Set and test protective relays to the settings provided in the coordination study. The manufacturer's instructions for the specific relay must always be used for information concerning connections, adjustments, repairs, timing and data.
- .2 Record all observations, data and test results.

.10 Wiring and Cables:

.1 Test all new conductors, including those at distribution centres for insulation resistance to ground (megger test).

.2 Test new service grounding conductors for ground resistance.

.3 Provide list of test results on approved verification form showing location at which each test was made, circuit tested and results of each test.

.4 Remove and replace entire length of cable if cable fails to meet any of the test criteria.

.11 Grounding:

.1 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.

.2 Perform tests before energizing new electrical distribution.

.3 Provide test report documenting successful test results.

.12 Transient Voltage Surge Suppression (TVSS):

.1 Visual and mechanical inspection:

.1 Check physical, electrical and mechanical condition. Inspect for damage or other defects.

.2 Compare equipment nameplate data with latest contractual documents/requirements. Check for proper mounting and adequate clearances.

.3 Check tightness of connections using calibrated torque wrench.

.4 Check for proper grounding.

3.3 TRAINING OF PERSONNEL

.1 The General Contractor shall be responsible for the overall training schedule and shall ensure that all training activities specified herein are completed.

.2 Electrical Contractor: The electrical contractor shall have the following training responsibilities:

.1 Provide designated personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of tested electrical equipment or system.

.2 Training shall be hands on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.

.3 During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

.4 The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer’s representative. Practical building operating expertise as well as in-depth

knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.

.5 Training shall include:

.1 Use the printed installation, operation and maintenance instruction material included in the O&M manuals.

.2 Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

.3 Discuss relevant health and safety issues and concerns.

.4 Discuss warranties and guarantees.

.5 Cover common troubleshooting problems and solutions.

.6 Explain information included in the O&M manuals and the location of all plans and manuals in the facility.

.7 Discuss any peculiarities of equipment installation or operation.

.6 Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.

.7 The electrical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls.

.8 Training shall occur after functional testing is complete, unless approved otherwise by Departmental Representative.

.9 Duration of Training. The electrical contractor shall provide training on each system for suitable period of time, to ensure a reasonable understanding of its operation by the trainee.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Section 26 05 00 - Electrical General Requirements

.2 Section 26 13 18 - 15kV Primary Switchgear Assembly to 15KV

.3 Section 26 05 14 - Power Cables and Overhead Conductors.

.4 Section 26 05 21 – Wires and Cables 1-1000V

1.2 REFERENCES

.1 IEEE Std 32 – Standard Requirements, Terminology, and Test Procedures for Neutral Grounding Devices.

1.3 QUALITY CONTROL AND ASSURANCE

.1 Submit type test certificates for:
- .1 Temperature rise.
- .2 Sound level.
- .3 Radio influence voltage.
- .4 Partial discharges (corona).
- .5 Basic insulation impulse level.

.2 At the site, energize transformers and apply incremental loads:
- .1 11% for first hour.
- .2 25% for next two hours.
- .3 50% for next three hours.
- .4 Full load.
- .5 At each load change, check ambient, enclosure, ventilating air and winding temperatures.
- .6 Adjust any cooling fan controls if required.
- .7 Adjust taps to provide nominal voltage at nominal load.

.3 Verify correct KVA ratings.

.4 Verify correct BIL rating.

.5 Witness and direct tap adjustments.

.6 Verify ground level.

.7 Verify operation of cooling fans.

.8 Verify grounding connections.

.9 Test for ground continuity.

.10 Perform winding temperature detection test.

.11 Test high solidly grounded fault system for proper operation.

PART 2 PRODUCTS

2.1 STANDARDS

.1 Reference is made in this Specification to the following standards, the latest issue and supplements of which shall apply and are hereby made a part of this Specification as if written in full herein:

- .1 Canadian Standards Association (CSA)
  - .1 C.13 Instrument Transformers
  - .2 C.22.2, No. 94 Special Purpose Enclosure
  - .3 C.22.1-section 26-240((2)(b)(i).
  - .4 C.22.4, No. 103 Tolerable limits and special methods of measurement of radio interference from HV lines and apparatus
  - .5 C.41 (IEEE No. 1) General principles upon which temperature limits are based in rating of electrical equipment
  - .6 C.88M90 Power transformers
  - .7 C.802-94 Maximum losses for distribution power and dry type transformers
- .2 Canadian Electrical Manufacturers' Association (CEMA)
  - .1 IGL-1 Transformer and apparatus bushings
- .3 American National Standards Institute (ANSI)
  - .1 C.57.12.90 Test code for distribution, power and regulating transformers and shunt reactors
  - .2 C.57.92 Guide for loading oil-immersed distribution and power transformers
- .4 National Electrical Manufacturers' Association (NEMA)
  - .1 TR1 Transformers, regulators and reactors

2.2 DESIGN

.1 The Trade Contractor shall carry out at no additional cost, all additional tests to obtain the approval of the Supply Authority and, where applicable, Canadian Standards Association (CSA).

.2 At the request of the Departmental Representative, supporting data shall be submitted to verify the design concept.

.3 Review by the Departmental Representative does not in any way relieve the Trade Contractor of responsibility for the adequacy of the design or the satisfactory performance of the equipment as specified.

2.3 SPARE PARTS

.1 Provide spare parts as follows:

- .1 One HV & LV bushing of each type used on the power transformers.
- .2 One gasket in a sealed package of each type and size used on the power transformers.
- .3 Fan and motor assembly for power transformer.

2.4 SHIPPING

.1 The Trade Contractor shall assure that all equipment, materials and other property furnished by the manufacturer is properly skidded, crated, packaged, or otherwise loaded on the carrier to assure protection from damage due to weather and normal shipping practices.

.2 Shipments shall be prepaid and carry sufficient insurance to cover against all damages, loss or theft during transportation.

.3 The Trade Contractor shall assume responsible for factory storage as necessary.

.4 Flanged connections shall have wood blind flanges bolted onto the flanges to protect the flanges from abuse and the equipment interior from contamination during shipping.

.5 Screwed end connections shall be capped. Other openings in equipment shall be plugged.

.6 Tag and mark all material used to plug or block equipment for shipping to ensure removal during installation.

2.5 MATERIALS

.1 Transformer overall maximum depth with all accessories shall be no greater than 2804mm and width no greater than 2164mm in order to facilitate installation and future removal. Each transformer shall be 1000 kVA, Δ/Y, - 12.47kV - 600/347 V three phase, four wire with the secondary solidly grounded, Dead Front, 65EC temperature rise over 40EC ambient, three phase, 60 Hz, continuous rated, Standard mineral oil, power transformer with all cooling fans, suitable for operation on a solidly grounded system. All current carrying parts including transformer windings shall be minimum 98% pure copper.

.2 The symmetrical fault level on the 12.5kV system to be determined from Utility Service Provider (Actual fault and Ultimate fault level).

.3 Each oil filled transformer shall have internal current-limiting fuse and equipped with a pressure relief device, as per C.22.1-section 26-240((2)(b)(i).

.4 Each transformer shall have a minimum efficiency to CSA-C.802-00 at 1MVA based on core.

.5 The high voltage windings shall be Δ (delta) connected for operation at 12.47kvolts (95KV BIL) 60 Hz, with taps in the high voltage winding connected to off load tap changers.

.6 The high voltage windings and bushings shall have an insulation class of 12.5kV, 95kV BIL.

.7 The tap changers for the high voltage winding shall have external manual operating handle for use while the transformer is connected (off-load), with position indicator and provisions for padlocking, mounted on the side of the transformer and provide 2-21/2% FCAN & 2-21/2% FCBN tap positions.

.8 HV bushings shall be 15kV class, 95kV BIL side mounted in an air filled weatherproof enclosure with separate removable panels for access to each phase where cable is terminated to bushing. Provide bolt-on, 600Amp, elastimold elbow. Concentric neutral cables are to be grounded at supply end only. Provide hinged padlockable door at grade to provide walk-in personnel access. Enclosure shall rest on concrete pad with 15 kV cables entering the enclosure from the bottom. Enclosure shall provide adequate space and proper orientation of terminals to:

.1 Prevent cross phasing of unshielded conductors.

.2 Provide full air clearance phase to phase and phase to ground of all unshielded phase conductors. Provide adequate crotch clearance and space for terminating stress cones.

.3 Provide adequate space for and include necessary cable support brackets and cable lugs.

.4 Provide a readily accessible ground connection for grounding of cable shields.

.9 The low voltage windings shall be wye-connected for operation at 347/600 volts, high performance grounded.

.10 The low voltage line and neutral bushings shall be side mounted, 1000volt class, brought out to an air filled weatherproof enclosure adequately sized for termination of long barrel two hole crimp type compression connectors suitable for 1200A. 3 phase, 4 wire bus duct/spade. Enclosure shall provide adequate space and proper orientation of terminals to:

.1 Prevent cross phasing of unshielded conductors.

.2 Provide full air clearance phase to phase and phase to ground of all unshielded phase conductors.

.3 Provide adequate space for and include necessary cable support brackets and cable lugs.

.4 Provide a readily accessible ground connection for grounding of cable shields and neutral link.

.11 With the HV tap connection in its neutral position, the percentage impedance voltage drop between the high voltage bushings and the output bushings of the low voltage winding shall be a minimum 5% and a maximum of 7.0% when based on 1MVA at 600V or 12.5 kV.

.12 Transformer audible sound level shall not exceed CSA standards when operating at full load rating and fan rating.

.13 Transformer tank shall be of welded steel plate construction. Tank cover shall be bolted and casketed to tank. Cover to contain bolted and casketed handholes or manhole(s) to allow access to complete top of core and coils. All gaskets shall be of cork-neoprene, nitrile rubber, or equivalent material, with gasket retainers provided on all oil tight casketed joints. One spare set of gaskets shall be provided for the handhole/manhole covers and all bushings and openings. Completely assembled tank shall be capable of withstanding full vacuum during oil processing operations.

.14 Tank mounted cooling fan radiators shall be structurally welded frame.

.15 A stainless steel diagram nameplate and connection diagram shall be furnished and located on the tank wall at approximately eye level. Information furnished shall conform to CSA-C88.

.16 Main drain valves for main tank shall be located at lowest point of tank to permit complete drainage of tank. Valve shall be 40 mm minimum, have flanged inlet, offset valve body, threaded outlet with pipe plug, and 12 mm sampling needle valve to drain only when main drain valve is open. Inlet flange shall be bolted to a mating flange welded to tank with a gasket between flanges, complete with gasket stop.

.17 Filter press valves for main tank shall be located on opposite side of tank from drain valves, 25 mm minimum size. Valve shall have flanged inlet, threaded outlet with pipe plug and permanent labeling.

.18 Weatherproof magnetic liquid level gauge with dial legible from ground level. Gauge shall be equipped with low level alarm contacts with leads extended to terminal blocks in the control cabinet suitable for local monitoring system.

.19 Pressure relief device shall be mounted on cover and shall be of mechanical type with alarm contacts and leads extended to terminal blocks in control cabinet. Rupture pressure value shall be identified on a nameplate.

.20 Top oil thermometer shall be located near top of transformer tank and be readily removable for inspection without lowering of oil level. Thermometer shall be equipped with high temperature alarm contacts with leads extended to terminal blocks in control cabinet.

.21 Lifting hooks shall be provided for lifting the completely assembled transformer.

.22 Jacking facilities shall include four jack lugs, one at each corner of base, suitable for hydraulic jacks.

.23 Tank cover shall include lifting eyes.

.24 Transformer c/w Internal fuses and copper windings.

.25 Core assembly shall include lifting lugs.

.26 Transformer base shall have members forming a rectangle which will permit rolling, pulling or skidding in the direction of the centre lines of the transformer. All steel members forming the base shall be level on the bottom to facilitate rolling. Outside edge of base to be beveled with an angle to facilitate starting of rollers. Pulling eyes shall be provided for pulling transformer in the direction of the centre lines of the transformer.

.27 Radiators shall be constructed of flat or round tube type elements with welded seams, header and flanges. Radiator flanges with gaskets shall be bolted to flanged headers welded into tank wall. Tank headers shall be equipped with built-in, position indicating type valves to permit removal of radiators without draining of tank oil.

.28 Radiators shall be equipped with vent and drain plugs, easily accessible for removal while transformer is energized, with lifting lugs welded to top and bottom headers.

.29 Transformer shall be Envirotemp FR-3-immersed with the coils operated and fully immersed in insulating liquid. The liquid shall have no measurable quantity of PCB or TCP contaminants and in no case shall exceed 5 ppm.

.30 Submit liquid samples for analysis to the Departmental Representative's independent testing organization after manufacture and prior to delivery and immediately following initial energization at the site. If, in the opinion of Departmental Representative's testing organization, the liquid contains unacceptable amounts of impurities, it shall be replaced immediately, without expense to Departmental Representative. It shall be the Trade Contractor's responsibility to remove and dispose of contaminated liquid in accordance with the guidelines of Authorities having jurisdiction.

.31 One winding temperature relay shall be installed in the centre phase of the low voltage windings of the transformer. Relay shall be located in well, sealed off from the main tank and include necessary auxiliaries with leads extended to terminal blocks in control cabinet suitable for remote monitoring on the Power Monitoring and Control System. Relay shall have facilities for field testing, with calibration information. Relay shall have four sets of staged contacts to perform the following functions at successive values of hot spot temperatures: 1) stage one fan cooling; 2) stage two fan cooling; 3) temperature alarm setting; 4) temperature shutdown setting.

.32 The current transformer for use with this relay shall be located as per manufacturer's standard design.

.33 A metal nameplate shall indicate the CT ratio, and the relay temperature settings for each stage.

.34 A weatherproof control cabinet with hinged, gasketted doors shall be supplied on the transformer tank wall at a height readily accessible to an operator standing at ground level.

.35 Control cabinet shall be provided with a breather and shall be of sufficient size to house the following equipment:

- .1 Phoenix contact terminal blocks UK 2.5 with all accessories for termination of wiring from alarm leads (#12 AWG); UK 5 series for current transformer leads (#10 AWG).
- .2 Combination disconnect switch and magnetic starters and other control equipment necessary for control of forced air cooling fans resilient mounted for protection against vibration. A selector switch shall permit manual or automatic operation of fans and shall be located in the control cabinet.
- .3 Control cabinet shall have removable bottom plate of sufficient size for entrance of conduit.
- .4 All alarm devices shall have electrically separate, normally open contacts suitable for 125 V DC brought out to a terminal block in the control cabinet.
- .5 Leads from control devices shall be wired in rigid steel or flexible watertight conduit to control cabinet terminal blocks. All conduit fittings and connectors shall be waterproof.
- .6 Wiring shall be 1000 V RWU90 XLPE identified at both ends with permanent plastic sleeve type wire markers.
- .7 Wiring and connections shall be vibration proof with all terminations and splices made in accessible cabinets and boxes.

.36 The control cabinet shall be used to terminate all leads to circuits external to the transformer.

.37 Fan motors shall be single phase, 240 or 120/208 volt, 60 Hz with fans mounted on cooler radiators. If different fan voltage is used, a control transformer shall be provided of sufficient capacity to operate all fans, complete with necessary protective devices. A weatherproof plug disconnect shall be provided in power supply lead to each fan motor. Fan starter circuits shall be complete with fan failure alarm contacts to indicate remotely on the Power Monitoring and Control System: loss of power; motor failure during forced cooling stage.

.38 Prior to painting, exterior metal surfaces shall be cleaned with shot blast and then iron phosphate coated. A prime coat of zinc chromate and iron oxide shall be applied followed by two finish coats of alkyd in ASA 61 grey.

.39 Routine tests shall be made on transformer as defined in CSA C.88M90 and NEMA TRI.

.40 Standard impulse tests for each transformer in accordance with American National Standard Requirements, terminology and test code for distribution, power and regulating transformers C57.12.90. Refer to General Provisions for testing requirements.

.41 Submit four (4) copies of certified test results to the Departmental Representative before shipment of transformer.

.42 Departmental Representative shall have the right to inspect at the factory, at any time during manufacture and assembly, all equipment and materials covered by these Specifications and to be present during any tests made on the equipment.

.43 Transformer shall be fitted with a weather-proof, tapped-type, neutral solidly grounded,

PART 3 EXECUTION

3.1 INSTALLATION

.1 Provide transformers as shown and as specified.

.2 Provide and terminate high voltage cable connections.

.3 Provide and terminate low voltage bus duct connections.

.4 Ground transformer components to ground grid using two #4/0 copper with 2 hole long barrel double crimp lugs equal to Burndy YA-2N and durium hardware.

.5 Provide wiring from thermometers, pressure relief, sudden pressure relay, oil level and fan status to Power Monitoring and Control System interface. Mount transformers on suitable anti-vibration pads as recommended by the manufacturer.

.6 Include for all installation costs such as reassembly of shipping splits, liquid filling, vacuum processing, special hoisting equipment and cranes.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Section 26 05 00 - Electrical General Requirements

.2 Section 26 05 14 – Power Cables and Overhead Conductors

.3 Section 26 12 19 – Pad Mounted, Liquid Filled , Medium Voltage Transformers

1.2 SCOPE OF WORK

.1 Medium voltage (15Kv) close-coupled metal-clad switchgear with fused load interrupter switches..

.2 Spare module.

.3 Delivery to site.

.4 On-site inspection, testing and commissioning.

.5 On-site training.

.6 Warranty.

1.3 REFERENCES

Applicable portions of the following standards:

.1 ANSI/IEEE C37.20.3-Standard for Metal-Enclosed Switchgear.

.2 ANSI/IEEE C57.12.28, pad-mounted equipment enclosure integrity.

.3 ANSI C37.57 Metal-Enclosed Interrupter Switchgear Assemblies – Conformances

.4 ANSI/IEEE 24 – Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings.

.5 ANSI/IEEE 48 – Standard Test Procedures and Requirements for High Voltage Alternating-current Cable Termination.

.6 ANSI/IEEE C37.11 – requirement for electrical control for AC High-voltage Circuit Breakers rated on a symmetrical current basis or a total current basis.

.7 ANSI/IEEE C37.09 – Standard Design and Production Testing.

.8 ANSI 61 – Light Grey Finishes for outdoor apparatus and Electrical Equipment.

.9 ANSI/IEEE C57.13 – requirements for Instrument transformers.

.10 CSA C22.2 No.58, High Voltage Isolating Switches.

.11 CSA Z460-05 -Arc-Flash Hazard Protection.

.12 ULC 977, Fused Power Circuit Devices

.13 IEC 60298, A.C. metal-enclosed switchgear and control-gear for rated voltages above 1KV and up to and including 52KV.

.14 NEMA SG5 –Power Switchgear Assemblies.

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data indicating:

.1 Outline dimensions

.2 Enclosure construction

.3 Lifting and supporting points

.4 Electrical single line diagram

.5 Equipment electrical ratings/ Bill of material.

.6 Floor anchoring method and dimensioned foundation template.

.7 Dimensioned cable entry and exit locations.

.8 Dimensioned bushing locations and cable termination height.

.9 Individual shipping weight of each component and total weight of each complete assembly.

. .10 Layout of internal components suitably identified.

.11 Connection and wiring diagrams for auxiliary devices.

.12 List of recommended consumable spare parts.

.13 Fuses Time current characteristic curves.

.14 Short Circuit Rating,

1.5 QUALITY ASSURANCE & CERTIFICATION

.1 Submittal procedures.

.1 Provide type test certificates indicating switchgear and components tested as an integrated assembly.

.2 Submit test procedures to customer, at least 10 days prior to testing.

.3 Submit three(3) copies of production test results, signed by a professional engineer, to customer before equipment is shipped from factory.

.4 Submit switchgear for CSA special inspection and local supply authority review.

.5 Submit certification from CSA special inspection.

.6 Submit three(3) copies of site inspection and commissioning test report.

.7 the manufacturer switchgear must be the same as manufacturer of the load break interruptor.

1.6 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for primary switchgear for incorporation into manual specified, -closeout submittals.

.2 Provide three(3) copies of operating and maintenance data instructions, including components and spare parts list, assembled into combined O & M manual. Include electronic file and hard copy of final relay settings.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Ship and store switchgear assembly in upright position.

.2 Keep equipment doors locked and protect equipment from damage and dust.

.3 Store in weather protected, warm, dry enclosure in accordance with manufacturer's instruction or recommendation.

.4 Inspect equipment upon delivery for completeness and damage prior to acceptance.

PART 2 PRODUCTS

2.1 METAL-ENCLOSED SWITCHGEAR

.1 The metal-enclosed switchgear with load interrupter switches shall consist of a multiple section line-up (typical representation on drawings) and be of outdoor non-walk-in type construction. The sections shall contain the load interrupter switches and the necessary accessory components. The equipment shall be factory-assembled (except for necessary shipping splits) and operationally checked. The assembly shall be a self-supporting, floor mounted bay.

.2 Assemble to form a rigid self-supporting completely enclosed structure providing steel barriers between sections, spring load, manual and electrical charged, factory assembled.

.3 In establishing the requirements for the enclosure design, consideration shall be given to such relevant factors as controlled access, tamper resistance, protection from ingress of rodents and insects, and the possibility of arcing faults within the enclosure.

.4 The integrated switchgear assembly shall withstand the effects of closing, carrying and interrupting currents up to the assigned maximum short circuit rating.

.5 The switchgear shall consist of power fuses; rating as shown on drawings c/w associated CT and PT's, contactor, Relays, built in demand metering in each compartment (voltage, Amps, kw, KVA, PF) and all associated accessories as required.

.6 Provide Red-Green Switch position indicator.

.7 Provide instrument transformers for power monitoring and surge arresters as recommended by manufactures c/w with monitoring display units and CT's..

.8 Provide voltage transformers for power monitoring and low voltage heaters and as recommended .

.9 Provide surge arrestors, distribution class, shall be suitable for 12.47kV, nominal min .10kV, MCOV 8.4OKV switchgear installation c/w mounting accessories and enclosure.

.10 The metal-enclosed switchgear shall be factory assemble, inspected and tested at the factory prior to shipment.

.11 Switchgear shall be metal-enclosed Load Interrupter Switchgear, Stand-alone, dead front, shall be suitable for outdoor, non walk-in , CSA Enclosure and concrete pad mount type, suitable for underground service entrances and outgoing feeders c/w bushing arrangement.

.12 Ventilated louvres, vermin, insect and rain proof with easily replaceable fiberglass filters.

.13 Use non- corrosive bolts and hardware.

.14 Full height outer doors, gasketed hinges on left side, provision for multiple padlocking. Three point latch, stops, to open at least 135 degrees with viewing windows of transparent for IR Scanning and shatterproof material for inspection of fuses and disconnecting switch position.

.15 Allow for future extension on both sides of cubicle unit.

.16 Inner door: hinged and bolted mesh steel screens to prevent inadvertent contact with exposed live parts, to open at least 90 degrees.

.17 Storage container on inside surface of door capable of accommodating three (3) spare fuses per bays. Include spare fuses.

.18 Metal pocket with weatherproof envelope and 1 set of drawings and diagram prints on inside surface of door.

.19 The integrated switchgear assembly shall withstand the effects of closing and carrying.

.20 Bushings for connection of incoming and feeder cables shall be rated 1200 Amp continuous for the connection of 1200 Amp elbows.

.21 Manual operating mechanisms and viewing windows shall be located in the front side of the switchgear.

.22 Access to this compartment is gained from the front or rear of the structure by removing a steel barrier.

.23 Main connections between busbars, major switching components and fuses of continuous current rating to match major switching components.

.24 High conductivity copper for busbars and main connections.

.25 Provision for extension of bus on both sides of unit without need for further drilling or field preparation.

.26 Brace busbar system including ground bus to withstand stresses resulting from short circuit currents specified.

.27 Silver surfaced joints, secured with non-corrosive bolts and Belleville washers tightened with torque wrench in accordance with manufacturer's recommendations.

.28 Identify phases of busbars by suitable marking.

.29 Provide 60A-120/208V/3-Phase/4W panelboard inside switchgear. Electrical Contractor to wire this panel from Emergency power source inside CSB building. All equipment to be rated NEMA 3X.

.30 Provide space heaters to suit local weather conditions, 120V or 208V, 60Hz, single phase or three phase, low watt density c/w thermostat and disconnect switch, in each cubicle/bay, power transformer for heaters, sized by the manufacturer with minimum of 500W, 100W Lamp outdoor rated and U ground weatherproof duplex receptacles in each cubicle with externally weather-proof mounted switches for lighting. Power for lighting, heaters and duplex receptacles to be from new panel as per item above. Electrical Contractor to provide dedicated power from CSB Emergency power source. All equipment to be rated NEMA 3X.

.31 Provide standard provisions for spare.

.32 Ratings:

- .1 15KV Voltage class, 95KV BIL (Impulse withstand voltage).
- .2 60Hz
- .3 Main Bus 1200A continuous and be fully insulated for its entire length with an epoxy coating by the fluidized bed process.
- .4 Short circuit rating: Minimum 40KA, RMS Symmetrical.
- .5 Arc-resistant to IEC 60298 App. AA to 12.5KA for 15 cycles.
- .6 Momentary Current ratings: Equal to the load break interrupter.
- .7 Equipment to be subject to CSA Approval if necessary by special inspection, and approval shall be indicated by a label affixed to the equipment frame.
- .8 In Bus Ampacity: 1200 amps, continuous.
- .9 Ground bus 600 amps.

.33 Equipment to be subject to CSA Approval if necessary, by special inspection and approval shall be indicated by a label affixed to the equipment frame.

2.2 LOAD INTERRUPTER SWTCHGEAR

.1 Interrupting rating of 6 times continuous current on contacts on manual operation. Interrupting capacity to withstand and close into circuit having available fault current 100,000 A RMS symmetrical, with HRC-L fuses.

.2 Switch blades and terminals silver plated copper with drilled holes and surface ground to ensure high quality surface contact.

.3 Replaceable arc suppressing contacts of silver tungsten construction with first-I, last-out operation.

.4 Positive switching action of operating mechanism for independent of speed at which handle is operated.

.5 Quick make, quick break, stored energy operating mechanism for manual and electrical closing operation.

.6 Operating handle mechanically interlocked with fuse access door with provision for double padlocking in open position.

.7 Operating mechanism arranged to prevent teasing operation of contacts. Mechanism designed so that it is impossible to close switch without first charging opening spring.

.8 Opening and closing springs of switch must be charged sequentially not simultaneously.

.9 Opening of switch no longer than 7Hz.

.10 Operating handle to remain static when opening on shunt trip or by mechanical push button.

.11 Switches to be from accessible for quick and easy installation or removal.

.12 Removable interphase barriers and grid type arc chutes.

.13 Provide switch interlock to prevent inadvertent closure of switches if the door of the enclosure is open.

.14 Three-pole gang-operated mechanism

.15 Manual quick-make, quick-break over-toggle-type mechanism that does not require the use of a chain or a cable for operation, and utilizes a heavy-duty coil spring to provide opening and closing energy

.16 The speed of opening and closing the switch shall be independent of the operator, and it shall be impossible to tease the switch into any intermediate position under normal operation

.17 Separate main and break contacts to provide maximum endurance for fault close and load

.18 interrupting duty.

.19 Insulating barriers between each phase and between the outer phases and the enclosure

.20 A maintenance provision for slow closing the switch to check switch blade engagement and slow opening the switch to check operation of the arc interrupting contacts.

2.3 GROUNDING

.1 On each switchgear provide two(2) two-hole grounding pads below the bushing wells for each way, and connect to copper ground bus not smaller than 50 x 6 mm.

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

2.4 ENCLOSURES FOR OUTDOOR SWITCHGEAR

.1 Free standing, Pad mounted, dead front, weather proof, enclosures shall be constructed per IEEE.ANSI C37.20.3 outdoor specifications. Exceeds NEMA 3R. Constructed from minimum 14-Gage hot-rolled steel sheet.

.2 Enclosure should have clear access to the bushings for cable terminations.

.3 The metal-enclosed load interrupter switchgear shall consist of deadfront, completely metal-enclosed vertical sections containing load interrupter switches and fuses (where shown) of the number, rating and type noted on the drawings or specified herein.

.4 Each vertical section shall have a flat weatherproof roof with labyrinth shaped joints. Use of gasket or caulking to make roof joints weatherproof shall not be permitted. All exterior openings shall be screened to prevent the entrance of small animals and barriered to inhibit the entrance of snow, sand, etc. 120-volt space heater c/w thermostat as recommended by manufacturer, LED lighting and dedicated U ground duplex receptacles shall be provided in each vertical section. Power for space heaters shall be furnished by a control power transformer mounted in the switchgear. Power for the lightings and the U ground duplex receptacles to be from CSB emergency power distribution panel.

.5 Each vertical section shall be ventilated at the top, bottom and front to allow airflow to provide colling and help prevent buildup of moisture within the structures. The ventilated covers shall eb externally removable to all safe maintenance of the filter media without providing access to live parts.

.6 Vertical section construction shall be of the universal frame type using die-formed and bolted parts. All enclosing covers and doors shall be fabricated from steel whose thickness shall be equal to or greater than those specified in ANSI/IEEE C37.20.3. No owner removable hardware for covers or doors shall be thread-forming type. To facilitate installation and maintenance of cables and bus in each vertical section, a split removable top cover and padlockable hinged rear door held closed by bolts shall be provided. A G90 grade galvanized base shall isolate equipment from contact with the concrete pad providing protection from rust. Heavy-duty hot dipped galvanized anchor clips shall be provided to anchor the switchgear to the concrete pad.

.7 Each vertical section containing a switch shall have a single, full-length, flanged front door and shall be equipped with two (2) rotary latch-type padlockable handles. Provision shall be made for operating the switch and storing the removable handle without opening the full length door.

.8 Enclosure shall be dust resistant. All ventilated openings shall be filtered to inhibit the ingress of dust. The ventilated covers shall be externally removable to allow safe maintenance of the filter media without providing access to live parts. All external doors and covers shall be gasketed.

.9 Provision for padlocking the switch in the open or closed position

.10 A hinged cover with rustproof quarter turn nylon latches over the switch operating mechanism to discourage casual tampering

.11 The switch shall be removable from the structure as a complete operational component.

.12 Each vertical section shall be ventilated at the top and bottom, both front and rear, to allow airflow to provide cooling and to help prevent buildup of moisture within the structure OR

.13 A. Enclosures shall be constructed per IEEE/ANSI C37.20.3 Outdoor specifications. (Exceeds NEMA 3R.)

.14 Each vertical section shall have a sloped weatherproof roof with labyrinth shaped joints. Use of gasket or caulking to make roofjoints weatherproof shall not be permitted. All exterior openings shall be screened to prevent the entrance of small animals and barriered to inhibit the entrance of snow, sand, etc.

2.5 LIGHTNING ARRESTORS

.1 Provide lightning surge arrestors with ratings in accordance with manufacture's recommendations. Arrestors shall be intermediate class, one per phase rated to protect equipment from potential surges with the following characteristics:

.1 Metal oxide surge arrestor to ANSI/IEEE C62.11 for better performance and high reliability of surge protection schemes. Include information in shop drawings.

.2 Arrestor housing separable type to meet ANSI/IEEE 386.

.3 MOV in series with non-linear resistance graded gap structure.

.4 Voltage rating – 15kV.

.5 Meet ANSI/IEEE standard 142.

.6 Provide Grounded Metal Safety Barrier to prevent in advert contact with any live parts, yet all full view inspection of switch blade positions.

.7 Provide door interlocked from being open when the switch is closed.

2.6 FUSES

.1 The switchgear shall be equipped with a FuseLogic system to provide single-phase protection with the following features:

.1 Direct Acting, (15KV, "E" Rated fuses) fuse tripping, to automatically open the manually operated load interrupter switch in the event of a blown fuse. For fuses rated higher than those shown, system shall be shunt trip operated directly from blown fuse contacts (provide control power as recommended by manufacturer). Blocking the closing of the switch shall further prevent potential single -phasing conditions when a fuse in blown or if a fuse is not installed.

.2 Prevention of potential single-phasing conditions by blocking the closing of the manually operated load interrupter switch when a fuse is blown or if a fuse is not installed.

.3 Three Form C auxiliary switches (1 per phase) for phase blown/missing fuse indication. One Form C auxiliary switch (1 for all 3phases) for blown/missing fuse indication.

.4 Fuses shall be fixed in position in a non-disconnect fuse mounting with provisions for removal and replacement from the front of the gear.

.5 Fuse shall be ULC listed.

.6 The Blown fuse indicator shall be an “extended Travel” type with a minimum of 1 inch of travel.

2.7 TRANSFORMER CONNECTIONS

.1 When the transformer and switch are outdoor, provide a 15" throat with a 5” flange (20" altogether) with flange dimensions to match the dimensions of the transformer flange.

.2 A transformer primary load interrupter switch shall include the following when connecting to an indoor or outdoor liquid filled transformer, such as mineral oil, FR3, or silicone filled transformer

.3 Cable or bus bar connection from the load side of the fuse (or load side of an unfused switch) to the HV bushing terminal pad on the primary of the transformer.

.4 Include a connection for the ground bar to connect the switch enclosure to the transformer enclosure.

2.8 COMPONENTS

.1 Over-Center Mechanism:

.1 The load interrupter switch shall be rated at 1200 amperes continuous and interrupting; fixed mounted on NEMA class A-20 Porcelain standoff insulators; manually operated; quick-make, quick-break with the speed of operation independent of the operator. To provide for dependable operation, the device shall not rely on chains or cables to drive the blade assemblies open and closed. The spring operator assembly shall be isolated from high voltage and coupled through a direct drive shaft.

.2 Switches shall separate current carrying paths and arcing interruption paths.

.3 Switch blades shall be mounted on insulators that are attached to grounded metal barriers. Switches that utilize blades mounted on a common shaft with insulation from blade to blade rather than blade to ground are unacceptable.

.4 The switch operating handle shall be permanently attached to the outside front of the switchgear and ready for immediate use, shall be covered by a full-height solid door. Removable handles are not acceptable. the handle must operate in the conventional fashion with the switch closed with the handle in the up position and the switch open with

the handle in the down position. Provisions shall be available for padlocking the switch in either the open or closed position.

.5 Voltage and Short Circuit Ratings: match ratings specified for assembly.

.6 Provide compression Lugs for termination Cables onto the switchgear terminal pads.

.7 Mechanical Interlocks: the high-voltage compartment door shall be interlocked to prevent opening with the load interrupter in the closed position. The interlock must be directly attached to the operating mechanism and should not rely on long cables and linkages.

2.9 ACCESSORIES& SPARES

.1 Provide one set of recommended consumable spare parts.

.2 A 20"W BUS TRANSITION SECTION SHALL BE PROVIDED.

2.10 FINISHES

.1 Apply finishes in accordance with section 26 05 00 - Common Works Results-Electrical.

.2 Prior to assembly, all enclosing steel shall be thoroughly cleaned and phosphatized. A powder coating shall be applied electrostatically, then fused-on by baking in an oven. The coating is to have a thickness of not less than 1.5 mils. The finish shall have the following properties:

.1	Impact resistance (ASTM D-2794)	60 direct/60 indirect
.2	Pencil hardness (ASTM D-3363)	H
.3	Flexibility (ASTM D-522)	Pass 1/8-inch mandrel
.4	Salt spray (ASTM B117-85 [20])	600 hours
.5	Color	ANSI 61 gray

.3 Supply 1 spray cans of each color paint for touch up.

2.11 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with section 26 05 00 - Common Works Results-Electrical.

.2 Nameplates:

.1 Switchgear designation: engraved lamacoid label-black plate, white letters, size 6

.2 individual cubicle designations: engraved lamacoid labels-black plate, white letters, size 4.

.3 WARNING SIGNS:

.1 Provide warning signs in accordance with section 26 05 00 - Common Works Results-Electrical and CAN/CSA C22.2 No.31.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Visually inspect switchgear for evidence of damage and verify that surfaces are ready to receive work.

.2 Visually inspect to confirm that all items and accessories are in accordance with specifications and drawings.

.3 Verify field measurements as shown on drawings and shop drawings.

.4 Verify the required utilities are available, in proper location, and ready for use.

.5 Beginning of installation means installer accepts existing surface conditions.

3.2 INSTALLATION

.1 Coordinate dimensions and weight of anticipated switchgear before rough-in and provide housekeeping concrete pads on concrete piles.

.2 The contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.

.3 All necessary hardware to secure the assembly in place shall be provided by the contractor.

.4 Set and secure switchgear assemblies in place on housekeeping pads, rigid, plumb and square.

.5 Tighten bus joints, electrical connectors, and terminates according to manufacturer's published torque-tightening values. Install equipment-grounding conductors for switchgear with ground continuity to main electrical ground bus. Check factor-made connections for mechanical security and electrical continuity.

.6 Locate switchgear and securely bolt to floor housekeeping pad. Make all bus and cable connections and securely ground the entire unit including the system neutral to the ground electrode system.

.7 Connect power and control cables in accordance with manufacturer's recommendations.

.8 Connect switchgear ground bus to ground bus as indicated on drawings and specifications.

.9 Check factory made connections for mechanical security and electrical continuity.

.10 Clean all exposed surfaces. Tough-up damaged coatings using non-abrasive materials and methods recommended by Manufacturer. Eliminate all visible evidence of repairs.

.11 Apply programmable settings to over current and phase protection devices.

.12 Supply and install incoming cable connections, complete with lightening Surge arresters with ratings in accordance with manufacture's recommendations. Arrestors shall be distribution class, one per phase rated to protect equipment from potential surges with the following characteristic:

.1 Metal Oxide Sure arrestor to ANSI/IEEE C62.11 for better performance and high reliability of surge protection schemes. Include information in shop drawings.

.2 Arrestor housing Separable type to meet ANSI/IEEE 386.

.3 MOV in series with non-linear resistance grade gap structure.

.4 Voltage rating – 15KV.

.5 Meet ANSI/IEEE Standard 142.

.13 Provide interconnecting wiring switchgear, control panels and terminal cabinets.

.14 Provide a single line diagram of the high voltage system as per Section 26 05 00.

.15 Provide connections to control and monitoring equipment.

.16 Bending of high-voltage cables should be avoided or minimized. All necessary bends should meet at lease the minimum radii specified by the cable manufacturer and as per local code requirement.

.17 Test and commission all switchgear equipment, check trip unit settings against coordination study and arc flash study to ensure safety for maintenance personnel and protection of components. Record all settings and provide copies to Departmental Representative and MLC include copies in O & M Manuals.

.18 Co-ordinate connection of main load terminals of main fusible disconnect switch for connection by hydro.

.19 Connect main secondary service conductors to load terminals of fusible switches.

.20 Run grounding conductor #3/0 AWG bare copper from ground bus to station ground.

.21 Adjust and set all available protection to optimal settings as per over-current and co-ordination study.

.22 Clean all exposed surfaces. Touch-up damaged coatings using non-abrasive materials and methods recommended by Manufacturer. Eliminate all visible evidence of repair.

3.3 QUALITY ASSURANCE

.1 Transport and install switchgear in accordance with manufacturer's instructions. Obtain Manufacturing installation manuals for reference.

.2 Testing and commissioning of 12.5 kV pad-mount switchgear will be performed by the manufacturer. Coordinate with manufacturer's field representative to hand over switchgear for testing and to ensure that testing is completed and approved by Departmental Representative before energizing.

.3 Assist factory representative to test and place primary switchgear in service.

.4 Check phase rotation of each feeder.

.5 Check for continuity of grounding system.

.6 Verify correct current ratings.

.7 Verify correct interrupting rating.

.8 Verify correct BIL rating.

.9 Test operation of each Load interrupters Switches and associated fuses.

.10 Verify correct labeling.

.11 Verify proper clearances.

.12 Verify single phasing operation.

.13 Groundside contract includes one (1) site visit by Manufactures to set up and commission 12.5kV switchgear. Coordinate and provide attendance where necessary.

.14 Provide the services of a qualified factory-trained manufacturer's representative to assist to contractor in installation and startup of the equipment specified under this section. The manufacturer's representative shall provide technical direction and assistance to the testing of the assembly and components contained therein.

.15 The Contractor shall provide three (3) copies of the manufacturer's field startup report.

.16 The Contractor shall provide a qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

.17 The Contractor shall provide a training session for up to five (5) Manufacturer's representative certification.

.18 The training session shall be conducted by a manufacturer's qualified representative and consist of instruction on the assembly, switches and major components.

3.4 FACTORY TESTING

.1 Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

.2 Factory tests as outlined above shall be witnessed by the Departmental Representative.

- .1 The manufacturer shall notify the Departmental Representative two (2) weeks prior to the date the tests are to be performed.
- .2 The manufacturer shall include the cost of transportation and lodging for up to three (3) Departmental Representatives. The cost of meals and incidentals expenses shall be the Departmental Representative responsibility.

.3 The manufacturer shall include the cost of all transportation and lodging for up to two (2) Departmental Representatives. The cost of meals and incidental expenses shall be the Departmental Representative's responsibility.

.3 The manufacturer shall provide three (3) certified copies of factory test reports.

3.5 SITE TESTING, COMMISSIONING AND TRAINING

.1 Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and startup of the equipment specified under this section. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

.2 The Contractor shall provide three (3) copies of the manufacturer's field startup report.

.3 Provide the services of a qualified commissioning technician to:

.1 Inspect the final installation.

.2 Carry out High Pot and operational tests, including interlocking.

.3 Test and program over current device settings provided by the customer.

.4 provide electronic file and hard copy of final relay settings.

.5 Deliver formal on-site training to customer's maintenance personnel.

.4 Allow for on-site testing to be carried out in three phases:

.1 Service entrance module

.2 Provide lump sum costs for each visit, plus per diem expenses and hourly rates for additional time on site.

.5 Warranty

.1 Provide 24 months warranty on equipment from date of commissioning.

3.6 TRAINING

.1 The Contractor shall provide a training session for up to five (5) owner's representatives at a job site location determined by the Departmental Representative.

.2 The training session shall be conducted by a manufacturer's qualified representative and consist of instruction on the assembly, switches and major components.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section covers items common to Sections of Division 26. These Sections supplement requirements of Division 1.

1.2 REFERENCES

.1 CSA International

.1 CSA C22.2 No.29-11, Panelboards and Enclosed Panelboards.

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 panelboards and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Include on drawings:

.1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

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 panelboards for incorporation into manual.

1.5 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.

.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 panelboards from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 PANELBOARDS AND CDPS

.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 Central Distribution Panel (CDP): 400Amp-347/600V/3-Phase/4W Generator Main Emergency CDP.

.3 347/600V panelboards and CDPs: bus and breakers rated for 42kA (symmetrical) interrupting capacity or as indicated.

.4 120/208V panelboards and CDPs: bus and breakers rated for 42kA (symmetrical) interrupting capacity or as indicated.

.5 CDPs: number of circuits, and number and size of branch circuit breakers as indicated.

.6 Minimum of 2 flush locks for each panel board.

.7 Two keys for each panelboard and key panelboards alike.

.8 Copper bus with neutral of same ampere rating of mains.

.9 Breaker suitable for bolt-on breakers.

.10 Trim with concealed front bolts and hinges.

.11 Trim and door finish: baked enamel.

.12 Include grounding busbar with terminals for bonding conductor equal to breaker capacity of the panel board.

.13 Equipment to have sprinkler proof enclosures and drip hood plates.

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 Bolt-on breakers as shown on drawings and section 26 28 16.02.

2.3 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 as indicated.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

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 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 00 - Rough Carpentry. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 19 – Waste Management and Disposal.

.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 19– Waste Management and Disposal.

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 RELATED REQUIREMENTS

.1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 REFERENCES

.1 CSA International

.1 CSA C22.2 No. 5-09, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide new matching Main Circuit breaker, 1200AF/AT, 600V, 3poles/phase, LSIG, fully adjustable, Minimum Short Circuit withstand rating shall be 42KA to be installed on DP-2. The DP-2 Switchboard is located in ATB man electrical room.

.2 Provide new matching branch LSIG 400AF/AT, 600V, 3 poles/phase Molded Case Circuit Breaker in DP-2 Switchboard, Min Short Circuit Withstand Rating shall be minimum 42KA, phase Instantaneous settings shall be independently adjustable, Breaker to Match Existing branch feeders in the existing DP-2 switchboard or shall be suitable for the existing switchboard installation.

.3 Provide new CDP c/w two (2) LSIG 400AF/AT and one (1) 250AF/200AT, 600V, 3poles/phase, molded case circuit breakers for CSB Emergency Generator Distribution Upgrades, Min. Short Circuit Withstand Rating Shall be 42KA for Breakers and System, Interchangeable Trip units to be set as per Short Circuit and Coordination Study. Exact location to be Determined on Site, the breakers shall be suitable for close Emergency power operations, Phase Instantaneous settings shall be independently adjustable.

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

.5 Provide new LSIG 300AF/AT, 600V, 3poles/phase, fully adjustable, to be installed on CSB Normal Distribution Panel for new load bank.

.3 Include time-current characteristic curves for breakers with interrupting capacity of as shown from section 1.4.2.1 to 1.4.2.3 symmetrical (rms) and over at system voltage.

.4 Certificates:

.1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 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: [_____].

1.4 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.

.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 off ground, 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: to CSA C22.2 No. 5

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

.1 Switchboard internal hardware to mount breakers to be included.

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

.4 LSIG molded case circuit breakers for low voltage main switchboard (branch feeders).

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

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

.6 Circuit breakers with interchangeable trips as indicated.

.7 Circuit breakers to have minimum 42kA symmetrical rms interrupting capacity rating.

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, instantaneous and ground fault tripping for phase fault short circuit protection.

.2 Provide breakers complete with trip units as indicated in this section and drawings.

2.4 OPTIONAL FEATURES

.1 Include:

.1 Shunt trip.

.2 Auxiliary switch.

.3 Motor-operated mechanism c/w time delay unit.

.4 Under-voltage release.

.5 On-off locking device.

.6 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 19– Waste Management and Disposal.

.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 19– Waste Management and Disposal.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 36 23 – AUTOMATIC TRANSFER SWITCHES

1.2 REFERENCE STANDARDS

.1 CSA Group (CSA):

.1 CSA C282-15 Emergency Electrical Power Supply for Buildings

1.3 PAYMENT

.1 Submit payment for services of qualified for Service technician in accordance with Section 01 29 83 - Payment Procedures for modification, testing, verification of upgrades required on existing Generator control system.

1.4 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 existing modification of control on existing generating system and include product characteristics, performance criteria, finish and limitations.

.3 Submit commissioning report.

1.5 QUALIFICATIONS

.1 Use qualified for Existing Generator technician.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Include materials as follows:

.1 Provide Electrical components to make system fully operational.

.2 Wiring and materials, including necessary rigid steel conduits and fittings for making connections.

.3 The power circuit cables will be RW90 (-40°C) cross link polyethylene,

.4 The control circuit cables will not be less than No. 14, RW90 multiple conductor colour or number coded.

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 generating equipment installation in accordance with manufacturer's 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 CONTROL AND TRANSFER PANEL

.1 Make control and power circuit connections as indicated for newly added ATS and control mechanism.

.2 Identify cables at both ends.

.3 Tag with slip-on wire maker, each wire end with number corresponding to number in panel.

.4 Make terminations with self-insulated terminals of flanged fork or ring type.

.5 Sequence of Emergency Power for newly added and modified existing emergency distribution system are:

.1 Upon normal power failure on the newly modified CSB power distribution system, the pertinent Existing Automatic Transfer Switch to start the generator, the existing Generator to reach at steady state per manufacturer recommendation, then, the existing Automatic transfer switch to switch to emergency power source (to Serve Emergency CSB power distribution system), is an open transition system.

.2 Up on normal power failure on the newly added and modified to ATB power distribution system, the pertinent Newly Added Automatic Transfer Switch to start the generator, the existing Generator to reach at steady state per manufacturer recommendation, then, the new Automatic transfer switch to switch to emergency power source (to Serve Emergency ATB power distribution system), shall be open transition system.

.3 Up on both normal power failures on CSB and ATB power distribution system, One of the Transfer switches to start the generator, the existing Generator to reach at steady state per manufacturer recommendation, then, both Automatic transfer switches to transfer to emergency power source but one at a time per manufacturer recommendation (to Serve both Emergency CSB and ATB power distribution system), shall be open transition system.

3.3 ADDITIONAL WORKS

.1 Complete any additional work as instructed by Departmental Representative to:

.1 Ensure equipment is safe to operate.

.2 Provide complete and operating system upgrade to suit the new added Emergency system and existing modified.

3.4 SITE QUALITY CONTROL

.1 Qualified technician to: inspect and verify that installation of interruptible power unit is acceptable and complete. Provide inspection report to the Departmental Representative.

.2 Commissioning: do site commissioning of existing upgrade of generator control unit by qualified technician in accordance with Section 01 91 13 - General Commissioning Requirements.

.3 Develop and submit commissioning report including time delay settings, operational set points and adjustment ranges.

.4 Refer to Section 01 91 13 - General Commissioning Requirements for commissioning requirements.

3.5 SYSTEM STARTUP

.1 Preparation: before starting unit, carry out thorough mechanical and electrical inspection of equipment, and perform following checks and adjustments:

.1 Disconnect battery cables from batteries to prevent accidental starting.

.2 Turn engine several revolutions by means of hand-barring devices to ensure parts are free and there are no obstructions to its running.

.3 Check engine/generator alignment readings to ensure they match readings attained at time of manufacture.

.4 Check fluid levels and top up as necessary. Pre-lubricate engine and turbochargers as recommended by engine manufacturer. Install drip pan beneath engine.

.5 Confirm cooling system antifreeze is effective to at least minus 40°C.

.6 Check belts for correct tension and adjust as necessary.

.7 Check and grease points.

.8 Check and tighten properly nuts, bolts.

.9 Confirm safety guards are in place and properly secured.

.10 Check linkages for damage and freedom of movement.

.11 Check fuel supply system for leakage.

.12 Ensure fuel supply and fuel injection systems are properly primed.

.13 Check and tighten properly electrical connections.

.14 Check starting battery electrolyte level specific gravity and for proper installation.

.15 Check battery charger for proper operation and adjust as necessary.

.16 Carry out generator winding insulation resistance test. If reading is unacceptable, carry out recognized drying procedure. Do not start unit until satisfactory reading has been achieved.

.17 Check jacket coolant heater for proper operation.

.18 Complete additional preparations deemed necessary.

.2 Performance verification: on completion of start-up preparations, take following action:

.1 Have at hand, during initial start-up, means for choking off air supply to engine air induction manifold in event of engine run away or other emergency.

.2 Reconnect starting battery cables to starting battery.

.3 Start unit only in presence of Departmental Representative and allow to warm up. Stop unit if abnormal conditions are encountered.

.4 Check for and correct leakage from exhaust system, fuel system, cooling system, and lubricating oil system.

.5 Adjust vibration isolators.

.6 Observe and confirm lubricating oil pressure and coolant temperature are within limits and no harmful vibration or sounds are evident.

.7 Ensure voltage is within operating parameters and automatic voltage regulator is operating correctly.

.8 Ensure manual voltage control is operating correctly.

.9 Ensure frequency is within operating parameters and electronic governor is operating correctly.

.10 Check engine air ventilation system for proper operation.

.11 Check operation of engine-mounted protective sensing devices and adjust as necessary.

.12 Check phase sequence of normal power supply and ensure emergency power supply are in same sequence.

.13 Check operation of electronic controller protection, transfer, timing, metering, and annunciator functions and adjust as necessary.

.14 Check operation and calibration of analog metering and adjust as necessary.

.15 Apply electrical load, read the metres, and correlate these readings.

.16 Demonstrate:

.1 Unit start, transfer to load, retransfer to normal power, unit shutdown, on "automatic" control.

.2 Unit start, transfer to load, retransfer to normal power, unit shutdown, on "test control". Unit start and shutdown, on "engine start" control.

.3 Unit cranking, start, and shutdown by means of engine-mounted key switch.

.4 Run unit on full (nameplate) load for minimum period of 4 hours to show load-carrying capability, stability of voltage and frequency, and satisfactory performance of engine ventilating system to provide adequate cooling, exhaust system.

.5 Every 1/2 hour carry out and record readings on Test Chart.

.17 Perform additional tests as required by Departmental Representative to confirm unit is operating satisfactorily.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 19 - Waste Management and Disposal.

.2

.3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 19 - Waste Management and Disposal .

.4 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

3.7 DEMONSTRATION AND TRAINING

.1 As directed by Departmental Representative and in accordance with Section 01 79 00 - Demonstration and Training carry out demonstrations of complete power unit for Project Acceptance Board.

.2 Deliver familiarization training of operating and maintenance staff.

- .1 Include instruction to site operation and maintenance staff for proper care, operation, and maintenance of equipment.
- .2 Maintain services for such period, and for as many visits as necessary to put equipment in operation, and confirm that operating personnel are conversant with aspects of its care and operation.

.3 Include fuel required for performing diesel-generator site test and top-up after acceptance test completion.

3.8 PROTECTION

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

.2 Repair damage to adjacent materials caused by electric power generating equipment installation.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 All sections as per TOC.

1.2 REFERENCES

.1 CSA International

.1 CSA C22.2 No.5-09, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, NMX-J-266-ANCE-2010).

.2 CSA C22.2 No.178.1-2007, Automatic Transfer Switches.

.3 CAN/CSA C60044-1 07, Instrument Transformers.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 2-1996(R2009), Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC, Part 8: Disconnect Devices for Use in Industrial Control Equipment.

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 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 Newfoundland and Labrador, Canada.

.1 Indicate on drawings:

.1 Make, model and type.

.2 Load classification:

.1 Motor load:

.2 Restricted use: resistance and general loads, 0.8 pf or kW.

.3 Single line diagram showing controls and relays.

.4 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.

1.4 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for 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.

1.5 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.

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

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Automatic load transfer equipment to:

.1 Open Transition

.2 Monitor voltage on phases of normal power supply.

.3 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.

.4 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.

.5 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.

.6 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

.7 New Automatic transfer switch (ATS) to match existing automatic transfer switch.

.8 Electrical Contractor to request Shop Drawing of existing equipment.

.2 The Bypass-Isolation Transfer Switch shall consists of two major modules – the automatic transfer and the bypass-isolation switch.

.3 The bypass section shall be with a quick make/quick break manual load transfer handle and a control/interlock system consisting of both mechanical and electrical interlocks. The bypass is equipped with normal failure sensing and a time delay to start the engine automatically if the ATS has been removed for service and a failure occurs. The modules are mounted in a compact enclosure and completely interconnected requiring only the normal source, emergency source and load cable connections. Once installed, no cables need to be removed to isolate the transfer switch module for maintenance or inspection. The automatic transfer switch may be withdrawn for testing or maintenance without disturbing the load.

.4 The transfer switch module has three positions:

.1 Automatic: The transfer switch is carrying the load, and the bypass switch is in the open position. This is the normal operating position.

.2 Test: The bypass switch is closed and feeding the load. The transfer switch has control power and may be operated for test purposes via the test switch on the enclosure door.

.3 Isolate: The transfer switch is withdrawn from all power and ready for maintenance. The load is served by the bypass switch.

.5 The Transfer Switch is installed on a draw-out mechanism, with electrical and mechanical interlocks for secure removal after load bypass. The CTS control/logic panel is mounted on the enclosure door and connected by a wire harness and multi-pin disconnect plugs. The transfer switch and/or the control panel may be tested, isolated and removed for maintenance without load interruption.

.6 The bypass-isolation switch module is the same basic design as the transfer switch module and thus has the same electrical ratings. Manually operated, it features high speed, quick make/quick break contact action. The bypass-isolation switch has three basic positions:

.1 Automatic: Normal bypass contacts open, emergency bypass contacts open.

.2 Bypass Normal: Normal bypass contacts closed, emergency bypass contacts open.

3. Bypass Emergency: Normal bypass contacts open, emergency bypass contacts closed.

2.2 MATERIALS

.1 Instrument transformers: to CAN/CSA C60044-1.

.2 Contactors: to NEMA ICS2.

.3 Contact Type Transfer Equipment: to CSA C22.2 No.178

.4 Two-4 pole contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked, motor/solenoid operated, open type with CSA enclosure.

.5 Rated: 347/600 V, 60Hz, 400A, 4 wire, 4 poles (Switched Neutral).

.6 Main contacts: silver surfaced, protected by arc disruption means.

.7 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.

.8 Auxiliary contact: silver plated, to initiate emergency generator start-up on failure of normal power.

.9 Fault withstand rating: Minimum 42 kA symmetrical for 3 cycles with maximum peak value of 50 kA.

.10 Lever to operate switch manually when switch is isolated.

.11 Neutral bar, switch rated: 400 A.

2.3 INTERLOCKS

.1 Bypass-Isolation Transfer Switch shall be supplied with all necessary electrical and mechanical interlocks to prevent improper sequence of operation as well as the necessary interlocking circuit for engine starting integrity.

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 Control transformers: dry type with 120 V secondary to isolate control circuits from:

- .1 Normal power supply.
- .2 Emergency power supply.

.3 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:

- .1 Voltage sensing: 3 phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2 V minimum undervoltage and over voltage protection.
- .2 Time delay: normal power to standby, adjustable solid state, 5 to 180 s,20 s to 10 minutes.

.3 Time delay on engine starting to override momentary power outages or dips, adjustable solid state, 3 to 20 s delay.

.4 Time delay on retransfer from standby to normal power, adjustable 5 to 180 s.

.5 Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable solid state, 20 s intervals to 10 minutes.

.6 Time delay during transfer to stop transfer action in neutral position to prevent fast transfer, adjustable, 5 s intervals to 180 s.

.7 Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches preset adjustable values.

.8 Neutral disconnected position delay: allow time for motors to delay between live sources, adjustable, 0 to 5 s.

.4 Solid state electronic in-phase monitor.

2.5 BYPASS-ISOLATION SWITCH

.1 A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.

.2 Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control interwiring shall be provided with disconnect plugs.

.3 Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.

.4 Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs which disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.

.5 The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.

.6 When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.

.7 Designs requiring operation of key interlocks for bypass isolation or ATSs which cannot be completely withdrawn when isolated are not acceptable.

2.6 MICROPROCESSOR CONTROLLER

.1 The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.

.2 A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to ± 1% of nominal voltage. Frequency sensing shall be accurate to ± 0.2%. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.

.3 All customer connections shall be wired to a common terminal block to simplify field-wiring connections.

.4 The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC).

2.7 ENCLOSURE

.1 The ATS/BPS shall be furnished in a Type 1 enclosure unless otherwise shown on the plans.

.2 All standard and optional door-mounted switches and pilot lights shall be 16-mm industrial grade type or equivalent for easy viewing & replacement. Door controls shall be provided on a separate removable plate, which can be supplied loose for open type units.

2.8 ACCESSORIES

.1 Ensure pilot lights indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel.

.2 Auxiliary relay to provide N.O. and N.C. contacts for remote alarms.

.3 Manual bypass and isolator: to both supplies.

2.9 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 switch: size 5 nameplates.

2.10 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 5 days minimum in advance of date of 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

2.11 CONTROLLER DISPLAY AND KEYPAD

.1 A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:

.1 Nominal line voltage and frequency

.2 Single or three phase sensing

.3 Operating parameter protection

.4 Transfer operating mode configuration: Open transition

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

2.12 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

.1 Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 60°C.

.2 Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

.3 The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

.4 Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

.5 The controller shall include a user selectable algorithm to prevent repeated transfer cycling to a source on an installation which experiences primary side, single phase failures on a Grounded Wye – Grounded Wye transformer which regenerates voltage when unloaded. The algorithm shall also inhibit retransfer to the normal (utility) source upon detection of a single phasing condition until a dedicated timer expires, the alternate source fails, or the normal source fails completely and is restored during this time delay period. The time delays associated with this feature shall be adjustable by the user through the controller keypad and LCD.

.6 Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 60°C.

.7 Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

.8 The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

.9 Source status screens shall be provided for both normal & emergency to pro-vide digital readout of voltage on all 3 phases, frequency, and phase rotation.

.10 The controller shall include a user selectable algorithm to prevent repeated transfer cycling to a source on an installation which experiences primary side, single phase failures on a Grounded Wye – Grounded Wye transformer which regenerates voltage when unloaded. The algorithm shall also inhibit retransfer to the normal (utility) source upon detection of a single phasing condition until a dedicated timer expires, the alternate source fails, or the normal source fails completely and is restored during this time delay period. The time delays associated with this feature shall be adjustable by the user through the controller keypad and LCD.

.11 Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout and trip setting capabilities (values shown as % of nominal unless otherwise specified):

PARAMETER	SOURCES	DROPOUT / TRIP	PICKUP / RESET
UNDERVOLTAGE	N&E,3Φ	70 TO 98%	85 TO 100%
OVERVOLTAGE	N&E,3Φ	102 TO 115%	2% BELOW TRIP
UNDERFREQUENCY	N&E	85 TO 98%	90 TO 100%
OVERFREQUENCY	N&E	102 TO 110%	2% BELOW TRIP
VOLTAGE UNBALANCE	N&E	5 TO 20%	1% BELOW DROPOUT

2.13 TIME DELAYS

.1 An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.

.2 A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

.3 Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.

.4 A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.

.5 A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:

1. Prior to transfer only.
2. Prior to and after transfer.
3. Normal to emergency only.
4. Emergency to normal only.
5. Normal to emergency and emergency to normal.
6. All transfer conditions or only when both sources are available.

.6 All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.

.7 All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

2.14 COMMUNICATIONS MODULE

.1 Shall provide remote interface module to support monitoring of vendor's transfer switch, controller and optional power meter. Module shall provide status, analog

parameters, event logs, equipment settings & configurations over embedded webpage and open protocol. Features shall include:

.1 Email notifications and SNMP traps of selectable events and alarms may be sent to a mobile device or PC.

.2 Modbus TCP/IP, SNMP, HTTP, SMTP open protocols shall be simultaneously supported.

.3 Web app interface requiring user credentials to monitor and control the transfer switch supporting modern smart phones, tablets and PC browsers. User will be able to view the dynamic one-line; ATS controls status, alarms, metering, event logging as well as settings.

.4 Secure access shall be provided by requiring credentials for a minimum of 3 user privilege levels to the web app, monitor (view only), control (view and control) and administrator (view, control and change settings). 128-Bit AES encryption standard shall be supported for all means of connectivity.

.5 Shall allow for the initiating of transfers, retransfers, bypassing of active timers and the activating/deactivating of engine start signal shall be available over the embedded webpage and to the transfer switch vendor's monitoring equipment.

.6 An event log displaying a minimum of ninety-nine (300) events shall be viewable and printable from the embedded webpages and accessible from supported open protocols.

.7 Four (4) 100 Mbps Ethernet copper RJ-45 ports, five (2) serial ports, Termination dip-switches and LEDs for diagnostics.

.8 DIN rail mountable.

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.

.2

3.2 INSTALLATION

.1 Locate, install and connect transfer equipment as indicated.

.2 Check relays, solid state monitors and adjust as required to ensure correct operation.

.3 Install and connect battery and remote alarms.

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 standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.

.4 Set selector switch in "Manual" position and check to ensure proper performance.

.5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.

.6 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 minutes, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown. Repeat, at 1 hour intervals, 2 times, complete test with selector switch in each position, for each test.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 19– Waste Management and Disposal.

.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 19– Waste Management and Disposal.

END OF SECTION