1 General

1.1 **SUMMARY**

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.2 Related Sections

.1 N/A

1.2 **CASH ALLOWANCES**

.1 N/A

1.3 **CODES, PERMITS AND INSPECTIONS**

.1 Applicable Codes and Standards

.1 RCMP PMM

.2 Canadian Electrical Code, Part-I 2015

.3 Electrical Safety Authority (ESA)

.4 Electrical and Electronic Manufacturers Association of Canada (EEMAC)

.5 National Electrical Manufacturers Association (NEMA)

.6 National Building Code 2010

.7 Canadian Standards Association (CSA)

.8 Underwriters' Laboratories of Canada (ULC)

.9 Illuminating Engineering Society (IES)

.10 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., (ASHRAE)

.11 CSA C282-09, Emergency Electrical Power Supply for Buildings

.12 CSA Z32-09, Electrical safety and Essential Electrical Systems in Health Care Facilities

.13 National Fire Protection Association (NFPA)

.14 American Standards Association (ASA or ANSI)

.15 Institute of Electrical and Electronic Engineers (IEEE)

.16 Electronic Industries Association (EIA)

.17 Telecommunications Industry Association (TIA)

.18 Building Industry Consulting Services, International (BICSI)

.19 Material Safety Data Sheets by product manufacturers

.20 Codes, standards, and regulations of local governing authorities having jurisdiction

.21 Additional codes and standards listed in Trade Sections

.22 Owner's standards

.2 Comply with Canadian Electrical Code, all local, provincial and federal laws, where applicable and with authorities having jurisdiction. Make any changes or alterations required by authorized inspector of authority having jurisdiction.

.3 Equipment and material must be acceptable to Electrical Safety Authority.

.4 Where materials are specified which require special inspection and approval, obtain such approval for the particular installation with the co-operation of the material supplier.

.5 Obtain and pay for permits and inspections required for work performed.

.6 Supply and install warning signs, nameplates and glass covered Single Line Diagrams as required by Electrical Safety Authority.

.7 Submit required Documents and shop drawings to authorities having jurisdiction in order to obtain approval for the Work. Copies of Contract Drawings and Specifications may be used for this purpose.

1.4 **REFERENCE STANDARDS**

.1 These Specifications supplement the referenced standards.

.2 Where standards differ between authorities, the most rigid apply.

.3 Where requirements of the specifications exceed referenced standards, the specifications apply.

1.5 **DEFINITIONS**

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE STD 100.

1.6 **DRAWING AND SPECIFICATIONS COORDINATION**

.1 In the case of discrepancies or conflicts between the Drawings and Specifications and local governing authority standards, contact Consultant and obtain direction. If direction is not available prior to close of Bids, include for the most costly arrangement, but ensure that direction is obtained prior to start of the Work.

1.7 **COORDINATION**

.1 Carefully examine Work and Drawings of all related trades and thoroughly plan the Work so as to avoid interferences. Report defects which would adversely affect the Work. Do not commence installation until such defects have been corrected.

.2 Coordinate Work of this Division such that items will properly interface with Work of other Divisions.

.3 All embedded openings shall be considered by structural and architectural disciplines.

.4 Architectural Drawings, all equipment arrangement and cable or cable tray route shall be rechecked with Architectural drawing before starting installation.

.5 Mechanical Drawings, all mechanical related loads (location and required power / voltage) shall be rechecked by Mechanical final drawing.

.6 Coordinate work of this Division to ensure that damage does not occur to the fireproofing work of any other Division.

1.8 **SUBSTITUTIONS**

.1 When only one manufacturer's catalogued trade name is specified, provide only that catalogued trade name, material or product.

.2 When more than one manufacturer's trade name is specified for a material or product, the choice is the bidders.

.3 No substitution is allowed upon award of contract.

1.9 **DIMENSIONS AND QUANTITIES**

.1 Dimensions shown on Drawings are approximate. Verify dimensions by reference to shop drawings and field measurement.

.2 Quantities or lengths indicated in Contract Documents are approximate only and shall not be held to gauge or limit the Work.

.3 Make necessary changes or additions to routing of conduit, cables, cable trays, and the like to accommodate structural, mechanical and architectural conditions. Where raceways are shown diagrammatically run them parallel to building column lines.

1.10 **EQUIPMENT LOCATIONS**

.1 Devices, fixtures and outlets may be relocated, prior to installation, from the location shown on the Contract Drawings, to a maximum distance of 3 m, without adjustment to Contract price.

.2 Switch, control device and outlet locations are shown diagrammatically.

1.11 **WORKING DRAWINGS AND DOCUMENTS**

.1 Where the word "HOLD" appears on Drawings and other Contract Documents, the Work is included in the Contract. Execute such Work only after verification of dimensions and materials and obtaining Consultant's written permission to proceed.

1.12 **INSTALLATION DRAWINGS**

.1 Prepare installation drawings for equipment, based upon approved Vendor drawings, to check required Code clearances, raceway, busway and cable entries, sizing of housekeeping pads and structure openings. Submit installation drawings to Consultant for review.

1.13 **"AS BUILT" RECORD DRAWINGS**

.1 Maintain a set of Contract Drawings on site and record all deviations from the Contract Documents. As a mandatory requirement, recording must be done on the same day deviation is made. Be responsible for full compliance with this requirement.

.2 Mark locations of feeder conduits, junction and terminal boxes and ducts or conduits run underground either below the building or outside the building.

.3 Where conduit and wiring are underground or underfloor, furnish field dimension with respect to building column lines and inverts with respect to finished floor levels or grades.

.4 Record deviations from branch circuit numbers shown on Drawings.

.5 Prepare diagrams of interconnecting wiring between items of equipment including equipment supplied by Owner and under other Specification Sections.

1.14 **TEST REPORTS**

.1 For each check and test performed prepare and submit a Test Report.

.2 Include record of all tests performed, methods of calculation, date and time of test, ambient conditions, names of testing company, test engineer, witnesses, also calibration record of all test instruments used together with manufacturers name, serial number and model number.

.3 Include calibration record, percentage error and applicable correction factors.

1.15 **SUBMITTALS**

.1 Submittals to be in accordance with Division 01 Submittal Procedures, the articles below and/or as indicated in each electrical specification section.

.2 Submit manufacturer's printed product literature, specifications and datasheet. Include product characteristics, performance criteria, and limitations.

.3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 Submittal Procedures.

.4 Submit shop drawings in accordance with Division 01 Submittal Procedures.

.1 Shop drawings: submit drawings stamped and signed by the general and electrical contractors. Shop drawings not submitted with contractor stamps will be returned not reviewed.

.2 Provide separate shop drawings for each isolated system complete with performance and product data.

.5 Obtain and pay for permits and inspections required for the work performed.

.6 Shop drawings:

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

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

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

.7 Quality Control:

.1 Provide CSA certified equipment and material.

.2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to site.

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

.4 Permits and fees: in accordance with contract.

.5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.

.6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.

.8 Where materials are specified which require special inspection and approval, obtain such approval for the particular installation with the co-operation of the material supplier.

1.16 **QUALITY ASSURANCE**

.1 Quality Control and Assurance: in accordance with Division 01 Quality Control.

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.

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

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

.3 Health and Safety Requirements: do construction and occupational health and safety in accordance with Division 01 Health and Safety Requirements.

1.17 **FACTORY WITNESS TESTS**

.1 Prior to Consultant attendance at factory for witness testing, perform the following:

.1 Successfully conduct test to be witnessed.

.2 Following successful testing, inform the Consultant, in writing, that tests to be witnessed have been successfully performed.

1.18 **SYSTEM STARTUP**

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

.2 Arrange and pay for services of Factory Service Engineer for major systems, to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

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

1.19 **OPERATING AND MAINTENANCE MANUALS**

.1 Refer to and comply with Division 01 and related Sections.

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

.3 Operating instructions to include following:

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

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

.3 Safety precautions.

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

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

1.20 **COMMISSIONING**

.1 Refer to Division 01 for additional commissioning requirements.

.2 The Commissioning Agent may also be present for any testing/commissioning activities and are to be notified by the Contractor in advance of these activities.

.3 Submit a copy of test reports of systems and equipment to the Commissioning Agent, prior to start of commissioning activity or as directed by Commissioning Agent.

.4 Where commissioning specifications are included as part of Division 01, the requirements of the Section entitled Electrical Commissioning are to supplement commissioning requirements of Division 01. Where variances or contradictions exist, the more stringent requirement will apply unless otherwise directed by Consultant.

1.21 **LOCAL ELECTRICAL UTILITY REQUIREMENTS**

.1 Comply with the latest conditions of supply requirements of the local electrical Utility having jurisdiction. Execute infrastructure work related to the local Utility in accordance with requirements and coordinated Utility requirements with the respective Divisions of the Work providing such work. Include for the following in relation to Utility:

.1 Preconstruction meeting;

.2 Access for electrical Utility's Inspector to be on duty for duration of work or as required by the Utility;

.3 Underground inspection: submission of approval drawings and application for inspection prior to any inspection of work;

.4 Approval of work and materials by electrical Utility’s Inspector prior to any backfilling work.

1.22 **SERIES RATED COMBINATIONS**

.1 Series rated combinations of over-current protective devices are only permitted where specified on plans otherwise provide full rating distribution.

2 Products

2.1 **APPROVALS AND QUALITY**

.1 Provide new materials bearing certification marks or labels acceptable under Canadian Electrical Code.

.2 Equipment must bear, on manufacturer’s label, certification mark or label acceptable under Electrical Safety Authority.

.3 Provide units of same manufacture where two or more units of same class or type of equipment are required.

.4 Manufacturer's names are stated in this Specification to establish a definite basis for tender submission and to clearly describe the quality of product that is desired for the work.

2.2 **STANDARD SPECIFICATIONS**

.1 Ensure that the chemical and physical properties, design, performance characteristics and methods of construction of all products provided comply with latest issue of applicable Standard Specifications issued by authorities having jurisdiction, but such Standard

Specifications shall not be applied to decrease the quality of workmanship, products and services required by the Contract Documents.

2.3 **MATERIALS AND EQUIPMENT**

.1 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.

.2 Factory assemble control panels and component assemblies.

.3 Ensure no counterfeit breakers are used in the project. Do random sample checks in non-factory supplied breakers.

.4 Enclosure CSA types referred to in this specification to be in accordance to CAN/CSA 22.2 No.94-M91(R2011)-Special Enclosures and/or their EEMAC/NEMA equivalent, whichever is more stringent.

2.4 **ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls as indicated.

.2 Control Wiring and Conduit: in accordance with section 26 05 05 – Electrical Requirements for Mechanical Equipment, except for conduit wiring and connections below 50V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.5 **WARNING SIGNS**

.1 Warning Signs: in accordance with requirements of authority having jurisdiction.

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

2.6 **WIRING TERMINATIONS**

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

2.7 **SPRINKLER PROOF EQUIPMENT**

.1 Ensure that electrical equipment installed in electrical rooms and other areas containing sprinklers is constructed such that exposure to water from the sprinkler heads does not impair the effectiveness of the enclosed equipment.

.2 Provide a separate cover or roof on all 2285 mm high equipment. Provide an overhang at the front, rear and sides to effectively prevent the entrance of water either at the top or through projecting faceplates, meters, etc.

.3 Where penetrations are made in drip shields, flash and seal using manufacturer's approved caulking to maintain drip shield integrity.

.4 Ensure that enclosure louvres are of outdoor design such that falling water or water running down the sides will not enter the enclosure.

.5 Where enclosure openings in the top or sides are required for outgoing conduits, provide waterproof conduit fittings.

.6 Provide panels and transformers with hoods.

.7 Provide sprinkler proof busways.

.8 In electrical rooms containing sprinklers provide wall mounted equipment such as pull boxes, junction boxes, splitter troughs, wireways, auxiliary gutters, cable troughs and disconnect switches located below the level of the sprinkler heads with the following accessories:

.1 Gaskets on doors and drip shields on equipment, panelboards, panels and enclosures.

.2 Louvres facing outward and downward where openings are required for heat dissipation. Expanded metal screening is not acceptable.

2.8 HOUSEKEEPING PADS

.1 Provide 100 mm high concrete pads under floor mounted electrical equipment. Extend pads 50 mm outside the equipment perimeter.

2.9 FIRE STOPPING AND SMOKE SEALS

.1 Where electrical material or devices pass through fire rated separations, make penetrations and provide fire barrier seals with a fire resistance rating equivalent to the rating of the separation.

.2 Prior to installation, submit for review, proposed fire barrier seal materials, method of installation and ULC system number.

.3 Provide fire stopping and smoke seals in accordance with Section 07 84 00.

2.10 MISCELLANEOUS METAL FABRICATIONS

.1 Provide miscellaneous structural supports, platforms, braces, brackets and preformed channel struts necessary for suspension, attachment or support of electrical equipment in accordance with Section 05 50 00.

2.11 SILICONE

.1 Products and materials containing silicone are not permitted.

2.12 EQUIPMENT COLOUR CODING

.1 Exterior finish paint colour for control panels, panelboards and devices on emergency and UPS systems:

.1 Emergency systems: red

.2 UPS systems: blue

2.13 EQUIPMENT IDENTIFICATION

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

.1 Nameplates: lamicoid 3 mm, black face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.

.2 Sizes as follows:

NAMEPLATE SIZES

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

NAMEPLATE SIZES			
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

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

.3 Wording on nameplates and labels to be approved by Consultant prior to manufacturing.

.4 Allow for minimum of twenty-five (25) letters per nameplate and label.

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

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

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

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

.9 Panelboards: indicate system, rated ampacity, voltage, phase, wire configuration and power source.

.10 Switchboard: indicate rated ampacity, voltage, phase, wire configuration.

.11 Receptacles: indicate circuit numbers using P-Touch type labels.

2.14 **WIRING IDENTIFICATION**

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

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1 as follows:

.1 Phase A – Red

.2 Phase B – Black

.3 Phase C – Blue

.4 Neutral – White

.5 Ground – Green

.6 Isolated Ground – Green and Yellow

2.15 **CONDUIT AND CABLE IDENTIFICATION**

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

.2 Code with plastic tape or paint at conduit system couplings.

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

System	Normal	Emergency	UPS
up to 15 kV	Yellow	-	-
347/600 V	Orange	Orange/Red	Orange/Blue
120/208 V	Black	Black / Red	Black / Blue
Fire Alarm	Red	-	-
Emergency Voice	Red / Blue	-	-
LAN	Green	-	-
Security	Red/Yellow	-	-
Low Voltage Control	White	-	-

2.16 **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 standard.

.2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1 (ANSI 61).

2.17 **PRODUCTS FURNISHED BY OWNER**

.1 Carefully examine the Vendor or Manufacturers' drawings and provide any incidental and miscellaneous materials, mounting hardware and supports required for complete systems.

3 Execution

3.1 **INSTALLATION**

.1 Complete installation in accordance with the Canadian Electrical Code except where specified otherwise.

.2 Complete installation in accordance with Alberta Building Code.

.3 Elevator Systems: Provide for “Related Work” listed and identified under Section 14 20 00, Elevators, to be executed by Electrical Contractor.

.4 Mechanical Systems: Provide for ‘Related Work’ listed and identified for Divisions 26, 27 and 28, under Mechanical Divisions 21, 22, 23 and 25, to be executed by Electrical Contractor.

3.2 **MANUFACTURER'S ATTENDANCE**

.1 Provide manufacturer's representatives to initially start-up each part of the Work, as specified, to check, adjust, calibrate and balance as applicable all components including controls and field wiring. Provide these services for such period and for as many visits as necessary to achieve complete working order in the subject Work.

3.3 **FIELD INSPECTION**

.1 Provide Field Engineer for inspection and certification of equipment during installation, testing and commissioning as required.

3.4 **HOUSEKEEPING PADS**

.1 Provide concrete pads to the requirements of Division 03.

3.5 **FIRE BARRIERS**

.1 Provide fire stopping to the requirements of Division 07

3.6 **PAINTING**

.1 Touch up finishes on electrical equipment found to be marred on completion of the Work using same colour and type of finish as originally used.

.2 Prime paint field fabricated metalwork.

.3 Other painting will be provided under Section 09 91 00.

3.7 **CORE DRILLING**

.1 Core Drilling Procedure

.1 Examine locations to be core drilled where:

.1 Diameter is greater than 25 mm

.2 Multiple drillings required and where the distance between centres is less than 10 times the diameter of the hole

.2 Examine by most suitable method including:

.1 X-ray

.2 Ferro scan

.3 Cable detection

.3 Examine from both sides of the structure to be drilled.

.4 Examine proposed core drilling locations to determine:

.1 Possible interference with

.1 Services

.2 Structural components

.5 Select locations as suitable for core drilling and label them:

.1 Uniquely number each drilling location and core so that markings will be legible after drilling

.2 Mark each core with a north pointing arrow where drilling a slab or upward pointing arrow where drilling a wall

.6 Without interfering with or damaging any services or structural elements, drill pilot holes sufficient to verify location of potential obstructions or for alignment purposes.

.7 Use impact drill when drilling holes of 25 mm diameter or less. For holes of greater diameter use core drill.

.8 Prepare report showing intended core drill locations including printouts, X-ray images. Submit the report for approval prior to drilling to Consultant.

.9 Proceed with core drilling only after approval has been received from Consultant.

.10 Confine drilling operation to time-of-day as stipulated by Consultant.

.11 Position suitable warning notices of a type acceptable to Consultant and exercise caution to ensure safety and protection of personnel and property during drilling

especially from effects of water, dust damage, or falling objects below the slab or behind the wall being drilled.

.12 Stop drilling immediately, and report to Consultant, if contact is made with foreign objects such as reinforcing steel (rebar), electrical conduit, water pipes, drainage pipes.

.13 Cover open holes with secured covers to guard against fall through of objects.

.14 Provide necessary firestopping, temporary or otherwise, sufficient to firestop holes that would be otherwise open during hours that the location is unattended. Coordinate placement of firestopping with Consultant.

.15 Store all cores or core fragments on site and make them available for inspection by Consultant. Dispose of the cores or core fragments after permission is received from Consultant.

3.8 SLEEVES, CONDUIT AND CABLE INSTALLATION

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

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

.2 Sleeves through concrete floors: sized for free passage of conduit, protruding 50 mm and water-tight.

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

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

3.9 LOCATION OF OUTLETS

.1 Do not install outlets back-to-back in wall; install boxes in adjacent stud wall partitions to preserve STC ratings of compartments.

.2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.3 Locate light switches on latch side of doors.

.1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.10 MOUNTING HEIGHTS

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

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

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

.1 Light switches and Dimmer Controls: 1200 mm.

.2 Wall receptacles:

.1 Mount vertically, unless directed otherwise on drawings.

.2 General: 400 mm.

.3 Above counter and millwork: 150 mm

.4 Mechanical Rooms: 1400 mm

.5 Hazardous Areas: 1200 mm

.3 LAN Outlets: 400 mm.

.4 Fire alarm pull stations: 1200 mm

.5 Wall mounted speakers or strobes: 2300 mm or 150 mm below ceiling

.6 Card readers: 900 mm

.7 Door operators: 900 mm

.8 TV Outlets: as required to suit location of equipment

.9 Panelboards: as required by Canadian Electrical Code or as indicated on plans

.10 Wall mounted exit signs: 150 mm above door frame

.11 Suspended mounted exit signs:

3.11 COORDINATION OF PROTECTIVE DEVICES

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

.2 Ensure all distribution equipment is labelled in accordance with the Arc Flash Study.

.3 Provide a signed letter from a Professional Engineer licensed in the Province of Alberta confirming the following:

.1 Settings of the protective devices have been adjusted as per the short circuit coordination study.

.2 Arc flash classification labels to all items of electrical distribution equipment have been installed in accordance with CSA Z462 and the requirements of the authority having jurisdiction.

3.12 FIELD QUALITY CONTROL AND COMMISSIONING

.1 Carry out testing and commissioning for electrical systems and equipment in accordance with relevant standards such as CSA, ULC, ANSI. Comply with the Acceptance Testing Specifications for the International Electrical Testing Association Inc (NETA).

.2 Conduct and pay for all testing and commissioning.

.3 Refer to each Section of Division 26, 27 and 28 for additional testing requirements for specific equipment components.

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

.5 Load Balance:

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

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

.3 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers

and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.6 Insulation resistance testing:

.1 Megger test all feeder circuits indicated on single line diagrams of Normal, Emergency and UPS Power Distribution System.

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

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

.3 Check resistance to ground before energizing.

.7 Advise Consultant, when testing to be performed.

.8 Manufacturer's Field Services:

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

3.13 **CLEANING**

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

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

End of Section