METROLINX

Electrical General Requirement Specification

Specification 26 05 00

Revision 01
Date: March 2023

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an Agency of the Government of Ontario

Amendment Record Sheet

Amendment in Clause No.	Date of Amendment	Description of Changes
Cover Page	March 2023	Removed 'Capital Projects Group' to reflect organizational changes
1.2.3, 1.3.4	March 2023	Updated numbering on Electrical Identification and Nomenclature Specification
3.3.24, 3.3.25, 3.1.4.2	March 2023	Updated and added installation requirements and testing requirements

LIST OF CONTENT

1. GENERAL

1.1. SCOPE OF WORK

1.1.1. Labour, products, equipment, and services necessary for electrical general requirements work in accordance with the Contract Documents.

1.1.2. This section covers general requirements for supply and installation of electrical equipment specified in Divisions 26, 27 and 28, as detailed on Contract Drawings.

1.1.3. The equipment furnished and the equipment installation, wiring methods and materials used shall conform to the latest edition of the Ontario Electrical Safety Code, Electrical Safety Authority (ESA) Bulletins and Supplements issued by the Electrical Safety Authority, and the applicable Metrolinx Standards. In case of any conflicts, the more stringent requirement shall apply.

1.1.4. In general, the following summarizes the electrical scope of work; refer to Contract Documents for project specific requirements.

a) Provide electrical distribution equipment including but not limited to switchboards, transformers, motor control centres, motor starters, panelboards, generators, automatic transfer switches, UPSs, inverters, chargers, cables, wire management systems, BAS, raceways, duct banks, receptacles, and plugs per Contract Documents.

b) Provide grounding and bonding system per Contract Documents.

c) Provide lighting, interior and exterior complete with lighting panels, fixtures, conduit, poles, wiring and controls per Contract Documents.

d) Provide egress and emergency lighting complete with lighting panels, fixtures, conduit, poles, wiring and controls per Contract Documents.

e) Provide receptacles and drop cords complete with conduits and wiring per Contract Documents.

f) Provide heat tracing system per Contract Documents.

g) Provide Fire Alarm (FA) System per Contract Documents.

h) Provide public address system complete with conduit and wiring per Contract Documents.

i) Provide intercom system complete with conduit and wiring per Contract Documents.

j) Provide conduit and wiring between the Building Automation System (or SCADA as required) and equipment to be monitored including but not limited to pumps, lighting, metering systems, photovoltaics, UPS, generators, gas detection, and other miscellaneous systems per Contract Documents.

k) Provide temporary lighting where required by Contract Documents.

l) Provide temporary power where required by Contract Documents.

m) Confirm existing site conditions as they apply to electrical systems and adjust work to suit site requirements. Advise Metrolinx of any discrepancies to Contract Documents prior to making any adjustments.

n) Coordinate work with other Divisions prior and during construction to avoid interference of equipment and services.

o) Cut, patch, and make good all holes made due to electrical system installation to match existing condition.

p) Correct and complete all construction deficiencies before scheduling commissioning.

q) Complete inspection, start-up, testing and commissioning of installed equipment to manufacturer's recommendations and Contract Documents.

r) Provide services of manufacturer’s technical representative for commissioning at no additional cost to Metrolinx.

1.2. DESIGN REQUIREMENTS

a) Design Electrical equipment and systems to all applicable standards of CSA, ULC, IEEE, ESA.

b) Design electrical equipment and systems to the latest version of the GO DRM, Metrolinx standard specifications and Metrolinx standard drawings.

c) Design electrical equipment and systems to standards and codes to be latest editions adopted by and enforced by local authorities having jurisdiction (AHJ).

d) Equipment installed outdoors in the Greater Toronto Hamilton region shall be designed to withstand the following environmental conditions without damage or degradation of operating characteristics. Where electrical equipment has specific requirements, these are provided in the related section. Where the AHJ has different requirements to the Metrolinx requirement, the most stringent requirement shall apply.

1) Altitude: 0 m to 1000 m (AMSL);

2) Relative humidity: 0 to 95% non-condensing;

3) Ambient Temperature: -40°C to 40°C;

4) Full solar exposure;

5) Wind: Peak Recorded Gust: 108 km/h;

6) Rainfall: Normal Annual: 786.9 mm Rainfall, Maximum in 24-hour period: 126 mm; and

7) Snowfall: Normal Annual: 125 cm, Maximum monthly: 100 cm, Maximum daily: 50 cm.

e) Equipment installed in a controlled environment shall be able to withstand the controlled environmental conditions without damage or degradation of operating characteristics.

f) All designs shall minimize EMF effects and do everything needed to reduce EMI on the site. The design shall include the selection and specification of equipment that will reduce or eliminate the EMI effects. Power and communication wiring shall be separated in all cased or by using metal enclosures and separate raceways throughout the system. The only exception being Power-over-Ethernet wiring.

g) The grounding system must be designed to Metrolinx grounding requirements including rail electrification grounding. The grounding system shall accommodate future rail electrification in accordance with Metrolinx standards MX-ELEC TRAC EW-SPEC, MX-ELEC TRAC EW-DW, MX-ELEC STR-SPEC, and MX-ELEC EM. In case of any conflicts, the more stringent requirement shall apply. The grounding design shall also address interconnection of different grounding systems including lightning, rail electrification, Metrolinx specific grounding and utility OESA grounding requirements.

h) The grounding system shall accommodate at each site grounding inspection wells for ground rods. There must be at least two grounding test wells per site.

i) The electrical utility service and associated utility service transformer shall be sized to accommodate known present and known future loads plus an additional 50% capacity for unknown future loads. The main service panel/board/switchgear and the feeder to the utility service transformer shall also match the utility service capacity. In all cases equipment ratings shall be selected from industry standard ratings only.

j) System protective devices (relays, fuses, breaker trip units, etc.) shall be selected and coordinated to ensure that the interrupter nearest the point of short circuit or high overload will open first and minimize disturbances on the rest of the system.

k) Brownfields sites and systems design shall be accommodated as follows:

1) Option 1 – Complete System Replacement

i) Where the electrical system is to be completely replaced the design shall allow for complete removal of all existing equipment. The design shall also allow for the complete removal without incurring damage or loss of function to any remaining equipment.

ii) The new equipment shall be installed, tested and commissioned in the same manner as a greenfields installation.

2) Option 2 – Partial System Replacement

i) Where only a partial section of an existing electrical system is to be replaced the design shall allow any new section to harmoniously interface with the existing section. The design shall also allow for the partial removal without incurring damage or loss of function to remaining equipment.

ii) The new equipment in the system shall be fully installed, tested and commissioned. While, only interfaces between the new equipment and existing equipment in the system shall be tested and commissioned.

3) Option 3 – System Extension

i) Where an existing electrical system is to be extended the design shall allow any new section to harmoniously interface with the existing section.

ii) The new equipment in the system shall be fully installed, tested and commissioned. While, only interfaces between the new equipment and existing equipment in the system shall be tested and commissioned.

4) Existing supervisory systems such as BAS, SCADA, or CHUBB security will need to interface to new electrical equipment. The design of the new equipment shall allow for a harmonious interface to the existing supervisory system. Where equipment is needed to interface and link the new equipment to the existing supervisory system this shall be included in the electrical scope of work. All supervisory system interfaces to new equipment shall be fully installed, tested and commissioned

1.3. RELATED WORKS

1.3.1. Section 26 05 01 – Technical Review Checklists

1.3.2. Section 26 05 13 - Medium-Voltage Cables.

1.3.3. Section 26 05 21 - Electrical Conductors and Cables.

1.3.4. Section 26 05 23 – Electrical Identification and Nomenclature

1.3.5. Section 26 05 31 - Splitter Boxes, Junction Boxes and Pullboxes.

1.3.6. Section 26 05 34 - Raceway for Electrical Systems.

1.3.7. Section 26 09 23 - Occupancy Sensors.

1.3.8. Section 26 12 13 - Liquid Filled Transformer.

1.3.9. Section 26 12 16 - Dry Type Transformer.

1.3.10. Section 26 13 26 - Metal-Clad Switchgears.

1.3.11. Section 26 23 00 - Low Voltage Switchgears.

1.3.12. Section 26 24 13 - Switchboards and Panelboards.

1.3.13. Section 26 24 19 - Motor Control Centres.

1.3.14. Section 26 27 26 - Receptacles and Plugs.

1.3.15. Section 26 28 00 - Circuit Breakers and Fuses.

1.3.16. Section 26 28 23 - Disconnect Switches.

1.3.17. Section 26 29 10 - Motor Starters and Contactors.

1.3.18. Section 26 32 00 - Backup Power Supply Generator.

1.3.19. Section 26 33 33 - Inverter Rectifier and Charger.

1.3.20. Section 26 33 53 - Uninterruptible Power Supply.

1.3.21. Section 26 36 23 - Transfer Switch.

1.3.22. Section 26 37 00 - Outdoor Load Bank.

1.3.23. Section 26 50 00 - Lighting and Controls.

1.4. REFERENCE STANDARDS

1.4.1. Ontario Electrical Safety Code (OESC).

1.4.2. Ontario Building Code (OBC).

1.4.3. Metrolinx Standards, Drawings and Specifications.

1.4.4. GO Design Requirement Manual (DRM).

1.4.5. Interim Standards for the Selection of New Electronic Devices and Cables in Metrolinx Facilities to Mitigate Potential EMI Effects Generated by the RER Electric Traction System MX-ELEC EMI-SPEC.

1.4.6. Metrolinx Electrical Safety Document.

1.4.7. CSA Z462, Workplace Electrical Safety.

1.4.8. CAN3 C235, Preferred Voltage Levels for AC Systems, 0 to 50,000V.

1.4.9. CAN3-Z299.4, Quality Assurance Program - Category 4.

1.4.10. CSA, Certification Standards and Electrical Bulletins.

1.4.11. CFAA, Canadian Fire Alarm Association.

1.4.12. CEMA, Canadian Electrical Manufacturers Association.

1.4.13. ESA, Electrical Safety Authority and Bulletins.

1.4.14. EEMAC, Electrical and Electronic Manufacturer's Association Canada.

1.4.15. IESNA, Illumination Engineering Society of North America.

1.4.16. IEEE, Institute of Electrical and Electronics Engineers.

1.4.17. NEMA, National Electronic Manufacturers Association.

1.4.18. OPS, Ontario Provincial Standards.

1.4.19. ULC, Underwriters' Laboratories of Canada.

1.4.20. SSPC, Surface Preparation Standards.

1.5. SPARE PARTS

1.5.1. See Contract Documents and related sections.

1.6. TRAINING

1.6.1. See Contract Documents and related sections.

1.7. WARRANTY

1.7.1. The contractor shall provide a manufacturer warranty for all electrical products with a minimum warranty period of two years, if not defined by other specifications to be a longer period.

1.8. DELIVERY, STORAGE AND HANDLING

1.8.1. Not applicable

1.9. SUBMITTALS

1.9.1. Product Data and Shop Drawings Package

a) Submit manufacturer's Product Data indicating:

1) Performance criteria, compliance with appropriate reference standard, characteristics, limitations and troubleshooting protocol;

2) Product transportation, storage, handling and installation requirements;

3) Technical data, Product data, supplemented by bulletins, component illustrations, detailed views, technical descriptions of items and parts lists; and

4) Product identification in accordance with Metrolinx Electrical Identification and Nomenclature Specification 26 05 23.

b) Submit Shop Drawings indicating:

1) Materials or equipment being supplied. Include thicknesses and finishes;

2) Details of construction, accurate dimensions. Include mounting and installation details;

3) Capacity, operating characteristics and performance;

4) Identifying number of specific equipment in accordance with Metrolinx Electrical Identification and Nomenclature Specification 26 05 23;

5) Non-catalogue items, prepared specifically for this project;

6) Supplementary data, with database explaining theory of operation;

7) Total weight;

8) Shipping sections;

9) Bill of material;

10) Connections, calculations, test results and loads;

11) Termination and interconnection lists;

12) Equipment nameplate schedule;

13) Nameplate drawings;

14) Interconnection lists, schematic diagrams with cross-referenced components lists and sequence of operations;

15) Equipment and components performance curves;

16) Names and addresses of local suppliers and service representative(s); and

17) Identification table complete with details of conduit size, wire or cable size, junction boxes, pull boxes and feeder panels/breaker identification. Complete as part of Shop Drawing submission.

1.9.2. Protection Coordination

a) Submit the following:

1) Complete schedule of all main protective relays, fuses and other protective devices listing device locations, function number, manufacturer, model number, size, range and setting; and

2) Protection Coordination and Load Flow study:

i) Study to include time current curves of protective devices in the system with corresponding short level levels, damage curves and single line diagram. All main protective devices, transformers, all large motors and main feeder cables shown be included on time current curves;

ii) Study to illustrate prospective fault currents and shall verify equipment short circuit withstand ratings specified for electrical equipment provided under the Contract;

iii) Study to illustrate protective device settings and ensure that the settings and sizes of all protective devices for each voltage level has been chosen to ensure maximum or optimum protection and coordination during electrical fault or overload conditions;

iv) Study to illustrate arc flash hazard classification analysis with calculations for electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centres. Equipment shall be labelled with potential electric shock and arc flash hazards classification per CSA Z462. Labels shall be located so that it is clearly visible to persons before examination, adjustment or maintenance of equipment; and

v) Study shall include all the assumptions and all the data.

1.9.3. Single line and Riser Diagrams

a) Submit and mount a single line diagram (863 mm x 562 mm), printed on non-fading and non-acid paper and mounted in non-combustible frame, protected by tempered glass to be fitted on wall in each electrical room or substation. Reviewed single line diagram shall include complete facility distribution system starting with incoming service of Local Utility Authority and proceeding through all the downstream distribution system. Diagram shall be complete with symbols, legends, over current-protective devices, revenue metering, Metrolinx metering, interlocking and transfer schemes.

b) Submit riser diagrams for but not limited to the following systems: BAS system, PA system, Intercom system, CCTV, network, per Contract documents and requirements. Reviewed riser diagram shall be placed in pouch inside cabinet panel door.

c) Submit fire alarm riser and shut down diagram within central alarm and control facility cabinet, including plan and zoning diagram of building, mounted in metal pouch in fire alarm cabinet.

1.9.4. Quality Assurance Package

a) Submit construction inspection and acceptance sign off checklists during construction as the work is completed. The checklists shall be complete with signatures and dates from the contractor and the owners on site representative. These checklists are to be completed and reviewed by the commissioning team at the time of commissioning. Contractor shall utilize Metrolinx standard checklists to create the Contract specific checklists.

b) Submit test report for each test performed. Tests shall be signed by testing engineer and where witnessed by Metrolinx or it's representative(s). Report shall include: records of tests performed, methods of calculation, date and time of test, ambient conditions, names of testing company, test engineer and witnesses if required.

1.9.5. Commissioning Package

a) Submit the following:

1) Commissioning plan and procedures (submit prior to scheduling commissioning);

2) Deficiency Report;

3) Commissioning Closeout Report; and

4) Certificate of Readiness. Certifying electrical installation ready and fit for service.

b) Submit the following for incorporation into Operation and Maintenance Manuals:

1) Complete set of reviewed Shop Drawings of equipment;

2) Complete bills of materials and spare parts showing manufacturer's names, addresses, local replacement sources and telephone numbers;

3) Stock list of recommended spare parts and quantity of each item;

4) Manufacturer's warranties;

5) Manufacturer's certified reports;

6) Installation instructions;

7) Appropriate servicing, trouble shooting and preventative maintenance schedule and instructions for equipment and systems. Equipment and components performance curves;

8) Field testing and commissioning reports;

9) Factory test reports;

10) Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of portion or feature of installation; and

11) Final ESA and/or local Hydro Certificates.

1.9.6. Regulatory Requirements Package

a) Submit Shop Drawings to AHJ and obtain approval that equipment or complete system meets their requirements before submission of drawings to Metrolinx.

b) Complete ESA inspection and approval of new installation.

1.9.7. As-Built and Record Drawings

a) Submit As-Built or Record Drawings indicating:

1) Accurately maintained, dimensioned record of cable, conduit, bus duct and equipment locations in tunnels, shafts, mechanical rooms, electrical rooms, switchgear rooms, ceiling spaces and other critical locations to avoid conflict with other trades. Show deviations and changes in Work from Contract Drawings;

2) Actual locations of conduits and ducts, piping, maintenance holes and related items located below or outside of structure;

3) Dimensions with respect to structural column lines or walls and elevations with respect to finished floor levels or grades, referenced to centre line of conduit, duct, or raceway for the following: conduits, ducts or raceways underground, underfloor, or in inaccessible locations; and

4) On each drawing in lower right-hand corner in letters minimum 13 mm high as follows: AS-BUILT (or Record Drawing): THIS DRAWING HAS BEEN REVISED TO SHOW ELECTRICAL SYSTEMS AS INSTALLED followed by signature of Contractor and date.

1.10. QUALITY ASSURANCE

1.10.1. All Quality Assurance submittals listed in this specification shall be provided.

1.10.2. All electrical work shall be carried by licensed electricians with experience and training in the equipment and systems (certified or manufacture approve) being installed in Ontario.

1.10.3. All electrical work shall be inspected and approved by Metrolinx or it's representative for acceptance. Interim and final inspections shall be performed with Metrolinx or It's representative present.

1.11. REGULATORY REQUIREMENTS

1.11.1. Obtain and pay for permits required by the AHJ and arrange and pay for inspection and testing.

1.11.2. Comply with authorities having jurisdiction (AHJ). Include for changes or alterations required by AHJ. Where a conflict is observed in the Contract Documents and AHJ requirements, the more stringent requirement shall apply.

1.11.3. Submit required documentation and drawings to AHJ to obtain approval for the Work. Submit any additional information, details and related items that AHJ requests.

1.11.4. Supply and install warning signs, labels, nameplates and glass covered diagrams as required by AHJ.

1.11.5. Where materials require special inspection and approval of CSA or AHJ, obtain such approval for that installation. If CSA certified equipment unavailable, obtain special approval for equipment from CSA and/or ESA.

1.11.6. Carry out all changes and alterations required by the authorized inspector of any AHJ without delay to the progress of the work and without extra cost.

2. PRODUCTS

2.1. GENERAL

2.1.1. Equipment and materials shall be in accordance with requirements of related sections and the Contract Documents.

2.1.2. Provide equipment suitable for its intended use for the environmental conditions experienced in the location without damage or degradation of operating characteristics.

2.1.3. Provide equipment for electrically noisy environments (EMI) that shall be able to withstand the EMI conditions without damage or degradation of operating characteristics.

2.1.4. Equipment shall be CSA certified as a system. Where CSA certified equipment is unavailable, obtain special approval for equipment from CSA, ESA or it's designated representative. Where CSA certified individual components are used/assembled to provide a complete system on site, obtain special approval for the complete system/assembly from CSA, ESA or it's designated representative.

2.1.5. Equipment shall be factory made where possible and not cost prohibitive. Site fabrication shall be minimized.

2.1.6. All manhole, handwells or handholes shall be drained and not store water.

2.1.7. All manhole, handwells or handholes shall have secured covers (bolted) and shall have the collars grounded.

2.1.8. All manhole, handwell or handhole covers shall be heavy duty capable of having vehicles driving over them.

2.1.9. Operating voltages: shall followthe latest edition of CAN3-C235.

2.1.10. Motors, electrical heating, control and distribution devices and equipment shall operate satisfactorily at 60 Hz within normal operating limits established by above standard.

2.1.11. Maximum voltage in public access areas shall be 240VAC.

2.1.12. Maximum voltage in communication rooms or mini hub rooms shall be 208VAC.

3. EXECUTION

3.1. GENERAL

3.1.1. Perform electrical work to Ontario Building Code, Ontario Electrical Safety Code and to Canadian Standards Association.

3.1.2. Provide regulatory requirements as provided in paragraph 1.11 of this specification.

3.1.3. Do not manufacture or install electrical equipment or systems until Shop Drawing review and acceptance by Metrolinx or it's representative and the AHJ.

3.2. ELECTRICAL SAFETY

3.2.1. Protect personnel during construction from physical danger from exposed energized equipment such as panelboard mains and outlet wiring. Shield and mark live parts "LIVE – XXX VOLTS" (label voltage as required, 600V, 208 V, 120 V, etc.).

3.2.2. Protect personnel during construction from physical danger from arc-flash hazards by assessment of hazards and provision of arc-flash labels.

3.2.3. Arrange for installation of temporary doors, barriers and signage for rooms containing electrical equipment. Keep doors locked except when under direct supervision.

3.2.4. Use minimum 1.5-hour fire rated temporary doors and barriers for rooms containing electrical equipment.

3.3. INSTALLATION

3.3.1. Protect, support and maintain existing active services as required for execution of Work without disturbing these services.

3.3.2. Do not disrupt existing lighting, power or communications systems unless approved by Metrolinx or it's representative.

3.3.3. Notify and obtain written permission from Metrolinx before working on or accessing any existing panel or electrical equipment.

3.3.4. Install electrical equipment in locations shown on Contract Drawings. Where conflicts or site conditions require deviation from work as specified or indicated in the Contract Documents, notify Metrolinx and provide required documentation for acceptance before proceeding. Commencement of Work means acceptance of existing conditions.

3.3.5. Quantities or lengths indicated in Contract Documents are approximate and do not gauge or limit Work. No adjustment to Contract Price allowed to complete Work.

3.3.6. Verify equipment access and coordinate with equipment supplier to ensure equipment can physically transport to installation location.

3.3.7. Metrolinx reserves the right to relocate electrical items during construction, but prior to installation, without cost, if the relocation per item does not exceed 3 m from the original location. No credits shall be anticipated where relocation per item of up to and including 3 m reduces materials, products and labor.

3.3.8. Metrolinx reserves the right for reconstruction of electrical items without cost, due to lack of timely submissions or approvals before commencing work. Remove, relocate or replace work to the acceptance of Metrolinx.

3.3.9. No change to Contract price is allowed for relocation of equipment incorrectly installed because of failure to check and coordinate details, Contract Drawings and interferences, prior to installation.

3.3.10. If temporary connections are required to maintain services during construction period, supply and install necessary material, equipment and labor to electrical safety codes and standards.

3.3.11. Notify other trades concerned of openings, anchors, hangers or other provisions necessary for installation of electrical Work for installation in structure, walls, floors and similar locations or may affect other Work. Coordinate electrical installation with other trades. Install electrical items in time to avoid cutting or patching of Work.

3.3.12. Protect electrical equipment from elements and damage by other construction activities in area. Install protective materials around and over services as required. Be present during excavation and backfilling to supervise installation.

3.3.13. Protect finished and unfinished work of other trades until completed work has been accepted.

3.3.14. Identify embedded, concealed or recessed equipment before construction. Before penetrating any surface, scan proposed work areas using Ground Penetrating Radar (GPR), pipe and cable locators, X-ray, or similar approved technology as necessary to find reinforcements, electrical cables and conduit, pipe, utilities, and other items that may be concealed.

3.3.15. Perform testing of packages of work and promptly make any changes necessary.

3.3.16. After completion of a package of work, notify Metrolinx to perform a final inspection for acceptance purposes. Any deficiencies identified by Metrolinx or it's representative shall be rectified and the inspection repeated for those deficiencies.

3.3.17. Obtain Metrolinx written approval prior to any final connections to existing operational electrical panels and equipment. Metrolinx will present and agree to the any connection on existing electrical panels and equipment.

3.3.18. Place packages of work into service at such time and in such order as Metrolinx may direct.

3.3.19. Unless otherwise specified, Contract Documents intended to cover ancillary items necessary for work. Supply and install all ancillary omitted items essential for complete and operational installation.

3.3.20. Unless otherwise specified, Contract Documents intended to result in completely operational electrical systems and equipment. Supply, install, connect, configure and test to achieve a complete and operational installation.

3.3.21. Space noted on the Contact Documents as reserved for future equipment supplied by other trades or by Metrolinx shall be left clean. At no point shall the spare space be utilized or blocked in any manner.

3.3.22. Floor mounted electrical equipment shall be mounted on 103 mm high concrete house-keeping pads in service rooms. There shall be a minimum of 53 mm of pad beyond the edge of the equipment.

3.3.23. In electrical rooms no equipment is to be mounted directly to the walls. The panels and equipment are to be mounded on u channel standoffs or on fire rated plywood complete with 2 coats of fire retardant paint.

3.3.24. Identify all equipment provided under the Contact in accordance with Metrolinx Electrical Identification and Nomenclature Specification 26 05 23. For an existing facility, there shall be no duplication of identification including but not limited to electrical rooms, communication rooms, switchgear, switchboards, panelboards, distribution boards, receptacles, lights, etc.

3.3.25. , If the existing identification is modified (i.e. room name is changed, panel name is changed, etc.), all existing equipment impacted by the change shall be provided with new identification in accordance with Metrolinx Electrical Identification and Nomenclature Specification 26 05 23.

3.3.26. Install wiring and connections to equipment supplied by other trades, such as wiring and interlocks of equipment and control devices specified in other Divisions.

3.3.27. Use flexible conduits to connect devices, mounted on removable panels and of sufficient length to permit panel removal without dislodging connected device.

3.3.28. Circuit designations on existing panelboards may not agree with field installation. In such cases trace and verify such circuits and update the circuit designations.

3.4. EXISTING EQUIPMENT

3.4.1. Electrical equipment requiring temporary or permanent relocation or power due to construction is the Contractor's responsibility. Contractor shall coordinate any relocation with Metrolinx.

3.4.2. All new and existing electrical equipment shall be connected to or disconnected from existing distribution system (e.g. switchgear, switchboards, panelboards, control panels, etc.) after approval by Metrolinx.

3.4.3. Include and provide additional items and accessories or connections obviously required to provide complete working system for relocated equipment but omitted from Specifications or not shown on Contract Drawings.

3.4.4. Contractor shall assume that all existing conduits in Work area contain live circuits.

3.4.5. Trace conduits and circuits feeding existing equipment in Work area obstructing and interfering with Contract Work. Maintain circuits live, and if required in use.

3.5. FACTORY FABRICATION

3.5.1. Factory assemble all equipment except for shipping splits.

3.5.2. Factory fabricate steel components such as supports, plates and hardware. Any hot dip galvanize shall also be performed in the factory,

3.5.3. Field welding of fabricated components is not permitted, bolting or clamping shall be used instead. Touch-up any cut sections with cold galvanizing zinc coating on site.

3.6. NEUTRAL CONDUCTOR AND PHASING

3.6.1. Install individually grounded neutral conductor/s for one-pole, two-pole or three-pole branch breakers of balanced, 3-phase 4-wire circuits unless noted otherwise.

3.6.2. For each single phase 347 V or 120 V circuit powering an end device, the circuit must have its own neutral conductor. Sharing or common neutral installations are not allowed in end devices using polyphase circuits. For example, a light pole with 3 light fittings on 3 circuits shall have 3 neutral conductors between the light fittings and the associated feeder panel.

3.6.3. Current carrying capacity of neutral conductors shall be equal or greater than the phase conductor to suit load conditions.

3.6.4. Balance single phase loads to minimize unbalance of three phase supply.

3.7. NOISE AND VIBRATION

3.7.1. If equipment operates with excessive noise or vibration due to incorrect installation or support, eliminate noise or vibration to acceptance by Metrolinx.

3.7.2. Make connections to noise producing and vibrating equipment with flexible conduit.

3.7.3. Install vibration isolators where indicated. Isolate transformers from structure with spring or rubber isolators when suspended and appropriate sandwich pads when floor mounted. Isolate diesel generator sets from structure with vibration isolators.

3.8. LOCATION OF OUTLETS

3.8.1. Location of outlets is subject to change at Metrolinx request, if information is given prior to installation.

3.8.2. Relocate outlets up to 3000 mm from original location at no extra cost or credit.

3.8.3. Relocations over 3000 mm reviewed and negotiated on individual basis.

3.8.4. Make relocations required as result of insufficient coordination, at no cost to Metrolinx. Relocations subject to acceptance by Metrolinx.

3.9. MOUNTING HEIGHTS

3.9.1. Mounting heights of equipment shall be measured from finished floor to vertical centerline of equipment unless specified or indicated otherwise.

3.9.2. If mounting height of equipment not indicated, verify with Metrolinx before proceeding with installation.

3.9.3. Install electrical equipment at following heights above finished floors, unless indicated otherwise:

a) Local switches: 1,200 mm;

b) Wall receptacles: Vertical orientation, generally 400 mm; 1,000 mm in Electrical, UPS, LAN, MCC and Mechanical rooms; 850 mm in office areas;

c) Telephone outlets: 850 mm;

d) Data outlets: 850 mm;

e) Fire alarm stations and handsets: 1,050 to 1150 mm;

f) Intercom stations: 1,500 mm;

g) Wall mounted speakers: 300 mm to top below finished ceiling; and

h) Locate receptacles above kitchen counter backsplash to underside of kitchen cabinet. Verify site condition before installation.

3.10. CONDUIT AND CABLE INSTALLATION

3.10.1. Assume existing conduits in Work area contain live circuits. Coordinate any Work on existing equipment with Metrolinx.

3.10.2. Relocate temporary or permanent electrical equipment and conduits as required.

3.10.3. Install 50 mm high raised concrete curb at floor openings for bus ducts through floor slabs.

3.11. LOAD BALANCING

3.11.1. 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 current readings. Submit recorded data to Metrolinx for review.

3.11.2. Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment. Measure phase voltages to reflect utility voltage fluctuations and set accordingly.

3.12. CARE, OPERATION AND START UP

3.12.1. Instruct Metrolinx's staff in operation, care and maintenance of installation at times arranged by Metrolinx and detailed in other Sections at no extra cost to Metrolinx.

3.12.2. Provide services of Contractor's staff to supervise startup of installation, check, adjust, balance and calibrate components at no extra cost to Metrolinx.

3.12.3. Provide these services for such period and for as many visits as necessary to put installation in working order and to ensure Metrolinx's staff conversant with all aspects of its care and operation at no extra cost to Metrolinx.

3.13. FINISH

3.13.1. Painting Procedure

a) Prepare and clean surfaces of electrical equipment requiring painting to SSPC SP3 for rust and SSPC SP1 for oil, grease, dirt and other contaminates.

b) Apply one coat of primer.

c) Apply 2 coats of finish paint. Colour of manufacturer's standard ASA grey except as specified otherwise. Paint all electrical equipment to EEMAC standard.

d) Apply paint in accordance with manufacturer's instructions regarding application methods, coating thicknesses, equipment, temperature and humidity conditions.

3.13.2. Contractor shall clean and touch up surfaces scratched or marred during shipment and installation, to match original paint finish.

3.13.3. Contractor shall clean, prime and paint exposed hangers, racks and fasteners to prevent rust.

3.13.4. Contractor shall provide touch-up paint.

3.14. FIELD QUALITY CONTROL AND COMMISSIONING

3.14.1. General

a) Field quality control and commissioning shall be performed in accordance with related sections. Field quality-control test reports shall be submitted to Metrolinx.

b) Commissioning shall verify electrical and mechanical operation is in accordance with Standards and recommendations of manufacturers.

c) A 3rd party commissioning agent shall be engaged to perform commissioning work and provide all required commissioning submittals.

d) Provide factory authorized and trained personnel to perform commissioning and start-up testing, including checkout, adjustments, balancing and calibration of components and systems, as required.

e) Provide these services as required to ensure installation is in proper working order and to ensure the Metrolinx's staff conversant with all aspects of its care and operation at no extra cost to Metrolinx.

f) Inspections by jurisdictional authorities shall include all appropriate local and provincial authorities, including but not limited to:

1) Building Inspection's Department;

2) Local hydro companies (local utility authority);

3) Fire services inspection's department

4) Ministry of Labour; and

5) Electrical Safety Authority.

3.14.2. Tests

a) Field testing shall be performing on all systems included in the Contract, including but not limited to:

1) Water supply pumps and controls;

2) Sanitary waste pumps and controls;

3) High voltage and or low voltage electrical distribution and control system;

4) Storm drainage system;

5) Heating, ventilating and air conditioning systems, (HVAC);

6) Fire protection and Alarm systems;

7) Miscellaneous mechanical systems;

8) Emergency lighting;

9) UPS system;

10) ATS and Generators;

11) BAS system; and

12) Communications systems (PA, data, intercom system, and CCTV).

b) Test wiring systems with switchboards, panelboards, fuseholders, switches and overcurrent devices in place and connected, as follows:

1) Dielectric test on equipment and wiring:

i) For 120/208V equipment and cables, apply 500 V AC, 60 Hz for three minutes between phase conductors and between each phase conductor and ground; and

ii) Ensure test voltages for 600 V equipment and cables are as recommended by manufacturers of equipment and cable.

2) Insulation resistance test:

i) After completion of Dielectric test, measure insulation resistance by means of approved resistance measuring instrument; and

ii) Minimum value of insulation resistance between connected system and ground: Minimum values prescribed under Insulation Resistance in Ontario Electrical Safety Code, ESA or manufacturer's recommendations.

3) Remove and replace shorted, grounded and defective conductors.

c) Test lighting system as follows:

1) Illumination: Test lighting illuminations levels meet design requirements; and

2) Control and switching: Test circuits for correct operation of devices, switches and controls.

d) Polarity test: Test sockets for correct polarity.

e) Voltage drop test: Perform voltage test at last outlet in each circuit, one on each circuit, with circuit fully loaded. If excessive drop in potential, locate cause and correct condition. Replace defective parts, materials, conductors, insulation or splices.

f) Phase balance: Measure load on each phase at each distribution panelboard and at main switchboard. Report results to Metrolinx. Make necessary rearrangement of phase connections to balance load on each phase. Make rearrangement as instructed by Metrolinx and restrict to exchanging connections at panelboards or at main switchboard. After making changes, submit to Metrolinx drawings or marked prints showing modified connections.

g) Supply voltage: Measure and report to Metrolinx line voltage of each phase at load terminals of main breakers. Make test with majority of electrical equipment in use.

h) Motor rotation: Check and report to Metrolinx that the phase rotation for each motor is correct. If rotation is incorrect, make required adjustments and recheck.

i) Motor loadings: Measure and report to Metrolinx line currents of each phase of each motor under load. Upon indication of unbalance or overload, thoroughly examine electrical connections and rectify any defective parts or wiring. If electrical connections correct, report overloads and phase unbalances to Metrolinx.

j) General operation: Energize and put into operation each electrical circuit and item. Make necessary repairs, alterations, replacements, tests and adjustments required for complete and acceptable operating electrical system.

k) Make tests in presence of Metrolinx. Perform General-Operation testing at time of acceptance of Work.

l) All testing shall be conducted in accordance with the latest edition of ANSI/NETA ATS – Standard for Acceptance Testing for Electrical Power Equipment and Systems.

3.14.3. Cleaning

a) Perform final cleaning in accordance with Contract documents.

b) Where equipment shows corrosion, or damage to finish of panels, panelboards fixtures or devices, touch-up surfaces to the acceptance of Metrolinx.

c) Polish plated work and glass. Replace burned out lamps.

d) Repair, adjust and lubricate mechanisms and leave in operating condition.

3.14.4. Training

a) Provide training, video instructions if appropriate and documentation in accordance with the Contract documents and as indicated within related sections.

3.14.5. Maintenance

a) Maintain all equipment and systems installed until Substantial Performance, in accordance with the Contract documents.

END OF SECTION