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| Version | Date | Description of Revisions |
| 1 | August 30, 2006 | Approved final document. |
| 2 | February 19, 2010 | Modified ‘Related Sections’ |
| 3 | July 10, 2013 | Final Draft – Consolidated Comments Spec Update Project. Incorporation of new Commissioning and Computerized Maintenance Management System Data Requirements Specification cross references. |
| 4 | July 28, 2014 | Changes to reflect renaming of commissioning specification and final review (AV). Addition of receptacle height options for industrial locations susceptible to floor water and flooding. |
| **5** | **February 4, 2015** | **Updated, Finalized Specification – Reference eDOCS #5630518 v7 (AV)** |
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NOTE:

This is a CONTROLLED Document. Any documents appearing in paper form are not controlled and should be checked against the on-line file version prior to use.

**Notice:** This Document hardcopy must be used for reference purpose only.

**The on-line copy is the current version of the document.**

# GEneral

## General

### These general instructions are intended to supplement and not to replace Division 1 - General Requirements.

### The requirements of this Section apply to and form part of all Sections of Division 16 – Electrical.

### The Contract is divided into divisions of work and a division may consist of the work of more than one Subcontractor. The responsibility as to which Subcontractor provides labour, materials, equipment and services required to complete the work rests solely with the Contractor.

## Related Sections

#### Section 01425 – Computerized Maintenance Management System Data Requirements

#### Section 01430 – Operation and Maintenance Data

#### Section 01600 – Material and Equipment

#### Section 01740 – Cleaning

#### Section 01810 – Equipment Testing and Facility Commissioning

#### Section 01820 – Demonstration and Training

#### Division 11 – Equipment (insert applicable specifications)

#### Division 13 – SCADA and Instrumentation (insert applicable specifications)

#### Division 15 – Mechanical (insert applicable specifications)

## References

### Comply with the latest edition of the following statutes codes and standards and all amendments thereto:

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

##### 519-2014 – IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems.

#### CSA Standard

##### C22.1-15, Canadian Electrical Code Part 1 (23rd edition)

##### C22.3 No.1-10, Overhead Systems

##### CAN3-C235-83 (R2010), Preferred Voltage Levels for AC Systems, 0 to 50 000 V

#### Ontario Electrical Safety Code, 28th Edition, 2021

#### UL Standards, ULC Standards

#### Building Code Act, 1992, O. Reg. 332/12, Ontario Building Code and O.Reg. 350/06, Division A Compliance, Objectives and Functional Statements.

#### The Contractor must be familiar with the facility power quality so any electrical components (including VFD’s) can fully function under typical levels of power quality as delivered by the Local Distribution Company (LDC). Contractor and supplier shall provide electrical devices to protect electrical components (including VFD’s) from sags and swells experienced from LDC at no additional cost to the Region.

## Measurement and Payment

.1 The work of this Section will not be measured separately for payment. All costs associated with the work of this Section shall be included in the Contract Price.

## Demonstration and Training

### Instruct the Region’s personnel in the operation, care and maintenance of equipment. Perform demonstration and training in accordance with Section 01820 – Demonstration and Training.

## Voltage Ratings

### Operating voltages: in accordance with CAN3-C235-83 (R2010).

### The Contractor shall determine the need for corrective measures, with respect to existing systems, to accommodate current designs of equipment and devices installed as part of the Work.

### Motors, electric heating, control and distribution devices and equipment shall operate satisfactorily at 60 Hz within normal operating limits established by CAN3-C235-83 (R2010). The equipment shall be capable of operating in the conditions it is placed in and in extreme operating conditions established in the above standard without any damage to the equipment.

## Permits, Fees and Inspection

### Submit to the Electrical Safety Authority (ESA) and, if required, the LDC all the necessary number of drawings and specifications for examination, approval and comments prior to the commencement of work.

### Pay all associated fees and obtain all required approval permits.

### The Consultant will provide the Contract Drawings and specifications required for submission to the ESA to the Contractor at no cost.

### Notify the Consultant of changes required by the ESA prior to making changes.

### Furnish Certificates of Acceptance from the ESA, LDC and any other relevant agency on completion of the work to the Consultant.

### Arrange for inspection of all work by all applicable authorities having jurisdiction over the work, including but not limited to the ESA. On completion of the work, present to the Region the final unconditional certificate of approval of the ESA, LDC (as required) and other applicable authorities having jurisdiction over the work.

### Comply with the requirements of the latest edition of the applicable CSA Standards, the requirements of the ESA and other relevant authorities, federal, provincial and municipal codes, the applicable standards of the Underwriters' Association (UL and ULC) and all other authorities having jurisdiction. These codes and regulations constitute an integral part of these specifications. In the event of conflict, the codes shall take precedence over the requirements of the Contract Drawings.

### Before starting any work, submit the required number of copies of drawings and specifications to the relevant authorities and the LDC for their approval and comments. Comply with any changes requested as part of the Contract, but notify the Consultant immediately of such changes for proper processing of these requirements. Prepare and furnish any additional drawing details for information as may be required at no cost to the Region.

## Materials and Equipment

### Provide all materials and equipment in accordance with Section 01600 – Material and Equipment.

### Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from CSA or by special inspection by the ESA, Consultant and Consultant.

### Ensure that control panels and component assemblies are assembled at the factory. CSA stickers shall be clearly affixed on such equipment.

## Electric Motors, Equipment and Controls

### Coordinate the installation of motors, equipment and mechanical work with electrical work.

### Coordinate all work with the Consultant, Consultant and Region staff in such a way as to minimize any operational impact (if any) on the system operated by the Region.

### Complete all electrical and control wiring for all equipment specified in Division 11 – Equipment, Division 15 – Mechanical and Division 13 – SCADA and Instrumentation.

## Finishes

### Shop finish metal enclosure surfaces by the application of rust resistant primer inside and outside. Apply a minimum of two coats of finish enamel.

#### Paint outdoor electrical equipment with an “equipment green” finish or an alternative colour as approved by the Consultant.

#### Paint indoor switchgear and distribution enclosures light grey as approved by the Consultant.

### Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation in order to match the original paint as approved by the Consultant.

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

## Electrical Equipment and Panel

### Identify electrical equipment with nameplates as follows:

#### Nameplates:

##### Lamacoid 3 mm thick plastic engraving sheet, white face, black core, mechanically attached with self-tapping stainless steel screws.

##### Do not use self adhesive nameplates.

#### NAMEPLATE SIZES – Refer to the individual Specification Sections.

#### Wording on nameplates shall be approved by the Consultant prior to manufacture.

#### Allow for an average of 25 letters per nameplate.

#### Identification shall be in English.

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

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

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

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

### Issue nameplates lists, for review and approval by the Consultant prior to manufacture.

### Lighting panels: Plates shall be mounted on inside of door, typical identification "Lighting Panel 'A' 120/208 V, 1 phase, 3 wire". Labels must be affixed on the outside of the panel doors.

### Disconnect switches and starters: Plates shall be mounted externally on switch box cover. Typical identification - "Pump No. 1, 575 V, 3-phase".

### Plates shall be installed after all painting has been completed and shall be secured with self-tapping stainless steel screws except on the inside of panel doors where gluing will be accepted.

### The manufacturers' nameplates shall be affixed to each item of equipment showing the size, name of equipment, serial number and all electrical information usually provided, including voltage, cycle, phase, kW (horsepower), etc., and the name of the manufacturer. Ensure that all stamped, etched or engraved lettering on plates is perfectly legible. Do not paint over nameplates and where apparatus is to be concealed, attach the nameplate in a location approved by the Consultant on the equipment support or frame.

### Identify all equipment with the corresponding remote controls.

## Wiring Identification

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

### Maintain phase sequence and colour coding throughout.

### Colour code: Refer to Section 13310 – Panel Specifications and Section 13305 - Field Wiring

### Control wiring shall have the same tag at both ends.

## Wiring Terminations

### Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

## Manufacturers and CSA Labels

### Visible and legible after equipment is installed.

## Warning Signs

### As specified in the Contract Documents and to meet requirements of ESA, Consultant and Region staff.

### Arc Flash Labels.

### Decal signs, minimum sized 175 x 250 mm.

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

### Shield and mark live parts "LIVE 600 VOLTS", or with appropriate voltage in English.

## Single Line Electrical Diagrams

### Mount single line electrical diagrams under Plexiglas on the wall in a location approved by the Consultant as follows:

#### Electrical distribution system: locate in main electrical room.

#### Electrical power generation and distribution systems: locate in power plant rooms.

### Drawings: 600 mm x 600 mm minimum size. Ensure LDC line designations are current and correct.

## Location of Outlets

### Do not install outlets back-to-back in the wall; allow a minimum of 150 mm horizontal clearance between boxes.

### Locate Ground Fault Circuit Interrupter’s in accordance with Canadian Electrical Code, Ontario Edition requirements.

### Change the location of outlets at no extra cost or credit to the Region, provided that the distance does not exceed 3,000 mm from the original location specified in the Contract Documents and the change is requested of the Contractor prior to the commencement of installation.

### Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of the door. Motion detector controls shall be installed in accordance with the Contract Drawings and the Region’s energy management objectives.

## Mounting Heights

### Mounting height of equipment is the distance from the finished floor to the topline of the equipment unless specified or indicated otherwise in the Contract Documents.

### If the mounting height of equipment is not specified or indicated in the Contract Documents, verify the mounting height with the Consultant before proceeding with installation.

### Install electrical equipment at the following heights unless indicated otherwise in the Contract Documents:

#### Local switches: 1200 mm.

#### Wall receptacle 300 mm: For industrial facilities and areas susceptible to flooding and water on floors 1400 mm or as indicated in the Contract Documents.

#### General: 450 mm. For industrial facilities and areas susceptible to flooding and water on floors, 1400 mm or as indicated on Contract Documents.

#### Above top of continuous baseboard heater: 200 mm.

#### Above top of counters or counter splash backs: 175 mm.

#### In mechanical rooms: 1400 mm.

#### Panelboards: as required by Canadian Electrical Code, Ontario Edition or as indicated in the Contract Documents.

#### Telephone and interphone outlets: 300 mm.

#### Wall mounted telephone and interphone outlets: 1200 mm.

#### Disconnect switches: 1400 mm.

## Load Balance

### Measure phase current to panelboards with normal loads (lighting) operating at the time of acceptance. Adjust branch circuit connections as required to obtain the best balance of current between phases and record changes. The maximum imbalance shall not exceed 20%.

### Measure phase voltages at loads and adjust transformer taps to within 2% or as approved by the Consultant of rated voltage of equipment.

### Submit to the Consultant, at the completion of work, a report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State the hour and date on which each load was measured and voltage at the time of the test.

## Conduit and Cable Installation

### Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: plastic, sized for free passage of conduit, and protruding a minimum of 50 mm.

### If plastic sleeves are used in fire rated walls or floors, remove the plastic sleeves before conduit installation or use rigid steel sleeves.

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

### Refer to Section 13305 – Field Wiring for details on separate conduit requirements by signal type.

## Field Quality Control

### Conduct and pay for following equipment and circuit tests:

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

#### Circuits originating from branch distribution panels.

#### Lighting and its control.

#### Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

#### Systems: fire alarm system, communications.

#### Instrumentation.

#### Variable Frequency Drives.

### Furnish the manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed in accordance with the manufacturer's instructions. The Contractor shall provide the Consultant with a list of manufacturer’s certificates to be provided and approved for the equipment relating to the Contract.

### Insulation resistance testing.

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

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

#### Check resistance to ground before energizing.

### Carry out tests in presence of the Consultant.

### Provide calibrated instruments (with documentation of calibration) , meters, equipment and personnel required to conduct tests during and at conclusion of project.

### Submit test results to the Consultant for review and approval.

## Trial Usage

### Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to the required values and settings in accordance with the short circuit and coordination studies detailed in subsection 1.24 below. Provide documentation of the values and settings to Consultant.

### Allow for 3 to 7 day trial usage for break in period.

### The Region and Region's representatives shall have the privilege of trial usage of the electrical system or parts thereof for the purpose of testing and verifying operational procedures.

### Trial usage by the Region shall not waive any of the Contractor’s responsibilities under the Contract.

### Trial usage shall not be construed as acceptance by the Region.

## Harmonic Testing/Analysis

### The Contractor shall provide to the Consultant for review a Harmonics analysis of the overall electrical system complete with measured harmonic distortion levels for both current and voltage. Harmonics testing shall be performed by a company approved by the Region. The study shall identify the harmonic distortion levels present in all orders of harmonic distortion. The point for this measurement to be point of common coupling that is in the line side of the main breaker in MCC unless noted otherwise in the Contract Documents. Carry out harmonic study for plant operation under normal and also under standby power under load conditions specified in the Contract Documents.

### Any recommendations identified in the Harmonics Study that are required in order to satisfy IEEE 519-2014 are to be implemented by the Contractor at no additional cost to the Region.

## Coordination Study and Short Circuit Study

### Short circuit and coordination study will be provided by the Consultant. The 1st version of the study will be performed at the final design stage, and the 2nd version (final) will be performed at Substantial Completion of the construction.

### The study data shall be presented in tables and on composite charts and shall include, but not be limited to, the following:

#### Maximum available short circuit current of systems.

#### Maximum available ground fault current of systems.

#### Feeder cables thermal short circuit damage curve.

#### Primary fuse to power the transformer.

#### Power transformer thermal short circuit damage curve, phase to phase, phase to ground.

#### Main secondary 600 volt system circuit breakers.

#### Largest 600 volt moulded case distribution breaker and characteristics.

#### Largest distribution transformer thermal short circuit damage curve.

#### Maximum available fault current, phase to phase and phase to ground for the 600 volt system.

#### Main 120/208 volt breaker and characteristics.

#### Maximum available fault current RMS symmetrical at each panel.

#### Establish the required settings for all protection relays and provide a record of settings.

#### Diesel engine generator breaker characteristics.

## Tests

### All equipment and electrical systems which are provided under Division 16 - Electrical shall be performance tested for electrical and mechanical defects. All defects and adjustments identified in the performance tests shall be rectified and all other adjustments shall be made by the Contractor prior to requesting an inspection by the Consultant.

### Submit the original copies of letters from the manufacturers of auxiliary systems indicating that the manufacturers’ technical representatives have inspected and tested the respective systems and are satisfied with the methods of installation, wiring and operation.

### Insulation resistance tests shall be performed for all wiring and equipment installed under Division 16 - Electrical. Insulation resistance tests shall be performed with a [500V megger] instrument for equipment up to 350V and with 1000V megger for 350 - 600V circuits and recorded in a log book for reference. The Contractor shall also submit a separate report of such test results to the Consultant. Lighting and power circuit feeders shall be meggered and the insulation resistance between live parts and ground shall not be less than that specified in the Ontario Electrical Safety Code, 28th Edition, 2021. During the performance of the test the neutral conductor shall be disconnected from the ground and reconnected afterwards.

### Conduits or ducts which are required to be installed but left empty shall be tested for clear bore using a ball mandrel of approximately 85% of the conduit or duct inside diameter. Any conduit or duct which rejects the ball mandrel shall be cleared at no additional cost to the Region. These tests shall be witnessed by the Consultant. A minimum of three days notice shall be given to the Consultant prior to testing.

### Single phase loads shall be connected so that there is the least possible imbalance of the supply. Common neutral shall be used for maximum 3-1 phase circuits, with each circuit on a different phase.

### Furnish all labour, materials, instruments and bear all costs for any tests as requested by the Consultant. The Consultant will provide Contractor a table of required tests and associated reports that must be provided prior to equipment commissioning. Test Reports shall be in suitable format to allow uploading to the Region’s CMMS (Maximo).

### Conduct and pay for tests of the following:

#### Field wiring to all transmitters and field devices.

#### Programmable Automation Controllers (PAC) I/O's, transmitters, Field Devices – Calibration.

#### Variable Frequency Drives.

#### Provision of calibration sheets.

#### Comply with the requirements of Division 13 – SCADA and Instrumentation.

### Carry out all tests in the presence of the Consultant. Provide notice to the Consultant a minimum of three Working Days prior to the proposed date of each test.

### Provide all calibrated instruments, calibrated meters, equipment and personnel required to conduct tests during and at the conclusion of the Work.

### Submit two copies of all test results for the Consultant’s review in addition to the copies included in Maintenance Data. Provide an Operation and Maintenance Manual and Maintenance Summary in conformance with the requirements of Region’s Standards for Operating Manuals as detailed in the Design Guidelines Section 17 – Operation Manual Guideline and refer to Section 01430 – Operation and Maintenance Data.

## Fire Transits

### All cable trays, conduit etc. transitioning through building walls to be sealed with a one hour fire rated caulking or fire transit.

### Fire transit shall be ULC listed.

### All details of fire transits to be reviewed and approved by the Consultant and Region staff.

## Cleaning

### Comply with the requirements of Section 01740 – Cleaning.

### Before energizing any system, inspect and clean the entire system, including the inside of switchgear, MCC and internal busbars, etc., to ensure that it is free from dust and debris.

### At the time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt.

### Clean all polished, painted and plated work brightly.

### Remove all debris, surplus material and all tools.

## Execution

### The use of permanent electrical system for temporary construction service shall be only allowed with written permission of the Consultant. The Region reserves the right to require the Contractor to provide electrical sub-metering for construction related energy use and be back-charged associated costs.

### Maintain at the Site, at all times, qualified personnel and supporting staff, with proven experience in erecting, supervising, testing projects of comparable nature and complexity.

### Maintain at the Site a copy of construction drawings red-lined (edited) that are regularly updated with all modifications or changes to the Contract Drawings.

### Expedite the work as follows:

#### Continuously check and expedite delivery of equipment and materials;

#### If necessary, inspect equipment and materials at the source of manufacture;

#### Continuously check and expedite the flow of necessary information to and from all parties involved;

#### Inform the Consultant promptly where information is required.

### The work of Division 16 - Electrical shall be coordinated with other Divisions in such a manner as not to interfere with other work and critical Region operations. In areas where the ducts, pipes, wiring and equipment for other Sections will be installed in proximity to pipes, wiring and equipment pertaining to this Division, the Contractor shall ensure that all pipes, ducts, wiring and equipment are installed in such a manner as to safeguard against process and/or HVAC piping water condensation or leakage or other hazards that may impact installed electrical equipment.

### Equipment, conduit, etc., installed but not coordinated with the work of other trades shall be relocated by the Contractor as directed by the Consultant without extra cost to the Region.

### Install equipment, conduit and cables in a workmanlike manner to present a neat appearance and to function properly to the satisfaction of the Consultant. Install exposed conduit runs parallel and perpendicular to building planes. Install conduit concealed in chases, behind furring, or above ceiling, except in unfinished areas. Install exposed systems neatly and group them to present a neat appearance.

### Maintain redlined drawings (updated regularly) on Site.

### Provide all required equipment and maintenance data as detailed in Section 01425 - Computerized Maintenance Management System Data Requirements.

## Commissioning

### For all commissioning activities on systems where components of this Specification Section are integral to functionality, refer to Section 01810 – Equipment Testing and Facility Commissioning. All inspection and testing activities shall be completed in accordance with the documentation provided to the Consultant prior to the start of commissioning such activities.

# PRODUCTS (NOT USED)

# execution (not used)

**END OF SECTION**