SPECIFICATIONS

LIST OF ELECTRICAL CONTRACT DRAWINGS

APPENDICES

Electrical General Requirements Section No. 16010

PART 1 – GENERAL

1.1 Description

.1 This section covers items common to sections of Division 16.This section supplements Division 1 – General Requirements.

.2 In case of a discrepancy between statement(s) or value(s) in this section or contract drawing(s), the higher statement or value takes precedence and shall govern.

1.2 Scope of Work

.1 In order to reduce power interruptions to Cedar Spring Campground, Parks Canada intends to replace the existing overhead power line with an underground system. Cedar Spring Campground is located on Beausoleil Island in Georgian Bay. Access to the site is by boat, and all materials and equipment must be barged to the island.This work is detailed on the contract drawings and specifications.

.2 Provide new wood poles for Hydro One riser, Hydro One meter and load break switch.

.3 Provide new load break switch on a new wood pole. Connect new single-phase 28kV underground cables to switch. Supply new single-phase overhead ACSR conductors from switch pole to Hydro One pole. Provide a single line diagram mounted on the pole.

.4 Provide new single-phase 28kV underground cables to new transformers and junction box.

.5 Provide new single-phase transformers and junction box.

.6 Connect new primary cables to existing primary cables in two locations; splices to be in accordance with OESC Rule 12-112. Refer to contract drawings for rating of existing primary cables.

.7 Connect existing secondary services to new transformers.

.8 Provide a key interlock on two existing and three new pad-mount transformers. Refer to Specification 16345. Key to be interlocked with new load break switch to prevent opening of transformers when primary switch is closed.

.9 Hydro One to remove all existing meters. Contractor to coordinate with Hydro One and provide meter base jumpers and covers for meter #J2634587 (at Maintenance shop). Refer to Specification 16345.

.10 Contractor to install warning sign on new pole and at each transformer and junction box.

.11 Contractor to confirm that lightning arrestors have been installed on existing transformers at dead end of primary cables. Provide arrestors as required.

.12 Work to commence following the closure of the campground in mid-October, 2014. The existing overhead primary conductors and all campground servicing will remain energized during the 2014 construction period. Parks Canada is presently working with Hydro One to acquire existing transformers #2080 (tag T-4) and #2082 (tag T-5). Connection of the new primary conductors to these

transformers cannot be made until the ownership is transferred to Parks Canada in the spring of 2015. At that time, the contractor must complete all contract works including energizing the new system and removal of the existing poles and conductors.

1.3 Definitions

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

.1 "Inspection Department or Authority" mean agents of any authority having jurisdiction over construction and safety standards associated with any part of electrical work on site.

.2 "Power Supply Authority" means electrical local utility company responsible for delivery of electrical power to project site.

.3 "Electrical Code" means Canadian Electrical Safety Code C22.1 or code in force at project location.

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

.5 "Provide" means fabricate, supply, install, test and commission the electrical system and/or equipment.

.2 Refer to CSA C22.2 No.0 for "Definitions and General Requirements".

1.4 Codes and Standards

.1 Do complete installation in accordance with the latest editions of the Canadian Electrical Code – CSA C22.1, the Ontario Electrical Safety Code and any local codes and requirements which govern the installation. Where these regulations conflict, apply the most stringent condition.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1-10 and No.7-M86 except where specified otherwise.

.3 Electrical Abbreviations: to CSA Z85_1983.

1.5 Care, Operation and Start-up

.1 Instruct Engineer and operating personnel in the operation (testing), care and maintenance of equipment.

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

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

1.6 Voltage Ratings

.1 Operating voltages: to CAN3_C235_83.

1.7 Permits, Inspection and Fees

.1 Submit drawings and specifications to Electrical Inspection Department and Supply Authority to obtain all required electrical permits.

.2 Notify the Electrical Inspection Department in sufficient time for them to inspect work. Contractor is responsible to arrange multiple inspections (as

required) to ensure the work has been properly inspected at completion of project.

.3 Contractor to keep a separate “logbook” related to the Electrical Inspections. Contractor must record inspector’s name, date and scope of inspections, recording all statements, decisions and permissions made during each inspection visit. Notify Engineer of any changes required by Electrical Inspection Department prior to making changes. Submit logbook to Engineer at completion of project.

.4 Submit to Engineer “Certificate of Acceptance/ Approval” from Electrical Inspection Department at completion of project. Building Occupancy will not be granted unless electrical inspection certificate has been completed and submitted to engineer.

.5 Division 16 Contractor to pay all associated fees for electrical permits, inspections and special product approvals.

1.8 Owner’s Inspector

.1 The Owner will provide an inspector (at the expense of the Owner) who will be on duty as required by the Owner as the work progresses. Prior to burying any work, the contractor must contact the engineer and arrange for inspection.

.2 A pre-construction meeting must be held prior to starting the project with the contractor's foreman and inspector present as well as any other key personnel.

.3 The Owner's inspector shall have the authority to stop work at any time if the contractor is not proceeding in accordance with contract drawings or ESA requirements.

.4 If any work is done in the absence of an inspector, the work may be ordered to be "opened up" for examination. If any faults in the workmanship or materials are discovered, the contractor must rebuild or replace as directed by the inspector, all at the contractor's expense.

.5 Owner's inspector shall not be responsible to ensure that trenches are in accordance with federal, provincial or local regulations.

.6 The contractor is responsible for all layout. There will be no excavation allowed prior to proper layout.

.7 Specific Inspection Times:

.1 Once the trench has been excavated, sand-padded and conduits/cables installed, the Owner's inspector must approve all works to date.

.2 After all cables have been installed in ducts/conduits, the Owner's inspector must be on site to approve installation prior to any backfilling.

.3 The above specific inspection times shall not be conceived to be the only dates that the inspector will be available. It is the inspector's discretion to be on site when required.

1.9 Coordination with “Power Supply Authority”

.1 The Engineer has submitted selected contract drawings to the Power Supply Authority prior to tendering. The contractor is responsible to coordinate and

satisfy all requirements of the Power Supply Authority, to ensure availability of (permanent) power service is provided at completion of project.

.2 Refer to contract drawings for scope of work by Power Supply Authority.

.3 Power Supply Authority:
Hydro One Networks Inc.
Barrie FBC
Ms. Diane Camelino
1-888-238-2398 ext. 6417

.4 Division 16 Contractor to pay all associated connection fees or charges for power supply authority services.

1.10 Coordination with Other Trades

.1 Be responsible and coordinate other sub-trade work with electrical requirements and ensure that there is no interference with or delay caused by such work to the electrical or other trades work.

.2 Notify other sub-trades of all openings, inserts, anchors, sleeves, hangers, foundations, etc., necessary for electrical work, and be responsible that these are provided and correctly installed at the proper time.

.3 Fully cooperate with all trades in the provision and maintenance of electrical power in all areas throughout the period of construction.

1.11 Construction/Shop Drawings

.1 Submit data (drawings) for review prior to commencement of manufacturing or installing with the exception of conduit, standard conduit fittings and low voltage wiring. Refer to Section 16011 for Shop Drawing Log.

.2 Show all details of construction, dimensions, capacities, weights, and electrical performance characteristics of equipment or material.

.3 Prepare composite construction drawings, fully dimensioned of cables, conduit, cable tray, bus duct, sleeves, clearances, pipes, ducts, etc., and equipment in mechanical and electrical equipment rooms, ceiling spaces and all other critical locations to avoid a conflict of trades. Base drawings on manufacturer's shop drawings. Drawings should be developed from consultation with and agreement of all trades involved.

.4 Prepare drawings of electrical equipment detailed on the Shop Drawing Log, Section 16011.

.5 Indicate the number or letter used on the drawings/specifications as an identification symbol on product data for panel boards, light fixtures, instruments and other equipment submitted.

.6 Bind one complete set of construction/shop drawings showing "As Built" conditions in each operating and maintenance instruction manual.

1.12 As-built Drawings

.1 Before commencing work obtain two sets of electrical drawings for showing "As Built" conditions. As job progresses, mark on field set of prints to indicate accurately all installed work. At completion of project, manually transfer all information onto second set of drawings using red marker/pen, and indicate

"Contractors Certified Approval of Accuracy" before submitting to Engineer for review and record use.

.2 Indicate on contract drawings "As-built" stamp.

1.13 Workmanship

.1 Install all equipment, conduit and cables in a workmanlike manner to present a neat appearance and to function properly.

.2 Install exposed systems and equipment neatly and grouped to present a neat appearance, without conflict to other services.

.3 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement with due allowance therefore, in terms of space and accessibility.

.4 Include in the work all requirements of manufacturers shown on the shop drawings or manufacturers' installation instructions, and make provision for future plant and equipment as shown.

.5 Replace without extra cost work unsatisfactory to the Engineer.

.6 Protect all equipment from damage during delivery to the site and during installation. Make good any damage or deterioration whatsoever and have it covered by replacement guarantee.

1.14 Materials and Equipment

.1 Equipment and material must be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department. Pay all associated fees.

.2 Factory-assemble control panels and component assemblies.

.3 Provide Canadian manufactured equipment and materials, except where specified otherwise or where Canadian made materials or equipment do not exist.

1.15 Equipment Identification

.1 Supply and install identification nameplates on all items identified on the single line diagram such as safety switches, disconnects, panelboards, control panels, etc.

.2 Nameplates:

.1 Lamicoid 3 mm thick plastic engraving sheet, UV rated with black face, white ore, and attached with adhesive glue/tape backing.

<u>NAMEPLATES:</u>

Size 1: 1 line, 3 mm high letters

Size 2: 1 line, 6 mm high letters

Size 3: 2 lines, 6 mm high letters

Size 4: 1 line, 12 mm high letters

Size 5: 2 lines, 12 mm high letters

Size 6: 1 line, 25 mm high letters

Size 7: 2 lines, 25 mm high letters

.3 Wording on nameplates to be approved by Engineer prior to manufacture.

.4 Allow for average of twenty-five (25) letters per nameplate.

.5 Identification to be English.

.6 Safety switches, disconnects, panelboards, control panel, starters and contactors: Size 4, indicate equipment description, voltage and phase(s).

.7 Terminal cabinets, pull and junction boxes: Size 2, indicate panelboard system and voltage.

.8 Provide a typewritten circuit directory with clear plastic cover for each panel board in a suitable holder on the inside of each panel door. Indicate breaker circuit number, rating, load description, and associated load data.

.9 On outside of panel board door, indicate tag number, capacity, phases and voltages. Use size 5 nameplate.

.10 Pad-mount transformers: size 7 nameplate, indicate tag number, capacity, primary and secondary voltages and impedance.

.11 Provide a UV resistant warning label mounted on each overhead primary and secondary pole at 1500mm above grade. Label to be suitable for outdoor installations. Text size to be 25mm high.

1.16 Wiring Identification

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

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1_1986.

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

1.17 Wiring Terminations

.1 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.

1.18 Manufacturers and CSA Labels

.1 Visible and legible after equipment is installed.

1.19 Single Line Diagram

.1 Provide an electrical single line diagram in a “UV-rated” and weatherproof frame at main service load break switch.

.2 Drawings: 600 x 600 mm minimum size. Develop drawing using “AutoCAD 2002 version. Submit CD copy of drawings to Engineer.

.3 Submit diagram to Engineer for review prior to installation.

1.20 Mounting Heights

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

Electrical General Requirements Section No. 16010

1.21 Excavation and Backfill

.1 Ensure that route and depth of excavation for underground electrical services is as indicated. Provide protective materials around and over services and be present at all times during excavation and backfilling to supervise work.

.2 Contact Electrical Inspection Authority prior to backfilling of electrical service cables.

.3 Disturbed portions of roads and parking areas to be reinstated with 150mm thick Granular A.

1.22 Field and Quality Control (Testing)

.1 Prior to the Owner's acceptance, all electrical equipment, materials and systems installed shall be subject to an inspection and applicable performance tests supervised by the Owner and/or the Engineer to ensure that the operation of the system and components satisfy the requirements of the Contract Documents.

.2 Refer to section 16012, Field and Quality Control (Testing).

END OF SECTION

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runge & associates inc. ENGINEERS

SHOP DRAWING LOG – Section No. 16011

Project Name and No.: Cedar Spring Campground – Power Line Burial – 13116M

R - Reviewed
RAM - Reviewed as Modified
R&R - Revise and Resubmit

Date: August 5, 2014

Item	Reviewed By	Status	Date Received	Date Returned	Comments
Section 16010 – Electrical General Requirements					
1.12 As-built Drawings					
1.15 Nameplates					
1.19 Single Line Diagram					
Section 16011 – Field and Quality Control (Testing)					
3.1 Field and Quality Control (Testing)					
3.2 Cable Testing					
3.3 Grounding System					
Section 16015 – Short Circuit, Coordination & Arc Flash Study					
2.1 Protective Device Evaluation					
2.2 Short Circuit Analysis Study					
2.3 Arc Flash Assessment Study					
Section 16120 – Wire & Cables					
2.1 High Voltage Cables					
2.5 Primary Cable Splices					
Section 16300 – High Voltage Switch and Wood Pole					
2.1 H.V. Fusible Switch					
3.2 Inspection, Testing and Start-up					
3.3 Warning Sign					

runge & associates inc. ENGINEERS

SHOP DRAWING LOG – Section No. 16011

Project Name and No.: Cedar Spring Campground – Power Line Burial – 13116M

R - Reviewed
RAM - Reviewed as Modified
R&R - Revise and Resubmit

Date: August 5, 2014

Item	Reviewed By	Status	Date Received	Date Returned	Comments
Section 16345 – Transformer & Meter Modifications					
2.1 Key Interlock System					
2.2 Meter Jumpers and Cover					
Section 16400 – Basic Electrical Equipment					
2.4 Transformer and Junction Box Vaults					
2.5 Padmount Transformers					
2.9 High Voltage Junction Box					

Field and Quality Control (Testing) Section No. 16012

PART 1 – GENERAL

1.1 General Conditions

.1 All sections of Division16 form part of the Contract Documents. Refer to Section 16010 for General Electrical Requirements related to this work.

1.2 Scope

.1 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to provide the Field and Quality Control (Testing) described herein.

.2 This section relates to all equipment designed, supplied and installed under the Division 16 of Specifications.

.3 It is the contractor's responsibility to collect all the required data for preparation of the testing requirements.

.4 Work listed herein must be performed by fully qualified personnel trained in such type of work.

1.3 Acceptable cable-testing companies/contractors:

.1 The following is a list of approved contractors to perform the cable-testing work:
- .1 Belwood Electric
- .2 Black and MacDonald
- .3 Eaton
- .4 Schneider
- .5 Rondar

PART 2 PRODUCTS

Not applicable.

PART 3 EXECUTION

3.1 General

.1 Prior to the Owner's acceptance, all electrical equipment, materials and systems installed shall be subject to an inspection and applicable performance tests supervised by the Owner or the Engineer to ensure that the operation of the system and components satisfy the requirements of the Contract Documents.

.2 Ensure that the system and its components are ready prior to the inspection and testing for acceptance.

.3 Conduct all testing by fully qualified personnel only. Tests requiring initial power energization of a system shall not be made without notification of the Owner or Engineer. Tests, checks and the like carried out by or on behalf of the Contractor shall be documented and certified at no additional cost to the Owner. Submit two copies of the test certificates to the Engineer.

.4 Carefully check wiring for each system or part of a system to ensure that the system will function properly as indicated by wiring and schematic diagrams, description of operation, etc.

.5 Manually operate alarms and control devices to check whether their operation during normal and abnormal operating conditions causes the proper effect.

.6 In addition to tests on purely electrical systems, supply the necessary labour and equipment for operational tests required by other Divisions where electrical services are involved and make final adjustments to the electrical controls at no additional cost to the Engineer.

.7 Perform tests on auxiliary or specialized systems with the assistance of the manufacturer's representative. Upon successful conclusion of the tests, obtain a certificate from the manufacturer stating that the system has been installed to their satisfaction and that it is in good working order.

.8 Ensure circuit protection devices such as overcurrent trips, relays and fuses are installed to values and settings as indicated.

.9 Replace at no addition charge all fuses, relays, wiring or other devices destroyed during field quality control (testing).

.10 Supply all instruments, meters and personnel required for the tests.

.11 Clean equipment by vacuum. Clean, wax and polish all new exterior surfaces, check and tighten all electrical connections.

3.2 Cable and Wire Testing:

.1 Limit all tests on cables in this voltage range to insulation resistance measurements using a megger: 500V instrument for circuits up to 350V systems; 1000V instrument for 351V to 600V systems and 5000V for high voltage cables up to 28kV. Test existing cables that are to remain "before" and "after" cables are moved and reconnected.

.2 Perform DC Hi-Pot testing on existing high voltage cables to existing transformer #2082, tag T-5 and to existing transformer #2080,tag T-4 (provisional item), as follows:

.1 Perform test procedures as per manufacturer's recommendations, and according to IEEE standards for cable type. Also, perform an "acceptance test" to verify and detect any defects in the cable insulation and terminations.

.2 Ensure all safety procedures are in place prior to testing of cables.

.3 Record all cable tests results from the DC Hi-Pot testing and submit to Engineer for review. Include a description of the testing method and procedure used, date of test, and name of operator, and test weather conditions.

.3 Record all test results in a logbook and submit to the Engineer for reference. Replace or repair all circuits which do not meet minimum requirements specified in the governing Electrical Safety Code. Measure insulation resistance of the following circuits:

.1 Power, lighting and motor feeders (with equipment disconnected): phase-to-phase, and phase-to-ground.
.2 Control, CT and PT circuits and cables: measure to ground only.
.3 Do not perform megger tests on control circuits containing transistorized or solid-state components.
.4 Where power factor correction equipment is installed, it may be necessary to disconnect the capacitors from the system prior to testing to avoid overvoltage.

3.3 Grounding System

.1 Test the ground system efficacy for compliance with CSA Standard C22.1, IEEE and Supply Authority requirements. Verify that the ohmic resistance values specified therein is not exceeded.

.2 Notify Inspection Authority and Power Supply Authorities that they may be present to witness Contractor testing and provide any assistance required by these authorities for their own testing procedures.

END OF SECTION

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Short Circuit, Coordination and Arc Flash Study

Section No. 16015

PART 1 – GENERAL

1.1 General Conditions

.1 All sections of Division 16 form part of the Contract Documents. Refer to Section 16010 for General Electrical Requirements related to this work.

1.2 Scope

.1 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to supply and install the Short Circuit and Coordination Study described herein.

.2 This section relates to all equipment designed, supplied and installed under the 16000 Series of Specifications, in particular, the overhead and underground power distribution network.

.3 It is the contractor's responsibility to collect all the required data for preparation of the studies and analysis.

1.3 Shop Drawings

.1 Submit shop drawings in accordance with Section 16010 – Electrical General Requirements.

PART 2 – PRODUCTS

2.1 Protective Device Evaluation

.1 Ensure all protective devices ratings and settings are properly coordinated to suit the actual equipment supplied and/or installed or to which it is being connected.

.2 Perform a short circuit study to determine the fault current values at all distribution levels/busses. Utilize latest IEEE, ANSI and CSA standards for determining short circuit values.

.3 Provide system co-ordination time-current curves on Log-Log paper (Keuffel & Esser sheets) for all protective devices and components. Include but not be limited to the following:

.1 All protective devices on the high voltage distribution system (7200/12,480V)
.2 All protective devices up to all transformers (pad mounted and pole mounted).
.3 High voltage power cables and fuse curves.
.4 Damage curves for the existing outdoor transformers: 3-phase, phase-ground, phase-phase and inrush current point.
.5 Damage curves for high voltage power cables.
.6 Three-phase and/or single-phase RMS bolted fault values, phase-to-phase and phase-to-ground. Obtain information from the local utility company.
.7 Symmetrical and asymmetrical fault currents.
.8 One-line diagrams one each log paper of the coordinated devices.

Short Circuit, Coordination and Arc Flash Study

Section No. 16015

2.2 Short Circuit Analysis

.1 Provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, and source impedance data including high voltage system characteristics. Submit typical calculations, tabulations of calculations and results, conclusions and recommendations.

.2 Calculate short circuit interrupting and momentary duties for an assumed 3-phase and/or single-phase bolted fault at secondary side of each transformer.

.3 Include in tabulation fault impedance, X/R ratios, asymmetrical faults, motor contribution, short circuit kVA/MVA, and symmetrical and asymmetrical fault currents.

2.3 Arc Flash Hazard Study

.1 Provide an Arc Flash Hazard Study for the electrical distribution system shown on the single-line drawings. The intent of the Arc Flash Hazard Study is to determine hazards that exist at each major piece of electrical equipment shown on the single-line drawing. This includes the new load break switch, high voltage connections and the secondary bus of each transformer.

.2 The study will include creation of Arc Flash hazard Warning Labels to be installed by the Contractor.

.1 The labels will include, as a minimum, the following:

.1 Flash hazard boundary (in mm).
.2 Incident energy (in cal/cm^2).
.3 Personal protection equipment rating description.
.4 Shock hazard (in volts).
.5 Approach Boundaries.
.6 Glove class.
.7 Name of equipment.
.8 Equipment fuse size and part number.
.9 Date of issue.

.3 The Arc Flash Hazard Study shall include the electrical distribution system equipment shown on the single-line drawing up to the secondary side of each high voltage transformer (i.e., three pad-mounted and two pole-mounted transformers). Perform the short circuit and protective device coordination study for the electrical distribution system before performing the Arc Flash Hazard Study. The Arc Flash Hazard Study shall consider operation during normal conditions alternate operations, emergency power conditions, and any other operations, which could result in maximum arc flash hazard.

.4 The Contractor shall have the study prepared by qualified engineers of an independent consultant. The independent consultant shall be a Registered Professional Electrical Engineer (licensed in the Province of Ontario) who has at least ten (10) years of experience and specializes in performing power system studies.

.5 The Arc Flash Hazard Study shall be performed using electrical engineering software computer software packages, such as EasyPower®, SKM, e-tap or equivalent, and in accordance with CSA 462, NFPA 70E, IEEE 1584 Standards and Ontario OH & S Act and Regulations.

Short Circuit, Coordination and Arc Flash Study

Section No. 16015

2.4 Report Submission

.1 Include the following sections in all reports and studies:
- .1 Description, purpose, basis and scope.
- .2 Tabulation of all device ratings versus calculated short circuit duties.
- .3 Time-current curves, tabulations, settings, fuse selection, etc.
- .4 Fault current calculations.
- .5 Commentary and conclusion.
- .6 Arc Flash Hazard Study
  - .1 The Contractor shall submit the Arc Flash Hazard Study and arc flash warning labels at least 30 days prior to energizing the electrical equipment, complete with three (3) copies of the power systems study and one (1) set of warning labels.
  - .2 All pertinent data, rationale employed, and assumptions in developing the calculations shall be incorporated in the introductory remarks of the study.
  - .3 The report shall include an Arc Flash Evaluation Summary Sheet listing the following additional items:
    - .1 Bus name.
    - .2 Upstream protective device name, type and settings.
    - .3 Bus line to line voltage.
    - .4 Bus bolted fault.
    - .5 Protective device bolted fault current.
    - .6 Arcing fault current.
    - .7 Protective device trip/delay time.
    - .8 Break opening time.
    - .9 Solidly grounded column.
    - .10 Equipment type.
    - .11 Gap.
    - .12 Arc flash boundary.
    - .13 Working distance.
    - .14 Incident energy.
    - .15 Required protective fire-rated clothing type and class.

PART 3 – EXECUTION

3.1 General

.1 Submit report to all parties related to the electrical works of the project.

.2 Perform the field adjustments and protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved studies.

.3 Verify all fuse selections as identified in the studies are installed in the proper fusible switch location.

END OF SECTION

Wires & Cables Section No. 16120

PART 1 – GENERAL

1.1 General Conditions

.1 All sections of Division 1 form a part of this Specification. Read and fully adhere to exactly as if repeated here in full.

.2 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.

.3 All sections of Divisions 1 to 16 inclusive form part of the Contract Documents. Refer to Section 16010 for General Electrical Requirements related to this work.

1.2 Scope

.1 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to install the complete wiring systems specified herein including, but not limited to:

.1 High and Low voltage wire and cables

.2 Include in the wiring system all wiring, terminations, wire markers, cable tags, cable ties, splice fittings, insulation tapes, connectors and miscellaneous materials necessary to complete the wiring system.

PART 2 – PRODUCTS

2.1 High Voltage Cables (1001 to 28000V)

.1 Conductors: stranded aluminum conductors, compact uncoated, Class B, with size as indicated on single line diagram.

.2 Conductor shield: extruded semi-conducting cross-linked polyolefin.

.3 Insulation: extruded, tree-retardant TR-XLPE 100% insulated level, 90ºC, rated 28kV.

.4 Insulation shield: extruded semi-conducting polyolefin. Covering shall strip freely from insulation, and when removed shall not leave conducting particles, threads, or residue on the surface of the insulation.

.5 Concentric neutral shield: consists of helically applied annealed solid copper round wire conductors to provide 100% conductivity.

.6 Jacket: non-conducting, linear low density polyethylene moisture resistant (-40°C), black colour, extruded to fill spaces between neutral wires for a smooth outer surface. Include cable length indications (i.e., flagged) in metres.

.7 Splices are acceptable only between existing and new cables as shown on the contract drawings. Splices to be in accordance with OESC Rule 12-112. Refer to contract drawings for rating of existing primary cables.

.8 Manufactured and tested to CSA C68.3-97. Each cable must be CSA approved and include a “Certified Test Result” report.

.9 This design is based on ampacities provided by General Cable.

Wires & Cables Section No. 16120

2.2 Cable Termination Requirements

.1 Contractor to provide the following terminations:
- .1 All high voltage terminations i.e. stress cones at riser poles and load break elbows at transformers.
- .2 Low voltage terminations to be completed by the contractor. All secondary lugs to be supplied and installed by contractor.
- .3 Contractor to perform cable tagging for each cable.
- .4 The above costs must be included in the contractor's submitted quotation.

2.3 Low Voltage Wire and Cable (1000V and Below)

.1 Conductors: stranded Copper conductors, with minimum power conductor size: No. 12 AWG, minimum control conductor size: No. 14 AWG.

.2 Power conductors: size as indicated, with cross linked polyethylene (XLPE) insulation rated 1000 V – RW90 or RWU90, as indicated.

.3 Control conductors: XLPE insulation rated 600 V – RW90.

.4 Control panel wiring: copper with thermoplastic insulation type TEW rated at 600 V.

.5 Provide multi-conductor cables wrapped with interstitial fillers and an overall PVC (minus 40°C) flame retardant, low acid gas evolution jacket.

.6 Insulated ground conductors forming part of a multi-conductor cable assembly shall have green colour coding.

.7 Colour coding of insulated conductors:
- .1 1-conductor cable-Black
- .2 2-conductor cable-Black, White
- .3 3-conductor cable-Red, Black, Blue
- .4 4-conductor cable-Red, Black, Blue, White
- .5 Multi-conductor cables-Number code
- .6 Intrinsically safe field wiring: Yellow

.8 Teck90 Cable requirements:
- .1 Conductors: Class B compressed stranded Copper conductors, size as indicated, with cross linked polyethylene (XLPE) insulation rated 1000V – RW90.
- .2 Inner jacket: Black PVC flame-retardant, moisture resistant
- .3 Armour: flexible interlocking aluminum armour.
- .4 Overall jacket: PVC flame-retardant, moisture and sunlight resistant, with fully printed label of cable description on jacket.
- .5 Compliances: cable rated for wet and dry installation, and hazardous locations. Compliant with CSA C22.2 Nos. 131 and 174, including CSA FT1 and FT4.
- .6 Armoured/Teck90 Cable connectors:
  - .1 Watertight connectors for non-hazardous areas.
  - .2 Class 1, Zone 1, Group II B rated connectors c/w sealing compound for hazardous areas.

2.4 Wiring Accessories

.1 Wire markers: computer printed, black letters on white background, self-laminating – vinyl markers, number of markers as required.

.2 Cable markers for cables or conductors greater than 13 mm diameter: strap-on type, rigid PVC, black letters on white background, with PVC covered aluminium straps.

.3 Terminal blocks: minimum 600 V rated, modular, sized to accommodate conductor size used.

.4 Where screw-type terminals are provided on equipment field wiring: terminate with pressure-type insulated copper fork tongue terminals.

.5 Splice connectors for wire sizes Nos. 12-10 AWG inclusive: compression spring type.

.6 Splice connectors for wire sizes No. 8 AWG and larger: split-bolt type, sized to suit number and size of conductors, c/w flame retardant foot-type insulator.

.7 Cable ties shall be nylon, one-piece, self-locking type.

.8 Connectors for Teck armoured cables installed in hazardous locations: design approved for the application.

.9 Connectors for Teck armoured cables installed in wet areas or outdoors: watertight design.

.10 Cable pulling lubricant: compatible with cable covering and will not cause damage and corrosion to conduits or ducts.

2.5 Primary Cable Splices

.1 Primary cables are to be spliced only as shown on the contract drawings.

.2 Acceptable products:

.1 Cicame Energie Inc. cable connectors, model USMF1 by 3M Canada.

.2 3M Canada Cold Shrink Inline Splice kits, model 5415A (15kV splice) and model 5456A (28kV splice).

.3 Splice kits to be installed in accordance with OESC Rule 12-112 and manufacturer's specifications.

PART 3 – EXECUTION

3.1 Installation – General

.1 Install all wire and cable according to the drawings, with a minimum power conductor size of No. 12 AWG and minimum control conductor size of No. 14 AWG.

.2 Pull cable into ducts and conduits in accordance with the cable manufacturer's recommendations, using patented cable grips suitable for the type of cable or using pulling eyes to be installed directly onto the cable conductors.

.3 Limit pulling tensions to those recommended by the manufacturer to avoid overstressing cable.

.4 Utilize adequate lubricant when pulling cables through ducts and conduits to minimize wear on cable jackets.

.5 Install all through wiring in junction and pull boxes having no connection within the box with a minimum of 150 mm of slack left inside the box.

.6 Install instrument and thermocouple extension wiring separate from power and control wiring.

.7 Make connections to equipment “pig-tails” with mechanical, insulated, screw-on connectors for wire sizes Nos. 12-10 AWG. For wire sizes No. 8 AWG and larger utilize split-bolt connectors, taped with three layers minimum of insulating tape.

.8 No splices shall be permitted in cable or wiring runs, and shall only be permitted in junction boxes.

.9 Unless otherwise specified, make all wiring tapes, splices and terminations with identified compression screw type terminal blocks, securely fastened to avoid loosening under vibration or normal strain. Make connections for interior and exterior lighting circuits and 120 V, 15 amp convenience receptacle circuits using screw-on or split-bolt connectors and insulating tape.

.10 Identify each conductor by plastic slip-on markers at each termination indicating the circuit designation or wire number.

.11 Identify each cable by attaching a suitable marker, stamped or indelibly marked with the cable number, at each end of the cable and in all intermediate manholes, junction boxes and pull boxes.

3.2 Trenching and Backfilling

.1 Prior to installing any electrical work, the site will be brought to within 150mm of final grade by the civil contractor.

.2 All trenching shall be coordinated with Owner and civil contractor.

.3 Backfill must be compacted to a minimum of 95% standard proctor maximum dry density.

.4 For underground trench work, refer to current Ontario Provincial Standard Specifications and Drawings available at the Ontario Provincial Government website.

END OF SECTION

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High Voltage Switch and Wood Pole Section No. 16300

PART 1 – GENERAL

1.1 General Conditions

.1 All sections of Division16 form part of the Contract Documents. Refer to Section 16010 for General Electrical Requirements related to this work.

1.2 Scope

.1 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to supply and install the high voltage switch and poles described herein.

PART 2 – PRODUCTS

2.1 High Voltage Fusible Switch Requirements (Load-Break Switch)

.1 S&C Catalogue Number 135332R4-E-T2 fusible Alduti-Rupter Switch for outdoor installation.

.2 Single or three-pole (as indicated on single line diagram), single air break style, load breaking c/w fuses, fuse holder, handle mechanism, key interlock and accessories.

.3 Vertical mounting configuration. Provide sufficient 1” diameter IPS galvanized piping to interconnect switch mechanism.

.4 Nominal voltage rating: 14.4kV.

.5 Maximum voltage rating: 17kV.

.6 BIL rating: 110kV.

.7 RMS continuous and interrupting rating: 600 amperes, 40kA momentary RMS Assym.

.8 Include a disconnect operating handle mechanism with 180-degree operation. Include sufficient length of 2”-diameter IPS galvanized piping, and all necessary accessories and mounting hardware. Pole height will be 45ft.

.9 Fuses: SMU-40 fuse units rated 14.4kV, 25kA RMS symmetrical interrupting capacity. Include three fuses for switch plus three spare fuses (6 in total). Fuse rating and speed will be based on final coordination study.

.10 S&C Catalogue number 4741R2T tin plated bronze connectors for single conductor #2AWG solid through 500kc mil stranded copper or aluminium. Includes two ½”-13x2 ¾” galvanized steel hardware for attachment to NEMA 2 hole terminal pads.

.11 S&C Catalogue no. MP-018-001 single phase LA bracket, one per phase. S&C Catalogue no. MP-003-001 distribution class arrester 6kV, 5.1kV MCOV metal oxide.

.12 S&C Catalogue no. SDA-10726-3 (shipped loose) key lock, dust cover and mounting kit for downstream transformer hoods.

.13 Fuse holders: SMD-40 Fuse Mounting, with Catalogue No. 3032R1.

.14 End Fittings; complete with cypoxy insulators and ED-365 operating mechanism

.15 Key interlock system to release interlocking key for access to pad-mount transformers. Acceptable manufacturers: “Superior Interlock Corp.” and “Kirk Key Interlock”.

.16 S&C switch mounting frame for single wood pole installation. Mounting frame to be hot-dipped galvanized steel. The fusible switch must be completely assembled (except the operating handle extension piping) on a common mounting frame and aligned at the manufacturer’s facility.

.17 Acceptable Manufacturers: S&C Electric Canada Ltd.

2.2 Wood Pole

.1 Wood poles to be Class 3, manufactured in accordance with CAN/CSA-015-05. Refer to contract drawings for pole heights.

2.3 Pole Assembly Accessories

.1 Cable terminations: 3M cold shrink silicone rubber termination kit, 28kV rated.

.2 Lighting Arrestors: Hubbell/Ohio Brass Intermediate Class, 3kV rated, 2.55kV MCOV duty cycle, metal oxide, one per phase.

.3 Cable “U” Guards: hot dipped galvanized, 14-gauge, bottom flared design, minimum 2.5m (8’), diameter size to suit installation.

.4 Mounting hardware: hot-dipped galvanized steel support brackets, washers, nuts, bolts, spools and eyes.

2.4 Guys and Anchors

.1 Guy anchors: hot dipped galvanized, screw type, size as noted on drawings.

.2 Guy wire: CSA approved, hot-dipped galvanized, stranded construction, size as noted on drawings.

.3 Guarding: yellow, polyethylene, minimum 2000mm length.

PART 3 – EXECUTION

3.1 Installation - General

.1 Supply and install the riser pole, meter pole and termination pole assembly as indicated on drawings. Supervise all excavation and assembly work, including grounding requirements.

.2 Obtain final approval from local inspection authorities prior to energization.

.3 Contractor to coordinate interconnection point with local hydro authority.

.4 Obtain fuse size, speed and rating from coordination study prior to ordering (refer to Section 16015).

3.2 Inspection, Testing and Start-Up

.1 Contractor to provide independent pre-service testing on new high voltage switch prior to energizing. Submit report to engineer for review.

.2 Provide the following inspections and testing:
- .1 Clean contacts on disconnect switch and coat with anti-corrosion protection.
- .2 Check and measure resistance of pole contacts (ductor test).
- .3 Measure insulation resistance of lightning arrestors.
- .4 Verify and check interlocks for correct operation.
- .5 Perform cable insulation test on high voltage cables.

3.3 Warning Signs

.1 Provide warning signs to meet requirements of Ontario Electrical Safety Code.

.2 Decal signs: minimum size 175x250mm.

END OF SECTION

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Transformer and Meter Modifications Section No. 16345

PART 1 – GENERAL

1.1 General Conditions

.1 All sections of Division 16 form part of the Contract Documents.

1.2 Scope of Work

.1 Perform field investigations to review existing condition to implement required modifications work. Submit shop drawings prior to performing work.

.2 Modifications to be performed during shutdown period for primary switch commissioning.

.3 Arrange for local Inspection Authority to review and approve proposed work prior to, and, after installation is completed.

.4 Work to Include:
- .1 Provide key interlock on two existing pad-mount transformers.
- .2 Hydro One will remove all existing meters. Contractor to coordinate with Hydro One and provide meter base jumpers and covers for meter #J2634587 (at Maintenance shop).

1.3 Shop Drawings

.1 Submit shop drawings in accordance with Section 16010 – Electrical General Requirements.

1.4 Timing and Coordination - Power Shutdowns

.1 The contractor is requested to submit a detailed schedule of anticipated power interruption to the existing main primary service to the campground.

.2 The power interruption schedule is to be reviewed and approved by owner and engineer prior to any work being performed. Refer to Section 16010.

PART 2 – PRODUCTS

2.1 Transformer Key Interlock

.1 Contractor to provide Type D key interlocks on existing transformers #2080, tag T-4 and #2082, tag T-5. Key to be interlocked with new load break switch. Interlock system to be designed to release the interlocking key from the load break switch to allow access to the pad-mount transformers.

2.2 Meter Jumpers and Cover

.1 Contractor to provide meter base jumpers and cover for existing meter base (#J2634587) at Maintenance shop.

.2 Acceptable Products:
- .1 Square D catalogue no. MCJB5 jumper bar kit.
- .2 Square D cover plate; contractor to confirm exact model required.

.3 Contractor to install meter jumpers and cover in accordance with manufacturer's specifications.

Transformer and Meter Modifications Section No. 16345

PART 3 – EXECUTION

3.1 Installation – Key Interlocks

.1 Contractor to coordinate supply and installation of key interlock system with Composite Power Group Inc., 695 Riddell Road, Unit 4, Orangeville, Ontario. Contact Richard Booy, 519-942-8485 ext. 112.

3.2 Installation – Meter Jumpers

.1 The meter jumpers shall be installed by a qualified electrical contractor or technician familiar with metering instruments, and in accordance with electrical safety code.

END OF SECTION

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Basic Electrical Equipment Section No. 16400

PART 1 – GENERAL

1.1 General Conditions

.1 All sections of Division 1 form a part of this Specification. Read and fully adhere to exactly as if repeated here in full.

.2 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.

.3 All sections of Divisions 1 to 16 inclusive form part of the Contract Documents. Refer to Section 16010 for General Electrical Requirements related to this work.

1.2 Scope

.1 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to install all equipment and materials specified herein and on the drawings.

1.3 Shop Drawings

.1 Submit shop drawing in accordance with Section 16010.

PART 2 – PRODUCTS

2.1 Enclosure Ratings

.1 Indoor and dry locations: EEMAC 12.

.2 Below grade, damp or outdoor locations: EEMAC 4X, or EEMAC 3R, as noted on drawings.

.3 Explosion Proof or hazardous locations: rated for Class 1, Zone 1, Group D.

2.2 Fusing

.1 CSA Certified to C22.2 Standard.

.2 Type: Class J fuse body, Time Delay (unless otherwise indicated on drawings)

.3 Interrupting rating: 200,000 Amps, with IEC Type 2 “no damage” protection.

.4 Voltage rating: 600VAC

.5 Amperage rating: refer to contract drawings.

.6 Include “blown fuse” indicator on fuse body.

.7 Acceptable manufacturers: Bussman, Ferraz Shawmut

2.3 Weatherproof Enclosure

.1 Rating: EEMAC 3R

.2 12 gauge cold roll steel exterior

.3 At least 10 fasteners to concrete slab

.4 Lift hooks appropriate placed

.5 Door stiffeners and panel stiffeners, sized to suit

.6 Angles welded to panel stiffeners, sized to suit, for mounting two 19mm plywood backboards

.7 3 point stainless steel handles

.8 Door stops and storage

.9 Continuous stainless steel hinges

.10 No centre mullion

.11 Finishes:
- .1 Exterior: Transformer Green
- .2 Interior: White

.12 .Acceptable Manufacturer: ABCO Custom Manufacturing Inc. (1.519.747.9794)

2.4 Transformer and Junction Box Vaults

.1 Provide a low profile precast concrete chamber for equipment noted on drawings.

.2 Include chamber drawings in shop drawing review submission.

.3 Refer to contract drawings for chamber details and installation requirements.

.4 Acceptable manufacturer: Utilicon Engineered Precast Structures or Brooklin Concrete Products Ltd.

2.5 Pad Mount Transformers, Single Phase

.1 Transformers must be single phase, tamper resistant, pad mount (including the appropriate labeling) constructed in accordance with CAN/CSA C227.3-F91 (R1997).

.2 Rating: kVA rating as per single line diagram, ONAN, single-phase, 60Hz, mini-pad mounted complete with current limiting fuses.

.3 Polarity: Additive.

.4 High Voltage (HV) rating: 7200VAC. Note, primary supply is rated from a 7200V grounded Y system (7200/12,480V).

.5 Low Voltage (LV) rating: 120/240VAC.

.6 HV insulation class: 15kV.

.7 LV insulation class: 1.2kV throughout.

.8 HV lightning arrester: Distribution class, elbow type, 6kV, 5.1kV MCOV, metal-oxide type.

.9 Winding material: Aluminum.

.10 HV taps: Four 2.5%, two above and two below normal voltage. Designate tap settings on nameplate.

.11 Maximum temperature rise at rated kVA and voltage: 65°C measured by resistance, with maximum 40°C ambient air.

Basic Electrical Equipment Section No. 16400

.12 Radio interference: transformers must operate without causing interference to radio and tv reception or telephone communication circuits higher than the limits set forth in CSA C44.4 No.103 Standard.

.13 Grounding: Transformer core shall be electrically connected to the tank. Two grounding busses complete with two-9.5mm holes at each location shall be provided on the transformer tank, one on HV side and one on LV side. Cover on the switching compartment shall be electrically bonded to the tank with extra-flexible copper braid.

.14 HV and LV Bushing Requirements:
- .1 The high voltage coil shall be terminated with two ESNA flower pot bushings, welded, complete with 200A, 28kV ESNA load break inserts (for loop feed system). Bleed wires shall be installed on each insert.
- .2 Insulated parking stand for insulated elbow connector shall also be provided between the two bushings in described above and shall operationally accept either the ESNA 160-ft or 160-sop accessories for feed through applications.
- .3 LV bushings shall be of the welded type, and shall be equipped with either plated copper or plated aluminum bars with five 14.5mm holes in line, spaced minimum 32.5mm apart.
- .4 HV bushings shall be tilted upwards and the LV bushings shall be rotated from vertical plane to provide for convenient primary and secondary cable connections.

.15 Transformer protection: HV side - RTE bay-o-net oil fuse cut-out with isolating link. Fuse to be overload sensing, replacement type element. Also include a current limiting fuse to comply with section 26-242 of OESC.

.16 Install warning sign which states, "Danger - High Voltage" on all transformers in accordance with ESA Bulletin 36-6-18.

.17 Load break switch: Two-position load break switch on primary side.

.18 Transformer Mechanical Features:
- .1 Cover to HV and LV sections shall be open 180 degrees, removable and must face roadway.
- .2 Cover must be tamperproof and weatherproof, equipped with pentahead bolt complete with cup washer locking device.
- .3 Cover must include provision for padlocking.
- .4 Include recessed lifting hooks for placement and removal of transformer.
- .5 Front cover sill shall be made removable from the transformer tank, and shall include two tamperproof emergency access holes approximately 65mm in diameter.
- .6 Include two foundation clamps.

.19 Transformer oil: Include oil in the transformer to a level which allows for maximum oil expansion. Oil type must meet CSA Standard C50-1965, latest edition.

.20 Vent: Include pressure relief device.

.21 Transformer Finish Marking:
- .1 Tank, sill and cover shall be sand-blasted (or chemically treated) to remove all rust. Afterwards, provide two coats of approved primer followed by two coats of outdoor paint.
- .2 Colour: Equipment green.

.3 Transformer base shall be coated with bituminous material to prevent corrosion.

.4 Inside cover of the HV and LV sections shall be coated with an anti-condensation compound.

.22 Transformer testing: All standard transformer tests as stated in CSA specification shall be carried out on each transformer. Include copies of the test results in the shop drawing submission.

.23 Transformer losses: no load and full load losses will be evaluated using the current mea formula. All transformers to be of the low loss design only, with no exceptions. Copies of the losses must be included in the shop drawing submission.

.24 All single-phase padmount transformers shall be protected by an internal current-limiting fuse and equipped with a pressure relief device. Working spaces around the transformer shall be at least 3m on the access side and 0.6m on all other sides; refer to OESC 26-242.

.25 Acceptable transformer manufacturers: CES, ABB, Cam Tran, Moloney Electric, and Carte.

2.6 Primary Cutouts and Fuse Links

.1 Polymer or porcelain type L.

.2 Voltage rating: 15.5kV.

.3 Amperage rating: As indicated on drawings.

.4 Acceptable manufacturer: Cooper Power Systems.

2.7 High Voltage Load Break Elbows (for pad mount transformers)

.1 Rating: 25kV, 200amp, size to accommodate conductor size and type as per contract drawings.

.2 Elbow rating to match primary cable rating.

.3 Fully shielded. Fully submersible molded rubber housing.

.4 100% peroxide cured construction includes insulation and conductive epdm materials.

.5 Acceptable manufacturer: Thomas & Betts Elastimold.

2.8 Miscellaneous Materials and Installation Requirements

.1 Install warning signs adjacent to all 15kV fuses with state, "Do Not Replace Fuses While The Supply Circuit Is Energized".

.2 Install warning signs on all poles which state: "Danger, High Voltage - Keep Off. If work on this pole or near wires is necessary, contact the local utility office." final wording to be coordinated with the park owner during construction."

2.9 High Voltage Junction Box

.1 Number of junctions: refer to single line diagram.

.2 Amperage rating: 200A, copper bus. Include load break elbows.

.3 Enclosure: heavy gauge steel, with electro statically powder coated equipment green colour.

.4 Acceptable manufacturer: Kabar Industries Ltd. or Pedestal Solutions Inc.

.5 Install warning sign which states, "Danger - High Voltage" on junction boxes in accordance with ESA Bulletin 36-6-18.

PART 3 – EXECUTION

3.1 Installation – General

.1 Install and/or connect equipment as indicated.

.2 Perform tests in accordance with Section 16010 – Electrical General Requirements and manufacturer's recommendations.

END OF SECTION

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Grounding Section No. 16450

PART 1 – GENERAL

1.1 General Conditions

.1 All sections of Division 16 form part of the Contract Documents. Refer to Section 16010 for General Electrical Requirements related to this work.

1.2 Scope

.1 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to install a complete grounding system.

PART 2 – PRODUCTS

2.1 Equipment

.1 AC System Grounding conductors: bare stranded copper, soft annealed size as indicated or as required by Ontario Electrical Safety Code.

.2 Grounding electrodes (rods): copper clad steel, 19mm diameter by 3m long.

.3 Provide clamps for grounding of conductor, size as required to outdoor grounding system.

.4 Acceptable manufacturers:
.1 Burndy
.2 Thomas & Betts

PART 3 – EXECUTION

3.1 Installation General

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

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

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process or mechanical compression connectors utilizing hydraulic tools.

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

.6 Soldered joints not permitted.

.7 Make connections to ground bus using mechanical clamp type connectors.

.8 Clean surfaces to which ground conductors or bus are bolted to surfaces of paint, rust, etc., and lightly coat both contact surfaces with an oxide-preventing agent before bolting connection to steel member.

.9 Protect ground conductors or bus subject to mechanical damage by rigid galvanized steel conduit or steel guards which shall be effectively grounded at both ends to the ground conductor they are protecting, regardless of length.

.10 Terminate ground wires forming an integral part of cables to equipment ground stud of enclosure at all terminations unless otherwise noted for single cables. Where stud is not provided, drill enclosure housing and install ground fitting.

3.2 Equipment Grounding

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, frames of motors, motor control centres, starters, all control panels distribution panels, outdoor lighting, fire alarm system, generators, building steel, etc.

.2 Provide an insulated ground conductor in all conduit raceways, sized as required by the Electrical Code.

3.3 Field Quality Control

.1 Perform tests in accordance with Section 16010 – Electrical General Requirements.

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

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

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