

1. GENERAL

1.1 Work Included

- .1 Complete and operational electrical system as required by the drawings and as herein specified.

1.2 Related Work

- | | | |
|----|-----------------------|-------------|
| .1 | General Requirements: | Division 01 |
| .2 | Site Work: | Division 02 |
| .3 | Concrete: | Division 03 |
| .4 | Process: | Division 13 |
| .5 | Mechanical | Division 15 |

1.3 Drawings and Specifications

- .1 The General Conditions, Supplementary Conditions and Division 01 are a part of this specification and shall apply to this Division.
- .2 The intent of the drawings and specifications is to include all labour, products and services necessary for complete work, tested and ready for operation.
- .3 Symbols used to represent various electrical devices often occupy more space on the drawing than the actual device does when installed. In such instances, do not scale locations of devices from electrical symbols. Install these devices with primary regard for usage of wall space, convenience of operation and grouping of devices.
- .4 These specifications and the drawings and specifications of all other divisions shall be considered as an integral part of the accompanying drawings. Any item or subject omitted from either the specifications or the drawings but which is mentioned or reasonably specified in and by the others, shall be considered as properly and sufficiently specified and shall be provided.
- .5 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.
- .6 If discrepancies or omissions in the drawings or specifications are found, or if the intent or meaning is not clear, advise the Contract Administrator for clarification before submitting tender.
- .7 Responsibility to determine which Division provides various products and work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of specifications.

1.4 Quality Assurances

- .1 Codes, Rules, Permits & Fees
 - .1 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this work.
 - .2 Comply with all rules of the Canadian Electrical Code, CSA Standard C22.1 and the applicable building codes.
 - .3 Quality of work specified and/or shown on the drawings shall not be reduced by the foregoing requirements.
 - .4 Immediately after award of contract and prior to installation, verify location, arrangement and point of attachment for service and service entrance equipment with supply authority and inspection departments. Failure to do so will render this Division responsible for any corrections necessary without additional compensation.
 - .5 Give all required notices, submit drawings, obtain all permits, licenses and certificates and pay all fees required for this work.
 - .6 Furnish a Certificate of Final Inspection and approvals from inspection authority to the Contract Administrator.
- .2 Standard of Workmanship:
 - .1 Execute all work in a competent manner and to present an acceptable appearance when completed.
 - .2 Employ a competent supervisor and a sufficient number of licensed tradesmen to complete the Work in the required time.
 - .3 Arrange and install products to fit properly into designated building spaces.
 - .4 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of manufacturers.

1.5 Submittals

- .1 Within 30 days of award of contract, the contractor shall submit a completed equipment procurement schedule which lists the manufacturer and model of equipment, indicating the projected ordering, shop drawing submittal date and delivery dates of all products to meet the required construction schedule.
- .2 Submit samples as required where specified in Division 16.
- .3 Prior to delivery of any products to job site and sufficiently in advance of requirements to allow ample time for checking, submit shop drawings for review as specified in Division 01. Submit shop drawings for all equipment as required in each section of this specification.

- .4 Prior to submitting the shop drawings to the Contract Administrator, the Contractor shall review the shop drawings to determine that the equipment complies with the requirements of the specifications and drawings.
- .5 The term “shop drawing” means drawings, diagrams, illustrations, schedules, performance characteristics, brochures and other data, which are to be provided by the Contractor to illustrate details of a portion of the Work.

Indicate materials, methods of construction and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of Work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

Adjustments made on shop drawings by the Contract Administrator are not intended to change the contract price. If adjustments affect the value of the work state such in writing to the Contract Administrator prior to proceeding with the Work.

- .6 Manufacture of products shall conform to revised shop drawings.
- .7 Keep one complete set of shop drawings at job site during construction.

1.6 Record Drawings

- .1 The Contractor shall keep one complete set of white prints at the site office, including all addenda, change orders, site instructions, clarifications and revisions for the purpose of record drawings. As the work on site proceeds, the Contractor shall clearly record in Red Pencil all as-built conditions, which deviate from the original contract documents. Record drawings to include circuiting of all devices, conduit and feeder runs (complete with conductor size and number) and locations of all electrical equipment.
- .2 Prior to substantial performance, the contractor shall obtain CAD files of all electrical drawings, using AutoCAD Release 2000, and use the services of a competent CAD operator to transfer all as-built information, including: Addenda, Change Orders, Clarifications, Revisions, Site Instructions and shop drawings. Upon completion, the contractor shall certify, in writing, that the as-built record drawings are complete and that they accurately indicate all electrical services, including exposed as well as concealed items.
- .3 Contractor to forward letter of certification and as-built CAD drawings to the Contract Administrator for final review. As-built drawings to be submitted in the form of one set of CAD files on compact discs and one set of mylar reproducible sepias.
- .4 The Contractor may purchase copies of the electrical contract drawings on floppy disc from the Contract Administrator for a fee of \$20.00 for each drawing file.

1.7 Operation and Maintenance Manuals

- .1 Within 30 days prior to substantial performance, the Contractor shall submit a draft copy of the proposed contents of each maintenance manual to the Contract Administrator for review. Once the draft copy is approved, the Contractor will supply 4 copies in suitably labeled, hard back, D-Ring type commercial binders, each complete with an index and tabbed title sheets for each section. Final copies of manuals to be received by Contract Administrator not less than 7 days prior to substantial performance.
- .2 All maintenance manual data shall be printed on 8 1/2" x 11" heavy bond, indexed, tabbed, punched and bound in the binders. Each manual shall have a title sheet, which is labeled "Operation & Maintenance Manual", and lists the Project name, Contractor's & Contract Administrator's names, date submitted, and a Table of Contents for each volume. If a manual exceeds 75 mm in thickness, provide additional manuals as required.
- .3 Each section of the manual shall contain the following information:
 - .1 Systems Descriptions. A brief synopsis of each system typed and inserted at the beginning of each section. Include sketches and diagrams where appropriate.
 - .2 Descriptive and technical data.
 - .3 Maintenance and operating instructions for all electrical equipment and controls. (These operating instructions need not be manufacturer's data but may be typewritten instructions in simple language to guide the City in the proper operation and maintenance of his installation.)
 - .4 Lubricating and servicing intervals recommended.
 - .5 A copy of all wiring diagrams complete with wire coding.
 - .6 List of spare parts of all electrical equipment complete with names and addresses of sales, service representatives and suppliers.
 - .7 Copy of test data.
 - .8 A motor list showing each motor number, name, horsepower, full load amps, overload settings, nameplate, current rating, heater size and type, and current being drawn, on the form specified in Section 16970.
 - .9 Include type and accuracy of instruments used to obtain test data.
 - .10 Copy of final inspection certificate.
 - .11 Copy of the purchase order, showing equipment make and model numbers issued to the manufacturer complete with all addenda. All cost details may be hidden.
 - .12 Copy of all warranty certificates.
 - .13 Set of final reviewed Shop Drawings.

- .14 Names, addresses, phone numbers and facsimile numbers of Contractor, Contract Administrators, sub-contractors and suppliers used on the Work together with a specification reference of the portion of the Work they undertook.

1.8 Product Handling

- .1 Use all means necessary to protect the products of this Division before, during and after installation and to protect products and installed work of all other trades.
- .2 Immediately make good any damage by repair or replacement at no additional cost to the City and to the approval of the Contract Administrator.
- .3 Remove advertising labels from all electrical equipment. Do not remove identification of certification labels.
- .4 Remove dirt, rubbish, grease, etc. resulting from this work from all surfaces, including the inside of all cabinets, equipment enclosures, panelboard tubs, etc.

1.9 Alternate and Separate Prices

- .1 In accordance with the Instructions to Bidders, state on the Tender Form in the space provided, the amount to be added or deleted from the base bid tender amount for the use and installation of equipment as an alternate to those specified.

1.10 Guarantee

- .1 Furnish a written guarantee to the City prior to final contract payment, which will be in effect for one year from the date of final acceptance of the complete work. Replace or repair at no cost to the City any defective material or workmanship except where, in the opinion of the Contract Administrator, such defects are due to the misuse or neglect by the City.
- .2 This general guarantee shall not act as a waiver of any specified or special equipment guarantees, which cover a greater length of time.

2. PRODUCTS

2.1 Selected Products and Equivalents

- .1 Products and materials provided shall be new and free from all defects. Defective products or materials will be rejected, regardless of previous inspections. The Contractor shall be responsible to remove and replace defective products at their expense, and shall be responsible for any resulting delays and associated expenses, which result from defective products being rejected. Related materials shall be of the same manufacturer throughout the project.
- .2 Products and materials referred to in the specifications by trade names, manufacturer's name and catalogue reference are those, which shall be used as the basis for the Tender.
- .3 The design has been based on the use of the specified product.

2.2 Quality of Products

- .1 All products provided shall be CSA Approved, Canadian Underwriters' Laboratory approved where applicable, and new, unless otherwise specified.
- .2 If products specified are not CSA approved, obtain special approval from the local regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
- .3 Products provided, if not specified, shall be new, of a quality best suited to the purpose required and their use subject to approval by the Contract Administrator.

2.3 Uniformity of Manufacture

- .1 Unless otherwise specifically called for in the Specifications, uniformity of manufacture shall be maintained for similar products throughout the work.

2.4 Product Finishes

- .1 Finish all cabinets, panelboards, switchboards, equipment cabinets, cable trays, etc. in ANSI 61 grey enamel unless otherwise specified.
- .2 Apply primer on all items, which are to be finished on the job.
- .3 Touch up all damaged painted finishes with matching lacquer, or, if required by the Contract Administrator, completely repaint damaged surface.

2.5 Use of Products During Construction

- .1 Any equipment used for temporary or construction purposes shall be approved by the Construction Manager and in accordance with the General Conditions, "Use of Premises." Clean and restore to "as new" condition all equipment prior to the time of substantial completion.
- .2 The warranty period shall not begin until the date of substantial performance of the work.

2.6 Non-Specific Date/Time Compliance

- .1 All equipment, hardware, software and firmware (for the purposes of this clause #, the "Product") delivered or deliverables resulting from any services provided are fully Date Compliant and the Product will not adversely or materially effect the daily business operations as a result of a date related computer problem (for the purposes of this clause #, the "Warranty"). Date Compliant means that the Product accurately and correctly processes and stores date/time data (including, but not limited to, calculating, comparing, displaying, recording and sequencing operations) including year, century and leap year calculations.
- .2 Provide documentary proof of Date Compliance prior to substantial completion listing all equipment and certifying their compliance.

- .3 Notwithstanding any other remedy available under this agreement or at law for breach of the Warranty, any Product that is not Date Compliant shall, within twenty-four (24) hours of receipt of notice of the breach, be repaired or replaced at the Contractors sole cost and expense, including parts, labour, transportation and insurance, so as to correct any failure to meet the Warranty.

3. EXECUTION

3.1 Coordination with Other Divisions

- .1 Examine the drawings and specifications of all divisions and become fully familiar with their work. Before commencing work, obtain a ruling from the Contract Administrator if any conflict exists, otherwise no additional compensation will be made for any necessary adjustments.
- .2 Lay out the work and equipment with due regard to architectural, structural and mechanical features. Architectural and structural drawings take precedence over electrical drawings regarding locations of walls, doors and equipment.
- .3 Do not cut structural members without approval of the Contract Administrator.
- .4 Coordinate with all divisions installing equipment and services, and ensure that there are no conflicts.
- .5 Install anchors, bolts, pipe sleeves, hanger inserts, etc. in ample time to prevent delays.
- .6 Examine previously constructed work and notify the Contract Administrator of any conditions, which prejudice the proper completion of this work. Commencement of this work without such notification shall constitute acceptance of other work.

3.2 Location of Outlets and Luminaires

- .1 Electrical drawings are, unless otherwise indicated, drawn to scale and approximate distances and dimensions may be obtained by scaling. Figured dimensions shall govern over scaled dimensions. Where exact dimensions and details are required, refer to Architectural and Structural drawings.
- .2 Outlet and equipment locations shown on the drawings are approximate. Locations may be revised up to 3 meters to suit construction and equipment arrangements without additional cost to the City, provided that the Contractor is notified prior to the installation of the outlets, or equipment.
- .3 Maintain luminaire locations wherever possible. Notify the Contract Administrator of conflicts with other services.
- .4 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of manufacturers.

3.3 Separation of Services

- .1 Maintain separation between electrical wiring system and building piping, ductwork, etc. so that wiring system is isolated (except at approved connections to such systems) to prevent galvanic corrosion.
- .2 In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.
- .3 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings shall not be used for the support of wiring.

3.4 Equipment Identification

- .1 3 mm thick plastic lamicoïd name plates, black face, white core, mechanically attached with self tapping screws, to be attached to the front face of the following equipment:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .1 Distribution Centres (Indicate designation, bus capacity, voltage)
 - .2 MCC's (Designation, voltage)
 - .3 Starters, contactors, Disconnects (Designation, voltage, load controlled)
 - .4 Panelboard (Designation, voltage, Bus Capacity)
 - .5 Automatic transfer switch (designation, voltage, rating)
 - .6 Terminal cabinets and pull boxes (system, voltage)
 - .7 Transformers (designation, capacity, primary and secondary voltage)
- .2 Color code exposed conduits (including conduits above T-bar ceilings), junction and pull boxes, and metallic sheathed cables with paint or plastic tape (25 mm wide band) at 15 metre intervals. Color coding to be as follows:

SYSTEM	MAJOR BAND	MAJOR BAND
High Voltage	Yellow	Purple
347/600 V Normal	Dk. Blue	
347/600 V Emerg.	Dk. Blue	White
120/208 V Normal	Lt. Blue	
120/208 V Emerg.	Lt. Blue	Black
UPS System	Lt. Blue	White
Fire Alarm System	Red	
Communication Circuits	Black	Yellow

- .3 Provide neatly typed circuit directories in panelboards to indicate the area or equipment controlled by each branch circuit.
- .4 All conductors shall be identifiable by coloured insulation and permanent markers at every terminal and accessible points throughout its entire run.

Conductors:

Equipment Grounding – Green
 Neutral Conductor – White

<u>347/600 Volt System</u>	<u>120/208 Volt System</u>
Phase A – Orange	Phase A – Red
Phase B – Brown	Phase B – Black
Phase C – Yellow	Phase C – Blue

3.5 Wiring to Equipment Supplied by Others

- .1 Equipment supplied by the City or under other Divisions will be moved to the installation site by others. However, the electrical connection to the equipment shall be done by this Division.

3.6 Testing

- .1 Refer to Section 16980 - Testing, Adjusting and Balancing of Electrical Equipment and Systems.

3.7 Single Line Diagram

- .1 Provide and mount a framed as-built single line diagram to be located adjacent to the main electrical equipment. Use a clear plexiglass cover. The diagram shall be 914 mm x 600 mm minimum, with all lettering Leroyed.

3.8 Instructions to City's Personnel

- .1 Refer to Section 16990 - Electrical Equipment and Systems Demonstration and Instruction.

3.9 Access Panels

- .1 Where electrical equipment, junction boxes, remote ballasts or the like are concealed, access panels shall be supplied. Panels shall be of adequate size for servicing of the electrical work and complete with necessary frames and hinged doors held closed with captive fasteners. Coordinate type and size of panels with the Contract Administrator.
- .2 In removable ceiling areas, provide markers on ceiling tile to locate equipment requiring access. Markers shall be of a type approved by the Contract Administrator.

3.10 Mounting Heights

- .1 Unless a conflict exists, use the following as mounting heights from finished floors to centre of device.

Thermostats	1400 mm
Panelboards, starters, and disconnects (to top of cover)	2000 mm
End of line resistors	1800 mm

3.11 Sealing of Wall and Floor Openings

- .1 All conduit and cable entries through outside walls of buildings, through partition walls separating electrical rooms from other areas, through fire separations, and through floors above grade shall be sealed to prevent passage of moisture, dust, gasses, flame, or to maintain pressurization.
- .2 Openings shall be sealed when all wiring entries shown on the drawings have been completed.
- .3 Sealing material shall be fire resistant and shall not contain any compounds which will chemically affect the wiring jacket or insulating material. Cable penetrations through fire separations to be sealed.

3.12 Sprinkler Proof Equipment

- .1 Electrical equipment installed where sprinklers are also installed shall be constructed so that water from the sprinkler heads shall not impair the effectiveness of the equipment. This will include, but not be limited to: Distribution Centres, Equipment Enclosures, Cabinets, Transformer enclosures, Panelboards.
- .2 A separate and complete roof shall be provided on free-standing or surface mounted equipment. An overhang at the front, rear and sides shall prevent the entrance of water either at the top or through projecting face plates, meters, etc.
- .3 Where conduits or cables are required to penetrate sprinkler proof roofs, rain tight connectors shall be used in conjunction with T & B 5260 Series sealing rings. Connectors shall be equal to:

- .1 Rigid Conduit - T & B Bullet Hubs
- .2 EMT - T & B 5123 Series (steel)
- .3 Teck Cable - T & B 10460 Series
- .4 Distribution, power and lighting panelboards and switchboards shall be complete with gasketed covers and doors.
- .5 Louvres shall be of the outdoor type.

3.13 Housekeeping Pads

- .1 All floor mounted electrical equipment installed by this Division shall be mounted on concrete housekeeping pads which , unless otherwise noted, shall be the responsibility of the Contractor.
- .2 The Contractor shall determine the extent of the housekeeping pads required and supply all information and details as to size and locations to the Contract Administrator within thirty days after the award of the Contract.

3.14 Sleeves

- .1 Provide sleeves of galvanized steel pipe with machine cut ends of ample size to accommodate conduits passing through walls, partitions, ceilings, floors, etc.
- .2 For wall, partitions and ceilings the ends shall be flush with the finish on both sides but for floors they shall extend 4" above finished floor level.
- .3 The space between the sleeve and the conduit shall be filled with Dow Corning silicone RTV foam for fire stop and caulked around the top and bottom with approved permanently resilient, non-flammable and weatherproof silicone base compound. Ensure that the seal is compatible with the floor and ceiling finishes.
- .4 Locate and position sleeves exactly prior to construction of walls, floors.
- .5 Failure to comply with the above requirements shall be remedied at this Division's expense.

3.15 Temporary Lighting and Power

- .1 Provide grounded extension cords and temporary lights as required for electrical work.
- .2 Coordinate with General Contractor for obtaining temporary power service.
- .3 If City's operations will be affected by any power outage required for this work, give adequate notice to the City and do not interrupt power until approval has been obtained.
- .4 Give adequate notice to Contractor of any power outage required for this work. Schedule outages to provide least interference with other work.

3.16 Insulation Resistance Testing

- .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
- .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
- .3 Check resistance to ground before energizing.
- .4 Carry out tests in presence of the Contract Administrator.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit test results for the Contract Administrator's review.

3.17 Load Balance

- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes (maximum deviation of 15%).
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

END OF SECTION