Electrical Specifications

for

City Of Pickering Fire Hall
553 Kingston Road
Pickering, Ontario

HCC PROJECT #17264

The undersigned has reviewed and takes responsibility for this design and has the qualifications and meets the requirements set out in the Ontario Building Code to be a designer.

*QUALIFICATION INFORMATION

Required unless design is exempt under DIV C 3.2.5.1 of the building code

HOWARD COHEN		24553
NAME	SIGNATURE	BCIN

*REGISTRATION INFORMATION

Required unless design is exempt under DIV C 3.2.4.1 of the building code

HCC ENGINEERING LIMITED	28954
FIRM NAME	BCIN

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Re-issued For Tender
June 10, 2024

Electrical Table of Contents

SECTION 26 05 00: GENERAL CONDITIONS.

1.1 Project Description:

1. The project encompasses the 553 Kingston Road, Pickering facility. In general, the work shall include, without being limited to the following:
    1. Provide new 120/240 Volt utility power service.
    2. Provide communications conduit systems, grounding systems, lighting, lighting control, fire alarm system, etc., as shown on the drawings.
2. The electrical contractor shall provide a comprehensive Methods of Procedures (MOP's) two weeks prior to each and every power shutdown. MOP's must include a detailed sequence of operations to be completed during the respective shutdown as well as a back out plan. MOP's must be approved by the client, landlord and the electrical engineer prior to any work taking place.

1.2 Sub-Contractors:

1. The Contractor may not assign or sub-contract any work without the prior written consent of the Construction Manager or his designated representative. A list of sub-contractors must be submitted with the tender response.

1.3 Substantial Completion Of Contract

1. All the equipment and wire must be cleaned and tested, before acceptance by the consultant.
2. This Contractor shall guarantee all equipment and work furnished under this Division for a period of **two (2) years** or such longer periods as may be provided in the warranty of the manufacturer of individual components, whichever is longer from the date of final acceptance by the Engineer. This contractor shall correct all defects developing as a whole or in part, due to defective workmanship, materials or defective arrangement of the various parts or materials damaged as a result of these defects or repairs. All defects shall be made good to the satisfaction of the Engineer at this Contractor's expense.
3. Replace, at no cost, all incandescent lamps burned out during a 30 (thirty) day period, all burned-out fluorescent and HID lamps for a period of 90 (ninety) days and all burned out LEDs based on a 70% lumen maintenance within a 5 year warranty period after date of issuance of certificate of Substantial Performance for the contract of this building.
4. Additional requirements as detailed in Section 26 05 00, paragraph 1.7, sentence 9.

1.4 Inquiries

1. All inquiries will be responded to in writing and will be distributed to all bidders.

1.5 Site Meeting

1. The site meeting will be scheduled during the tender period by the project manager.

1.6 Examination of Premises And Work

1. Visit and examine the site where the work is to be done. Become familiar with all features and characteristics of the site and/or any existing structure before submitting a bid. No allowances will be made by the Owner for any difficulties encountered by this Contractor due to any peculiarities of the site, surrounding public or private property that existed when the Tender was submitted.
2. This Contractor shall examine the structural, mechanical, architectural and electrical and any other drawings issued to satisfy himself that the work can be satisfactorily carried out. Before commencing work or prefabrication, examine the work of other trades and report at once any defect or interference affecting the work of the electrical trade.
3. Where variances occur between the drawings and the specifications, or within either document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the contract sum. The Engineer will decide on the item and manner in which the work shall be installed.
4. All bidders shall familiarize themselves with and adhere to the owner's building standards and guidelines.

1.7 Terms And Conditions

1. DEFINITIONS

    1. The term Owner shall be understood to refer to City of Pickering.
    2. The term consultant shall be understood to refer to Howard Cohen, P. Eng., RCDD/LAN, MBA.
    3. Not used.
    4. The term electrical contractor shall be understood to refer to the successful bidder to this specifications package.
    5. The term Contract shall be understood to refer to all items and conditions of this specification, Drawings, the complete tender package, the Contractor's tender submission and any other future contractual arrangements. All such items and conditions shall be binding unless agreed otherwise by the Contractor, Consultant and Owner.
    6. The term Project shall be understood to refer to the complete supply and installation of the Electrical System and components, as defined in this specification and Drawings.
    7. Wherever the words "equal", "equivalent", "approved", or "approved equal" are used, it shall be understood to mean, "equal", "equivalent", "approved", or "approved equal" in the opinion of the Consultant only.
    8. Wherever the words "install", "provide", or "supply and install", are used it shall be understood to mean "provide and install, inclusive of all labour, materials, installation, testing, and connections" for the item to which referred.
    9. "Concealed" is defined as "out of sight" in "normal" viewing conditions, and includes buried in concrete, above acoustic tile or gypsum board ceilings, within masonry or gypsum board constructed walls, within cable trays of below raised access floors.

2. These specifications or the drawings shall not be used alone. Any item or subject omitted from one, but mentioned or reasonably implied in the other, shall be provided. Misinterpretation of any requirements of either the specification or drawings shall not result in any additional charge after submission of Tender. This Contractor shall, by careful study of the total requirements, include all necessary components to make each system workable.
3. This paragraph not used.
4. The Contractor shall co-operate fully with the Owner, Consultant, landlord and landlord's agent and all contractors, sub-contractors and other persons working on the site.

5. The Contractor shall do the complete installation in accordance with the latest editions of the National Building Code, Ontario Building Code, Canadian Electrical Safety Code, C.S.A., or other Codes or governing authorities of competent jurisdiction. In case of discrepancies with this or the manufacturer's specifications, the Contractor shall notify the Consultant immediately.
6. Obtain and pay for permits and ESA plans approvals (note: Building Permit obtained by owner) and inspections required for work performed. Provide Certificate (s) of Acceptance from the Authorities Inspection Department, upon completion of work.
7. Submit required Documents and shop drawings to authorities having jurisdiction in order to obtain approval for the Work. Copies of Contract Drawings and Specifications may be used for this purpose. Prepare any additional information, details and drawings which these authorities may require.
8. The Contractor must comply with all requirements of the Occupational Health & Safety Act.
9. In order to meet the requirements of substantial completion the electrical contractor must complete the following:
    1. Installation and successful testing of all electrical system devices as per mutually agreed to tests and commissioning plan.
    2. Overall system test demonstrating system operation and coordination of the utility systems.
    3. Commissioning of all systems including access control systems, intrusion systems, CCTV systems and duress systems
    4. Client training for all systems including access control systems, intrusion systems, CCTV systems and duress systems.
    5. Submission of all coordination and permit documentation for the Consultant's review.
    6. Submission of all record and As-built documentation.
    7. Correction of any deficiencies in the electrical system.

1.8 Schedule

1. Include for all necessary overtime required to carry out the project. The successful contractor will not be permitted claims as a consequence of this requirement. Successful Contractor to submit a full construction schedule before starting any work.
2. Sufficient manpower, materials, equipment, appliances and services are to be kept on site at all times to maintain the scheduled completion of work.
3. All work required to be done after office hours and weekends (including x-raying, core drilling and power shutdowns), shall be included in the tender price. Note: All x-raying and core drilling shall be provided by the electrical contractor.
4. Work associated with power shutdowns and with testing and commissioning of electrical systems must be carried out on Sunday mornings from 1am to 4 am. All shut downs must be approved by Owner and by Landlord.
5. **Contractor must provide a dedicated on-site electrician for 8 hours on the Monday following each cutover.**

1.9 Contract Drawings

1. The Drawings for the electrical system work are diagrammatic performance Drawings, intended to convey the scope of work and indicate the approximate sizes and locations of equipment and outlets. The Drawings do not intend to show Designer's Architectural, Mechanical or Structural details.
2. Do not scale or measure Drawings, but obtain information regarding accurate dimensions, from the dimensions shown or by site measurements. Follow the Drawings for laying out the work.

3. Make, at no additional cost, any changes or additions to materials and equipment necessary to accommodate Structural conditions (offsets around beams, columns, etc.).
4. Alter at no additional cost, the location of materials and/or equipment as directed, provided that the changes are made before installation, and do not necessitate additional materials.
5. Change location of termination panels and devices at no extra cost providing cable length increase resulting from relocation does not exceed 3m (10 ft.) and information is given before installation.
6. Confirm at the site, the exact location of equipment.
7. Any miscellaneous materials, hardware, devices, wiring, etc., not specifically described, but required for the installation and operation of the electrical system, shall be provided and included as part of the Bid.

1.10 Materials And Equipment

1. All materials and equipment shall be completely new and unused products of only the most recent manufacturer model or version number, C.S.A. certified, and manufactured to the Standards specified.
2. Where there is no alternative to supplying equipment which is not C.S.A. certified, obtain special approval from the local Inspection Department.
3. No damaged, chipped or marked equipment or materials will be accepted and must not be installed.

1.11 Substitutes

1. Manufacturer's Basis of Design product part numbers and / or product photos have been included as part of this specifications package as the basis for the specification and tenders. and to clearly describe the quality of the product that is required for the work. A specific Manufacturer's name and model number also represents specific physical dimensions and operational requirements required on this project.

2. Substitutes will only be considered when submitted in sufficient time to review the proposal before tender closing. Proposals must be submitted at least two weeks prior to the deadline for Addenda Issues and for light fixtures must include detailed photometric plots for proposed light fixture substitutions. The photometric plots must be of the entire floor plan and must include all partitions and workstations (based on 5’ high furniture panels). After reviewing the proposals, the Engineer will preliminarily accept or reject the proposed substitute(s). Addenda will be issued to confirm the preliminary acceptance of proposed substitutions. Preliminary acceptance of substitutes does not constitute approval for the use of those substitutes in the work.

4. It is the Contractor's responsibility to demonstrate in his proposal that the proposed substitutions are compatible with all related work and that the characteristics are equal to, or superior to the original specified items, including, but not limited to:

    - performance;
    - physical characteristics (i.e. dimensions, weights);
    - electrical characteristics (i.e. voltage, number of phases, rated load amperage);
    - availability;
    - noise characteristic (i.e. generated sound power, attenuation).
    - average max to min and average light levels (light fixtures).
    - lighting power density.
    - illuminated surface area.
    - lumen maintenance.

5. This Contractor shall be responsible for any additional costs necessary to accommodate substitutes.

6. All shop drawings submitted for approved substituted equipment shall be marked as such by the Contractor.

1.12 Operation And Maintenance Manuals

1. Provide five (5) hard copy sets of operation and maintenance manuals for equipment and products supplied.
2. Provide three (3) soft copy scanned sets of operation and maintenance manuals for equipment and products supplied. Media shall be USB sticks.
3. Include the following information in the Operation and Maintenance manuals:
    - Names and address of local suppliers for the items included.
    - Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature is not acceptable.
    - Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of the installation.

4. Review information provided in the maintenance instructions and manuals with the Owners' operating personnel to ensure a complete understanding of the electrical equipment and systems and their operation.

1.13 Progress Payments

1. Submit a complete breakdown of the Contract with each progress billing, indicating percentage of work complete, in a form acceptable to the Owner/Consultant.
2. The amount of monies to be allocated for close out documents must be 3% of contract value. This does not include monies allocated for testing, measurement and verification, commissioning, training, etc.

1.14 Shop Drawings

1. Submitted Shop Drawings must indicate details of construction, dimensions, capacities, weights and electrical performance and flame spread characteristics of equipment or materials, as well as specification reference Section number and project name.
2. Shop Drawings shall be provided with sufficient space on the front for all Consultant's and Contractor's "review" stamps.
3 Work affected by submittal shall not proceed until review is complete.
4. Review submittal prior to submission to Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of the work and Contract Documents and bears the Stamp of Communications Contractor.
5. Changes made to the Shop Drawings by the Consultant will not affect the Contract Price.
6. Submit Shop Drawings for all material and equipment referred to in contract document.

1.15 Field Supervision

1. Throughout the duration of the Project, a properly qualified Electrical Field Supervisor must be available at all times. The Supervisor who starts the work must not be changed unless requested by the project manager, or written permission from the project manager is obtained.
2. In addition, provide proper office supervision of the work. The person responsible for office supervision must visit the site as often as necessary, to ensure work is properly performed, and attend weekly site meetings when so requested.

1.16 Site Responsibilities

1. Maintain work areas to be free of construction debris and waste. The disposal of all materials shall be the responsibility of the Contractor.
2. Make all necessary arrangements to transport materials and equipment to and within the site. The Contractor shall be responsible for arranging for the use of any hoists, lifts, pulleys, winches, cranes or service elevators.
3. The Contractor is responsible for complete storage, handling, delivery, and installation of all materials used in the performance of the work.
4. Obtain a copy of the Landlord's leasehold design manual and ensure that all requirements are complied with.

1.17 Deliveries / Access

1. Coordinate all deliveries to site with the Building Manager. Book loading dock and service elevators 72 hours in advance. Contractor must pre-arrange all site access and authorization for all site personnel and subcontractor personnel with the Building Project Manager or his representative

1.18 Testing And Commissioning

1. Provide testing and commissioning as per Testing and Commissioning Plan to be reviewed and approved by the Consultant and Project Manager for all items and their related components.
2. Supply all required equipment maintenance and operations manuals, for owner's staff use.
3. Provide all required software for monitoring, annunciation and control/dispatch applications

1.19 Other

1. It is the responsibility of the Contractor to perform all cutting, patching and repair related to the electrical system work.
2. Work by the electrical contractor shall be protected during erection against disfigurement, contamination or damage by mechanical abuse or harmful materials. Protective covers shall be installed where exposure to potential damage is likely. The contractor shall ensure that no eating, drinking or smoking is carried out in the finished areas. Damages resulting from a breach of these requirements shall be repaired at the cost of the electrical contractor.
3. Existing and adjacent finishes, work and structures shall be protected from damage resulting from work of this project.

1.20 Record and As-Built Drawings

1. The Contractor shall maintain two sets of drawings on site. Clearly mark on these drawings all changes and deviations from the contract drawings and in particular mark the actual location of all feeder conduit locations.
2. All deviations from the contract drawings shall be recorded on the "as-built" drawings, including those changes due to Addenda, Site Instructions or Change Orders.
3. After the date of Substantial Performance, obtain from the Consultant, a set of AutoCAD Version 2017 CD of the most recent Electrical System Drawings. These Drawings shall be marked up to record clearly, neatly, accurately and promptly all locations of Electrical System deviations as a result of Change Orders, Consultant's or Owner's Instruction, site conditions, etc. Utilize normal recognized CAD procedures that match the original drafting methodology. Submit the revised As-Built AutoCAD CD and Drawings (three sets) with changes clearly indicated to the Consultant for review and final presentation to the Owner.
4. For the disk drawing submission described above, the electrical contractor must include as part of the lump sum price $450.00 plus HST to have HCC Engineering supply the AutoCAD floor plans denoted as 'Issued for Tender' on disks.

1.21 Drawings

1. For exact details and quantities, refer to the later sections of this document and to drawing E-1.1, E-1.2, E-1.3, E-2.1, E-3.1, E-5.1, E-6.1 and E-7.1 denoted as 'Re-issued for Tender June 10, 2024.'

1.22 Contract

1. Conform to the conditions stated in the Contract Form, Document CCDC-2.
2. A confidentiality agreement will form an integral part of the contract and will be provided to the successful contractor.

1.23 Cleaning

1. It is the responsibility of the Contractor to dispose of all waste related to this project.
2. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
3. On a daily basis, remove waste materials, rubbish, tools, equipment, machinery, surplus materials and clean all sight exposed surfaces.
4. All materials must be stacked neatly and safely.

5. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.
6. Cleaning operations shall include those areas used for temporary site access or used on a temporary basis to facilitate work.
7. The contractor will remove all garbage from site on a daily basis at his own expense.
8. Failure to provide housekeeping and/or maintain a clean work area to the satisfaction of the project manager will result in the project manager providing the necessary housekeeping and/or maintenance service with all related costs, including mark-up's, being charged to the electrical contractor.

1.24 Demolition

1. Disconnect and remove existing conduit and wiring in partitions to be demolished and existing 'BX' cables, conduit and wire in ceiling where existing outlets, lighting fixtures, devices and mechanical equipment are to be removed.
2. Remove all branch circuit wiring and raceways originating from the existing receptacle panels. Wiring and raceways shall be removed back to the source panel. Circuits utilized to feed existing to remain mechanical equipment and other 120/208 volt sources to remain must be maintained.
3. Remove all existing electrical outlets and light switches as well as the associated wiring and raceways not being reused and/or not required for new layout (note: existing outlets and switches to be removed are not shown on the drawings). Provide blank coverplates at all locations where electrical and/or communications devices were removed in which partitions are not being demolished.

1.25 Digital Photos

1. Provide digital photos of all progress to date on a weekly basis. Each photo submission must be reviewed and approved by the consultant prior to continuing with the installation.

End of Section

SECTION 26 05 01: COMMON WORK RESULTS - ELECTRICAL.

PART I: GENERAL

1.1 Reference:

1. This section forms part of every section of Division 26.

1.2 Access Doors:

1. Not Required.

1.3 Cleaning:

1. Clean devices and other surfaces that have been exposed to construction dust and dirt. Clean the insides and outsides of panels and other electrical equipment and completely remove all debris and tools from the project.

1.4 Codes and Standards:

1. Complete the installation of the work in accordance with latest editions of the National Building Code, Canadian Electrical Safety Code, C.S.A., U.L.C., N.F.P.A, O.S.H.A. or other codes, as required.
2. Comply with CEC Electrical Bulletins in force at time of Bid submission. While not identified and specified by number in this Division, they are to be considered as forming part of related Standards.
3. Abbreviations for electrical terms are as per C.S.A. Z85.

1.5 Finishes:

1. All shop finished metal equipment and enclosure surfaces, must be prepared by removal of rust and scale from the raw metal, degreasing, cleaning, application of rust resistance primer inside and outside, and at least two coats of finish enamel paint. Use factory standard colours unless otherwise specified. Colour reference numbers are Sico.
2. Paint exterior surfaces of indoor electrical equipment to manufacturer's standard.
3. Clean and touch-up (to Consultant's acceptance) surfaces of shop-finished equipment that is scratched or marred during shipment or installation, so as to match original paint.
4. Leave with the Owner, 0.22 gal. of paint of each colour used, in the form of liquid or spray, to allow for future touch-up of damaged areas.

1.6 Inserts, Hangers and Sleeves:

1. Provide hangers, inserts, sleeves and supports as required.
2. Inserts are to be of lead shield type.
3. Hangers must not be welded to structural steel members and burning of holes in structural steel is prohibited.
4. Sleeves are to be of a type suitable for the application and be sealed and made watertight. Sleeves through concrete shall be sized for free passage of conduit, and installed flush with underside of concrete slab and extend 100mm (4") above finished floor unless otherwise shown.

1.7 Intent:

1. It is the intent of these drawings and specifications that the Contractor provide complete and operational systems as required.
2. Where differences occur, the maximum condition shall govern.
3. Any miscellaneous items, hardware, devices, wiring, etc., not specifically described, but required for the operation of the system, must be provided and included as part of the Bid.

1.8 Mounting Heights:

1. Mounting height of equipment is from finished floor to center line of equipment unless specified or indicated otherwise.
2. If mounting height of equipment is not indicated, verify with Consultant before proceeding with installation.

1.9 Owners Instruction and Trial Usage:

1. Instruct the Owner's operating personnel in the startup, operation, care and maintenance of all the equipment. All equipment to be tested, operational and commissioned before instruction. Provide sheets for signatures of Owner's representative and operating personnel present at each instruction period.
2. Arrange and pay for the service of the manufacturer's factory service Engineer/Technician to supervise the start-up of his equipment installation, and to check, adjust, balance and calibrate components.
3. Provide these services for such period and for as many visits as necessary to ensure that the Owner's operating personnel are conversant with all aspects of its care and operation.

    1. Prior to any instruction sessions, commissioning coordinator shall submit check lists of each system or equipment indicating their operation status for acceptance by the Owner.
    2. Coordinate all instruction sessions to suit Owner's operation personnel schedule. Submit proposed instruction session schedule c/w training agenda three weeks prior to session start date to Owner for review.

5. The Owner's operating personnel must be permitted to operate the systems under the contractor's supervision for a reasonable period of time prior to Substantial Completion of Contract. This use shall not be misconstrued as acceptance of the equipment.

1.10 Plywood Backboard:

1. Supply and install all plywood backboards required for the work of this Division. Plywood to be highest quality fire retardant fir. 1200 mm wide x 2400 mm high (4'-0" wide x 8'-0" high), 19mm (3/4") thick unless otherwise specified. Prime and paint backboards on both sides with fire retardant paint, equal to CGSB spec. #1-GP-151M, of a colour to match the equipment and services mounted thereon as defined in "Finishes" above. Do not paint over fire rated stamps.

2. Plywood backboards are to be provided for mounting the following surface wall mounted equipment:
    - Cabinets.

- Contactors.
- Control Panels
- Disconnect Switches.
- Junction Boxes 600mm (2 ft) square and larger.
- Pull Boxes.
- Panel Boards.
- Splitters
- Transient Voltage Surge Suppression Units.
- External Breakers

3. Where practical, group devices on a common backboard.

1.11 Protection:

1. Protect exposed live equipment during construction for personnel safety.
2. Shield and mark live parts “LIVE 600 VOLTS”, or with appropriate voltage in English.

1.12 Sealing:

1. Where cables or conduits pass through non fire-rated floors, walls or roof, provide internal and external sealing thereto.
2. Retain the service of a specialty sealant contractor for the work required.
3. Comply with manufacturer’s installation instructions for all sealant applications.
4. For non-fire rated locations, Sealant shall be silicone, that meets requirements of CGSB 19-GP-23, for the size of the joint required, and the types of materials being bonded.
5. For fire rated locations, the fire stop shall meet the requirements of ULC with regards to the type of assembly and the fire separation.
6. Provide architecturally approved air barrier seals and vapor barrier seals to electrical items passing through or terminating within walls, roofs and decks, humidity controlled areas and pressurized areas.
7. All materials used for fire stopping of penetrations must be Hilti Limited manufactured product only.

1.13 Sprinkler Proofing:

1. All areas of this building are protected by a wet sprinkler system. All electrical equipment to be configured for installation in such an environment.

1.14 Warning Signs:

1. Provide warning signs, as specified to meet requirements of Ministry of Labour Safety Inspection, Inspection Department, Authorities having jurisdiction and Consultant.
2. Use decal signs, in English minimum as required by Authorities.

1.15 Wire Pulling Lubricant:

1. Lubricant to be non-corrosive and CSA approved for the type of cable used.
2. Lubricants to be soap or wax based, depending upon application. Use soap based for short runs and for semi-conducting insulated wires, and wax based for long runs.

End of Section

SECTION 26 05 20: WIRE AND BOX CONNECTORS.

PART I - GENERAL

1.1 Work Included:

1. Provide all wire and box connectors required for a complete electrical system installation.

PART II - PRODUCTS

2.1 Materials:

1. Pressure type wire connectors are to be manufactured to CSA C22.2 No.65. Clamps and connectors are to be manufactured to CSA C22.2 No. 18.
2. Building Wire Connectors shall be:
    1. For wire sizes up to #6 AWG - Ideal “Wing Nut” or Gardner - Bender “Wing Gard”.
    2. For Wire Sizes #4 AWG and larger:
        - End to end splices - Burndy YS.
        - Parallel splices - Burndy UC.
        - At studs and bus bars - Burndy QQA (CU / AL).
        - Two or three conductors in parallel - Burndy Q2A or Q3Q (CU / AL).
3. Cable connectors shall be:
    1. For armored TECK cables, watertight type, with open compounded head - T&B series “Spin-on 2” with corrosion resistant boot.
    2. For armored cables steel type with nylon insulated throat - T&B “TITE-Bite”.
    3. Clamps or connectors for armored cable, flexible conduit, non-metallic sheathed cable shall be as required.

PART III - EXECUTION

3.1 Installation:

1. Remove insulation carefully from ends of conductors and:
    1. Install connectors and tighten as recommended by manufacturer.
    Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
    2. Install bushing stud connectors in accordance with EEMAC 1Y-2.

End of Section

SECTION 26 05 21: WIRES AND CABLES.

PART I - GENERAL

1.1 Work Included:

1. Provide building wire as detailed below and as required for a complete electrical installation.

PART II - PRODUCTS

2.1 Materials

1. Wire in Conduit:

    1. Conductor material to be annealed commercial grade, copper, 98 percent conductivity, up to #10 AWG solid, with RW90 insulation, #8 and larger, stranded, with RW90 insulation, unless noted otherwise, 300V rating for fire alarm, security and other low voltage circuits, 600V rating for 120 / 208V circuits, 1000V rating for 240 / 416V circuits, 1000V rating for 277 / 480V circuits, 1000V rating for 347 / 600V circuits.

    2. Colour Coding:

        1. 120 / 208V, circuits:
        Two conductor, 1 phase: 1 black, 1 white
        Three conductor, 1 phase: 1 red, 1 black, 1 white
        Three conductor, 3 phase: 1 red, 1 black, 1 blue
        Four conductor, 3 phase: 1 red, 1 black, 1 blue, 1 white

        2. 347 / 600V, circuits:
        Two conductor, 1 phase: 1 orange, 1 white
        Three conductor, 1 phase: 1 orange, 1 brown, 1 white
        Three conductor, 3 phase: 1 orange, 1 brown, 1 yellow
        Four conductor, 3 phase: 1 orange, 1 brown, 1 yellow, 1 white

        3. Ground wires: green.

    3. Low voltage Armored Cables Type AC-90:

        1. Type to be AC-90, Multi-conductor, with solid, annealed commercial grade 98 percent conductivity tinned copper conductors and cross-linked polyethylene with R90 insulation, 600 volt rating, on #10 and #12 size only.

        2. Colour Coding:
        Two conductor, 1 phase: 1 black, 1 white
        Three conductor, 1 phase: 1 black, 1 red, 1 white

        3. Grounding to be uninsulated, solid copper, with impregnated paper separator.

4. Low voltage Armored Cables - TECK:

    1. Type to be TECK, single conductor with annealed. Class B, stranded copper conductors and cross linked polyethylene, RW90 insulation, 1000 volt rating for #8 AWG and larger.

    2. Grounding to be uninsulated tinned stranded copper, with non-hygroscopic filter material to maintain circular cross-section.

    3. The inner and outer jackets to be PVC “Flamenol” suitable for –40 degC, with mylar tape separator and aluminum strip, armour helically wound and interlocked.

PART III - EXECUTION

3.1 Installation:

1. General:

    1. Wire shall be installed in conduit, and sized for the connected load (s) and protection as required, unless otherwise specified.
    2. All single neutrals ran with Phase ‘A’,’ B’,’ C’ conductors to be minimum #10 AWG. #12 AWG neutrals may be used when run from final junction box to wiring devices.
    3. Minimum power conductor wire size shall be #12 AWG. Use solid conductors for #10 and smaller and stranded conductors for #8 and larger. All wiring shall be copper conductors, RW90 (90degC ampacity).
    4. Home runs in excess of 25 m (75 ft.) for circuits protected by a 15A over current device, shall be #10 AWG. Refer to drawings for additional requirements.
    5. The current carrying capacity of the feeders, subfeeders and branch circuit conductors shall be sized to equal or better than shown on the drawings. If wire or cable sizes with equivalent current carrying capacity other than that specified is used, ensure that the voltage drop shall not be more than 2%.
    6. The number of wires indicated for various systems is intended to show the general scheme only. The required number and type of wires shall be installed in accordance with the manufacturer’s diagrams and with the requirements of the installation.

2. Wire in Conduit:

    1. Provide pigtails at all outlets for wiring devices. All neutrals and branch circuits shall be connected in each outlet box to avoid a break in the neutral or the circuit wire when fixture or wiring device is disconnected.
    2. At each junction, pull and outlet box make a 360 deg. loop of the stripped uncut ground conductor under the ground screws.

3. Low Voltage Armored Cables - (Feeders):

    1. Do not directly bury in or below concrete slabs or walls.
    2. Do not encircle single conductor cable with ferrous metal.
    3. No splices will be permitted.
    4. Single conductors of the three or four wire circuit shall be run with uniform spacing of not less than one cable diameter throughout the feeder length.
    5. Use wood throated cable clamps to ensure proper and uniform cable spacing.
    6. Where cables are installed on walls, provide mechanical protection over them up to 2.4m (8 ft.) above finished floor, using a 12 gauge U section aluminum cover.
    7. Cable connections to all enclosures, boxes and panels shall be by means of a watertight malleable aluminum connector.

End of Section

SECTION 26 05 27: GROUNDING.

PART I - GENERAL

1.1 Work Included:

1. Provide all grounding to conform with the Canadian Electrical Code and the latest instructions of the Inspection Authority, with any further requirements as noted herein.

PART II - PRODUCTS

2.1 Materials:

1. All grounding conductors stranded copper, bare or insulated as indicated on Drawings or in Specifications.
2. All ground wires are to be FT-4 rated factory green. Green tape, spray paint or any other means to alter the colour of the conductor is not permitted.
3. Use Cadweld or Burndy Thermoweld process for all weld connections. AMP of Canada Ltd. Wrench-Lok grounding connectors are an acceptable equivalent to welded connections.
4. All ground connectors to be designed and approved for grounding purposes.

PART III - EXECUTION

3.1 Installation:

1. Ground all conduit, and all non-current carrying metal parts, equipment cases, frames, bases, brackets, etc.
2. Grounding of all trays, AFCR's, racks, cabinets, etc. provided by the electrical contractor.
3. Ground each piece of fixed equipment back to the panel feeding that equipment, by one of the following methods:

    1. Conduit shall **not** be utilized for the ground return conductor.
    2. Where the conduit is flexible, install a separate bare soft drawn copper ground inside the conduit. At the switchboard or distribution panel, provide a grounding bushing, loop the ground conductor through the bushing, and connect to the switchboard ground bus. At the fixed equipment, connect to an internal ground bus, or connect to the inside of the metal enclosure utilizing approved screws and connectors (remove all paint). Run a separate (dedicated) insulated ground wire in all conduits to all devices and fixtures.
    4. Where equipment is fed by a multi-conductor power cable, provide a ground conductor in the cable. At the switchboard or panel, connect to the ground bus. Use a grounding connector on the cable for positive grounding of the metallic sheath. Loop the ground wire to the grounding connector.
    5. Run a separate ground wire in all flexible conduits. Connect each end to ground bus or lug or connector.
    6. Where mechanical protection is required for insulated grounding conductors install in rigid conduit.

7. Provide weld connection or wrench type grounding connectors for:
   All connections between grounding conductors.
   All connections to building steel.
   All connections between grounding conductors and cable lugs.
8. Arrange grounding to provide the minimum impedance paths for ground fault currents. Provide any additional grounding required for approval by the inspecting authorities.

3.2 Equipment Grounding

1. Install grounding connections to typical equipment including non-current carrying metal parts of transformers, generators, motors, circuit breakers, cable sheaths, raceways, pipe work, screen guards, switchboards, meter and relay cases, any exposed building metal and building structural steel.

End of Section

SECTION 26 05 29: HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS.

PART I - GENERAL

1.1 Work Included:

1. Provide fastenings and supports as required for a complete electrical system installation.

PART II - PRODUCTS

2.1 Support Channels:

1. U shape pre-galvanized steel, size 41 mm x 41 mm x 22 mm (1-5/8” x 1-5/8” x 7/8”), for surface mounting, suspending, or inserting into poured concrete walls and ceilings as required.
2. All channel fittings to suit channel type.
3. All other fittings to suit equipment weight, location and surface as required.

PART III - EXECUTION

3.1 Installation:

1. Secure plywood backboards, channels, luminaires, equipment and fittings to wood with wood screws, to solid masonry, tile and plaster surfaces with lead anchors, to poured concrete with self-drilling expandable inserts, and to hollow masonry walls with toggle bolts.
2. All ceiling mounted equipment shall be independently supported from the structure. Do not support equipment from ceiling support system.
3. Support equipment, conduit or cable using clips, spring loaded bolts, or cable clamps designed as accessories to basic channel members.
4. Fasten exposed conduit or cables to building using:
    1. Two-hole steel straps to secure surface conduits and cables 50 mm (2”) and smaller.
    2. Two-hole steel straps for conduits and cables larger than 50 mm (2”).
    3. Beam clamps to secure conduit to exposed steel work.

5. For suspended support system:
    1. Support individual cable or conduit runs with 6 mm (1/4”) diameter threaded rods and spring clips.
    2. Support two or more cables or conduits on channels support by 6 mm (1/4”) diameter threaded rod hangers where direct fastening to building construction is impractical.
    3. Support suspended luminaire using two or more lengths of Weldless “Single Jack”, bright zinc plated steel chain, Canadian Standard #10 gauge, 13 links per foot.

6. Provide metal brackets, frames, hangers, clamps and related type of support structure where indicated or as required to support conduit and cable runs.
7. Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

8. Do not use wire lashing or perforated strap to support or secure raceways or cables.
9. Do not use supports or equipment installed for other trades for conduit or cable support.
10. Install fastenings and supports as required for each type of equipment, cable and conduits, and in accordance with manufacturer's installation recommendations.
11. Hangers shall be spaced such that there is a hanger within 610mm (24") of every bend and that the maximum spacing does not exceed the limits indicated in OESC code.
12. All conduit or cable shall be supported at equipment mounted on spring isolators, with spring hangers for at least 4572mm (15').

End of Section

SECTION 26 05 31: SPLITTERS, JUNCTION, PULL BOXES AND CABINETS.

PART I - GENERAL

1.1 Work Included:

1. Provide splitters, junction boxes, pull boxes and cabinets as shown on the drawings and as required for a complete electrical installation.

PART II - PRODUCTS

2.1 Splitter Troughs:

1. Splitter trough construction is to be based on CSA C22.2 No. 76.
2. They shall have sheet steel enclosure, with welded corners and formed hinged cover suitable for locking in closed position.
3. Connection bars are to match required size and number of incoming and outgoing conductors as indicated.
4. Provide at least three spare terminals on each set of lugs in splitter troughs less than 400A and feed through lugs where required.
5. Provide double lugs for neutrals where required.
6. Enclosures shall be CSA/EEMAC Type 1 modified to sprinkler proof enclosure.

2.2 Junction and Pull boxes.

1. Junction and pull boxes construction is to be based on CSA C22.2 No. 40.
2. They shall be suitable for surface mounting and be of welded steel construction with screw-on flat covers.
3. For flush-mounted pull and junction boxes, provide covers with 25 mm (1”) minimum extension all around.

2.3 General Cabinets:

1. Type D or E to be sheet steel, for surface mounting, complete with screw on cover (D) or hinged door (E), and return flange overlapping sides, handle and catch.

PART III - EXECUTION

3.1 Splitter Installation:

1. Install splitter troughs where required. Mount plumb, true and square to the building lines.
2. Extend splitters for full length of equipment arrangement except where indicated otherwise.
3. Provide water tight connections for all services entering the top of the splitter trough.

3.2 Junction, Pull Boxes and Cabinet installation:

1. Install junction, pull boxes and cabinets in inconspicuous but accessible locations.
2. Only certain junction and pull boxes are indicated. Provide pull boxes so as not to exceed 30 m (100 ft) of conduit run between boxes, and after every 2 (two) 90 deg. bends.

3.3 Identification:

1. Install nameplates.

End of Section

SECTION 26 05 32: OUTLET BOXES, CONDUIT BOXES AND FITTINGS.

PART I - GENERAL

1.1 Work Included:

1. Provide outlet and conduit boxes and fittings as required for a complete electrical system installation.

PART II - PRODUCTS

2.1 Outlet and Conduit boxes - General

1. The construction of outlet boxes, conduit boxes and fittings is to be based on CSA C22.2 No.18.
2. Boxes shall be suitable for the utilization voltage.
3. Combination boxes shall have barriers where outlets for more than one system are grouped.
4. Recessed 100 mm (4”) square or larger outlet boxes shall be complete with single or ganged plaster rings to suit application.

2.2 Sheet Steel Outlet boxes:

1. Electro-galvanized steel single and multi-gang device boxes for flush installation, shall be minimum size 75 mm x 50 mm x 37 mm (3” x 2” x 1-1/2”) unless otherwise specified or required. 100 mm (4”) square outlet boxes shall be used when more than one conduit enters one side, with extension and plaster rings as required.
2. Boxes for door switches and push buttons shall be sized as required.
3. Utility boxes for connection to surface mounted EMT conduit, shall be minimum 100 x 54 x 48 mm (4" x 2-1/8” x 1-7/8”) size.
4. Square or octagonal outlet boxes for lighting fixture outlets, shall be minimum 100 mm (4”) size.
5. Square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls, shall be minimum 100 mm (4”) size.

2.3 Masonry Boxes:

1. Electro-galvanized steel masonry single and multi-gang MBD boxes shall be used for flush mounted devices in exposed block walls.

2.4 Concrete boxes:

1. Electro-galvanized sheet steel concrete boxes shall be used for flush mounting in concrete, with matching extension and plaster rings as required.

2.5 Conduit Boxes:

1. Cast FS or FD feraloy boxes with factory-threaded hubs and mounting feet shall be used for outlets connected to surface mounted rigid conduit.

2.6 PVC Boxes:

1. F series and octagon boxes shall be moulded type, with fastening ears and screwed secured covers as required.

2.7 Fittings - General:

2. Bushing and connectors shall be with nylon insulated throats.
3. Provide knock-out fillers to prevent entry of foreign materials.
4. Use conduit outlet bodies for conduit up to and including 32 mm (1-1/4”) and pull boxes for larger conduits.
5. Provide double locknuts and insulated bushings on sheet metal boxes.

PART III - EXECUTION

3.1 Installation:

1. Support boxes independently of connecting conduits.
2. Fill boxes with paper, foam sponges or similar approved material to prevent entry of construction material.
3. Size box wiring chambers in accordance with Canadian Electrical Safety Code.
4. Gang boxes together where wiring devices are grouped.
5. Provide matching blank cover plates for boxes without wiring devices.
6. Use combination boxes where outlets for more than one system or voltage are grouped.
7. For flush installations, mount outlets flush with finished wall using plaster rings to permit wall finish to come within 5mm (1/4”) of opening.
8. Provide correct size of openings in boxes for conduit and armored cable connections. Reducing washers are not allowed.

End of Section

SECTION 26 05 34: CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS.

PART I - GENERAL

1.1 Work Included:

1. Provide conduits, conduit fastenings and conduit fittings as detailed below and as required for a complete electrical installation.

PART II - PRODUCTS

2.1 Conduits:

1. Rigid and epoxy coated conduit shall be threaded, galvanized steel and shall be manufactured to C.S.A C22.2 No. 45.
2. Electrical metallic tube (EMT) conduit and couplings shall be manufactured to C.S.A. C22.2 No. 83.
3. Flexible metal conduit and liquid tight - flexible metal conduit shall be manufactured to C.S.A. C22.2 No. 56.

2.2 Conduit Fastenings:

1. Conduit straps shall be steel, double hole for rigid or EMT conduit. Single hole straps are not acceptable.

2.3 Conduit Fittings:

1. Fittings for conduits shall be manufactured to C.S.A. C22.2 No.18. Provide coatings as per conduit.
2. Fittings for rigid conduit shall be steel threaded type, and for EMT conduit, to be steel set screw type.
3. Fittings for EMT conduit in wash bays to be steel compression fitting type.
4. Fittings for flexible conduit and exposed conduit outdoors to be liquid-tight type, straight or angled threaded for rigid and compression for EMT conduit.
5. Expansion fittings for rigid or EMT conduits shall be of the watertight type, with an integral bonding assembly, suitable for deflection in all directions.

2.4 Pulling Cables:

1. Pulling cables shall be polypropylene and of a strength suitable for tension to be pulled.

2.5 Waterproof Membrane:

1. Conduits penetrating waterproof membranes shall be PEM #6372.

PART III - EXECUTION

3.1 Installation (General):

1. The conduits for the following circuits and systems shall be run separately:

   - 120/208 volt utility power distribution.
   - 347/600 volt utility power distribution.
   - Normal power to luminaries.
   - Emergency power to luminaries and exit signs.
   - Fire alarm system multiplex loop devices.
   - Fire alarm system signaling devices.
   - Security, Duress, Intrusion and CCTV system devices.
   - Telephone and data systems.
   - Control wiring.
   - Paging System

2. All conduits to be surface mounted (exposed, EMT) in mechanical and electrical service spaces and rooms and concealed elsewhere unless otherwise shown.
3. Wiring in ceiling spaces and in all partitions shall be EMT.
4. Exposed conduits shall be installed to conserve headroom and cause minimum interference in spaces through which they pass.
5. Use rigid conduit up to 2.4 m (8’ -0”) above finished floor where exposed indoors
6. Use RGS conduit PVC coated galvanized rigid steel Robroy Permacote in all outdoor locations and in areas that are not environmentally controlled.
7. Use electrical metallic tubing (EMT) above grade, and above 2.4 m (8’-0”) above finished floor where exposed indoors.
8. Use flexible liquid tight metal conduit for connection to motors, and transformers.
9. Bend conduit without heating. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
10. Mechanically bend conduit over 20mm (3/4”) diameter.
11. Field threads on rigid conduit must be of sufficient length to draw conduits tight.
12. Install pulling cables in all conduits that are to remain “empty”.
13. A maximum of 2 (two), 90 deg. bends, or equivalent up to 180 deg., will be permitted without installation of a pull box. Radius of bends must be no less than 10 (ten) times the conduit diameter.
14. Conduits must be dry, before installing wires.
15. Support all branch conduits from building structure. Do not clip conduits to ceiling hangers, sprinkler pipes, plumbing or BAS wiring hangers.

3.2 Surface Conduits:

1. Surface conduits shall be run parallel or perpendicular to building lines.
2. Conduits located near any heat producing equipment shall have 1500 mm (5 ft.) clearance.
3. Conduits adjacent to structural steel, beams or columns shall be run within the flanged portion, unless otherwise shown.
4. Group exposed conduits on surface or suspended channels.
5. Do not pass conduits through structural members except where indicated and approved by Landlord.
6. Do not locate conduits less than 75 mm (3") parallel to steam or hot water lines. Provide a minimum clearance of 25 mm (1") at crossovers.

3.3 Conduit Size:

1. The minimum conduit size shall be 19 mm (3/4").
2. All undimensioned conduits in the drawings are 19 mm (3/4").

3.4 Expansion Fittings:

1. Conduit expansion fittings shall be provided on all conduits crossing expansion joints, and at maximum of 60 m (200 ft.) spacing.
2. Install expansion fittings perpendicular to expansion joint.
3. Refer to structural drawings for location of expansion joints.

End of Section

SECTION 26 27 26: WIRING DEVICES.

PART I - GENERAL

1.1 Work Included:

1. Provide all wiring devices indicated on drawings and described below.

PART II - PRODUCTS

2.1 Standards:

1. Construction of manually operated general purpose AC switches is to be based on CSA C22.2 No. 111, snap switches on CSA C22.2 No.55, and receptacles, plugs and similar wiring devices on CSA C22.2 No. 42.
2. Devices shall be Specification Grade and of one manufacturer throughout

2.2 Switches:

1. Switches shall be suitable for the voltage and load controlled and shall be single pole or three way as indicated.
2. They shall have terminal holes approved for No. 10 AWG wire, silver alloy contacts, and urea or melamine moldings for parts subject to carbon tracking.
3. They shall be suitable for back and side wiring, and rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
4. White ‘Decora’ style switches shall be used for 120V circuits, in all finished areas.
5. White ‘Decora’ style switches shall be used for 347V circuits in all areas.

2.3 Receptacles:

1. Duplex receptacles shall be CSA Type 5-15R, 125 volt, 15 Amp, U ground and CSA Type 5-20RA, 125 volt, 15/20 Amp, U Ground.
2. They shall be colour, as specified on site by interior designer, ‘Decora’ style.
3. They shall be suitable for No. 10 AWG, back and side wiring, have break-off links for use as split receptacles and shall have eight (8) back wired entrances, four (4) side wiring screws and double wipe contacts with riveted grounding contacts.

2.4 Coverplates:

1. Coverplates shall be colour, as specified on site by interior designer in finished areas and stainless steel in unfinished areas.
2. Use die cast aluminum coverplates for wiring devices mounted for surface mounted FS or FD boxes, and pressed steel coverplates for utility surface boxes.
3. Use weatherproof spring-loaded, cast aluminum coverplates complete with gaskets for exterior mounted single receptacles and switches, or where indicated.

PART III - EXECUTION

3.1 Installation:

1. Switches:

    1. Install single throw switches with lever in “UP” position when switch closed.
    2. Install switches in gang type outlet box when more than one switch is required in one location.

2. Receptacles:

    1. Install receptacles in gang type outlet box when more than one device is required in one location.

3. Coverplates:

    1. Protect coverplate finish until painting and other work is finished, or install after painting is complete.
    2. Do not use flush type coverplates on surface mounted boxes.

End of Section

SECTION 26 28 13.01: FUSES – LOW VOLTAGE.

PART I - GENERAL

1.2 Work Included:

1. Supply and install fuses in disconnect switches, etc. as required to complete this contract.

PART II - PRODUCTS

2.1 Fuses - General:

1. Plug and cartridge fuses shall be manufactured to CSA C22.2 No. 59.
2. HRC fuses shall be manufactured to CSA C22.2 No. 106 and to have interrupting capability of 200,000A symmetrical.
3. Fuses shall be the product of one manufacturer.
4. Fuse type reference L1, L2, J1, R1, etc. have been adopted for use in this specification.

2.2 Fuse Types:

1. HRCI - J fuses.
    1. Type J1, time delay, capable of carrying 500% of its rated current for 10 seconds minimum.
    2. Type J2, fast acting.
2. HRC - L.
    1. Type L1, time delay, capable of carrying 500% of its rated current for 10 seconds minimum.
    2. Type L2, fast acting.
3. HRC - R fuses (For UL Class RK1 fuses, peak let-through current and I^2t values not to exceed limits of UL 198E table 10.2.)
    1. Type R1, (UL Class RK1), time delay capable of carrying 500% of its rate current for 10 seconds minimum, to meet UL Class RK1 maximum let-through limits.
    2. Type R2, time delay, capable of carrying 500% of its rated current for 10 seconds minimum.
    3. Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.
    4. HRCII - C fuses.

PART III - EXECUTION

3.1 Installation:

1. Install fuses in mounting devices immediately before energizing circuit.
2. Ensure circuit fuses fitted to physically matched mounting devices. Install Class R rejection clips for HRCI-R fuses.
3. Ensure correct fuses fitted to assigned electrical circuit.
4. Fuses protecting motor loads and transformers to be type J1 for up to and including 600A and L1 for ratings above 600A.
5. Fuses protecting feeder circuits to be type J2 for up to and including 600A and type L2 ratings above 600A.
6. Fuses protecting other services or equipment shall be of the type required for that purpose.

End of Section

SECTION 26 28 23: DISCONNECT SWITCHES - FUSED AND NON-FUSED.

PART I - GENERAL

1.1 Work Included:

1. Provide all disconnect switches shown on the drawings and as required for motors.

PART II - PRODUCTS

2.1 Equipment

1. Fuseholder assemblies to CSA C22.2 No. 39
2. Fusible and non-fusible disconnect switches shall be installed in CSA enclosures.
3. Provide for padlocking in “OFF” switch position by one lock.
4. Provide a mechanically interlocked door to prevent opening when handle in “ON” position.
5. Provide fuses sized as required.
6. Fuseholders in each switch shall be suitable without adapters, for type of fuse as specified.
7. Provide quick make, quick break action.
8. Provide ON-OFF switch position indication on switch enclosure cover.
9. Enclosures shall be CSA/EEMAC Type 1 modified to sprinkler proof enclosure.

PART III - EXECUTION

3.1 Installation:

1. Install disconnect switches with or without fuses as required.
2. Provide water tight connections for all services entering the top of the disconnect switches.

End of Section

SECTION 26 51 00: INTERIOR LIGHTING.

PART I - GENERAL

1.1 SUMMARY

1. Section Includes:

    1. Interior lighting fixtures, lamps, ballasts, LEDs and drivers.
    2. Emergency lighting units.
    3. Exit signs.
    4. Lighting fixture supports.
    5. Retrofit kits for fluorescent lighting fixtures.

2. Related Sections:

    1. Section 26 09 23 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.2 REFERENCES

1. ANSI/NFPA 70, National Electrical Code

2. IESNA LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products

3. IESNA LM-80, Approved Method for Measuring Lumen Maintenance of LED Light Sources

4. IESNA TM-21, Luminaire Classification System for Indoor Luminaires

5. UL1598, Standard for Safety of Luminaires

1.3 ACTION SUBMITTALS

1. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, and finishes.

2. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

1.4 INFORMATIONAL SUBMITTALS

1. Field quality-control reports.

1.5 QUALITY ASSURANCE

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with NFPA 70.

3. Luminaires shall be fully assembled and individually electrically tested prior to shipment.

4. Manufacturers of LED luminaires shall demonstrate a suitable testing program to ensure system reliability and to substantiate lifetime claims.

5. The sole use of IESNA LM-80 data to predict luminaire lifetime is not acceptable.

6. At time of manufacture, electrical and light technical properties shall be recorded for each luminaire. At a minimum, this should include lumen output, CCT, and CRI. Each luminaire shall utilize a unique serial numbering scheme. Technical properties must be made available for a minimum of 5 years after the date of manufacture.

7. Luminaires shall be provided with a minimum 5 year warranty covering, LEDs, drivers and paint finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2. LED, fluorescent and HID lamps shall be of 1 (one) manufacturer, either in total, or in groups defined by lamp type.

3. Drivers / ballast and lamps provided under this contract must be an approved combination by both respective manufacturers

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

1. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

2. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

3. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

4. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

5. Metal Parts: Free of burrs and sharp corners and edges.

6. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

7. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

8. Diffusers and Globes:

    1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
        a. Lens Thickness: At least [0.125 inch (3.175 mm)] minimum unless otherwise indicated.
        b. UV stabilized.
    2. Glass: Annealed crystal glass unless otherwise indicated.

9. Fixture Bodies:
    1. Lighting fixture bodies shall be of minimum 20 gauge cold rolled prime steel of rigid construction with knockouts as required.
    2. Fixtures shall be finished in baked white enamel with exposed surfaces matching the exposed t-bar ceiling specified in other sections and shall resist chipping, corrosion, and discolouration. Before finishing, all metal shall be chemically degreased and neutralized. Finish shall not be less than two coats of enamel, sprayed and baked on. Reflecting surfaces shall be white with an average reflectance of not less than 85%.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

1. General Requirements for Electronic Ballasts:

    1. Comply with UL 935 and with ANSI C82.11.
    2. Designed for type and quantity of lamps served.
    3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
    4. Sound Rating: Class
    5. Total Harmonic Distortion Rating: Less than 10 percent.
    6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
    7. Power Factor: 0.95 or higher.

2. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.

3. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.

    1. Ballast Manufacturer Certification: Indicated by label.

4. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

1. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

    1. Lamp end-of-life detection and shutdown circuit.
    2. Automatic lamp starting after lamp replacement.
    3. Sound Rating: Class A.
    4. Total Harmonic Distortion Rating: Less than 20 percent.
    5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
    6. Operating Frequency: 20 kHz or higher.
    7. Lamp Current Crest Factor: 1.7 or less.
    8. BF: 0.95 or higher unless otherwise indicated.
    9. Power Factor: 0.95or higher.
    10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.5 BALLASTS FOR HID LAMPS

1. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features unless otherwise indicated:

    1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
    2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
    3. Rated Ambient Operating Temperature: 104 deg F (40 deg C).
    4. Open-circuit operation that will not reduce average life.
    5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

2.6 DRIVERS FOR LED FIXTURES

1. Electronic Driver for LED Fixtures: Comply with UL 1310 Class 2 requirements for dry and damp locations. EMI compliance with FCC Part 15 Class A. Include the following features unless otherwise indicated:

    1. Rated for 50,000 hours of life, unless otherwise noted.
    2. Type: Constant current
    3. Sound Rating: Class A.
    4. Total Harmonic Distortion Rating: 20 percent or less.
    5. Power factor at full load: >0.90
    6. Efficiency at full load: >85%
    7. Input Voltage: 120V - 277V (+/- 10%)
    8. Frequency Range: 50 – 60 Hz (+/- 10%)
    9. Transient Protection: NEMA SSL – 2010, Non-Roadway 2.5KV
    10. Over voltage and load protection: Yes, non-latching
    11. Ambient Operating Temperature: -30C to 50C
    12. Dimming Control: DALI
    13. Dimming Range: 10% - 100%

14. Source/Sink Current: 1mA max.

2.7 EXIT SIGNS

1. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

2. Internally Lighted Signs:

    1. Lamps for AC Operation: Fluorescent, two for each fixture, 20,000 hours of rated lamp life.
    2. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
    3. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

        a. Battery: Sealed, maintenance-free, nickel-cadmium type.
        b. Charger: Fully automatic, solid-state type with sealed transfer relay.
        c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
        d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
        e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.8 EMERGENCY LIGHTING UNITS

1. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

    1. Battery: Sealed, maintenance-free, lead-acid type.
    2. Charger: Fully automatic, solid-state type with sealed transfer relay.
    3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
    7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.

2.9 FLUORESCENT LAMPS

1. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 85 (minimum), color temperature 4000K, and average rated life 40,000 hours unless otherwise indicated.

2. T8 rapid-start lamps, rated 17 W maximum, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI 85 (minimum), color temperature 4000K, and average rated life of 40,000 hours unless otherwise indicated.

3. Compact Fluorescent Lamps: 4-Pin, CRI 85 (minimum), color temperature 4000K, average rated life of 12,000 hours at three hours operation per start, and suitable for use with dimming ballasts] unless otherwise indicated.

    1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
    2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
    3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
    4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
    5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
    6. 57 W: T4, triple tube, rated 4300 initial lumens (minimum).
    7. 70 W: T4, triple tube, rated 5200 initial lumens (minimum).

2.10 HID LAMPS

1. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature 1900 K, and average rated life of 24,000 hours, minimum.

2. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 70, and color temperature 4000 K.

3. Pulse-Start, Metal-Halide Lamps: Minimum CRI 70, and color temperature 4000 K.

2.11 LED FIXTURES

1. Except as otherwise indicated, provide LED luminaires, of types and sizes indicated on fixture schedules.

2. Include the following features unless otherwise indicated:
    1. Each Luminaire shall consist of an assembly that utilizes edge-lit LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).
    2. Luminaire optics shall consist of precision formed optical assembly with positively retained high grade acrylic lenses using laser precise micro-prism patterns to provide directional distribution
    3. Each luminaire shall be rated for a minimum operational life of 100,000 hours utilizing a maximum ambient temperature of (25°C).
    4. Light Emitting Diodes tested under LM-80 Standards for a minimum of 10,000 hours.
    5. Color Rendering Index (CRI) of 85 at a minimum.
    6. Color temperature 4000K, unless otherwise indicated.

7. Rated lumen maintenance greater than 92% lumen output for 100,000 hours and theoretical L70 hours greater than 448,000 for recessed LED troffers.
8. Fixture efficacy of 115 Lumens/Watt, minimum
9. Fixture depth shall be no greater than 3.25”
10. 5 year luminaire warranty, minimum.
11. Photometry must comply with IESNA LM-79.
12. Luminaries shall be Design Lights Consortium Premium Qualified
13. The individual LEDs shall be constructed such that a catastrophic loss of the failure of one LED will not result in the loss of the entire luminaire.
14. Luminaire shall be constructed such that driver may be replaced or repaired without the replacement of the whole fixture.

3. Technical Requirements

1. The luminaire shall not consume power in the off state.
2. Operation Voltage: The luminaire shall operate from a 50 HZ to 60 HZ AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
3. Power Factor: The luminaire shall have a power factor of 0.9 or greater.
4. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent.
5. Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.

4. Thermal Management

1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
2. The LED manufacturer’s maximum thermal pad temperature for the expected life shall not be exceeded.
3. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
4. The luminaire shall have a minimum heat sink surface such that LED manufacturer’s maximum junction temperature is not exceeded at maximum rated ambient temperature.

2.12 LIGHTING FIXTURE SUPPORT COMPONENTS

1. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

2. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

3. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

4. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

5. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.13 RETROFIT KITS FOR FLUORESCENT LIGHTING FIXTURES

1. Ballast and Lamp Change Kit: UL 1598, Type II. Suitable for changing existing ballast, lamps, and sockets.

PART 3 - EXECUTION

3.1 INSTALLATION

1. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

2. Lamp and Driver / Ballast Installation:

    1. Refer to luminaire schedule and drawings, for lamp and driver / ballast requirements.
    2. Install lamps only when the luminaires are clean.
    3. Ensure that lamps are suitable for luminaires before energization and lamp length and colours are that as specified. Report any discrepancies to the consultant.

3. Luminaire Installation:

    1. Install luminaires accurately and carefully aligned complete with all mounting hardware. Ensure any suspension rods are vertical.
    2. All luminaires shall be supplied with accessory items such as yokes, plaster rings, frame adjusters, etc., where required for proper installation.
    3. At the time of date of “Substantial Completion” all luminaires, lenses, louvers and lamps must be clean and the lamps illuminated.

4. Luminaire Support:

    1. All fixtures in finished ceilings must be chained by 2 points directly to main structure such that they are supported independently of the ceiling system.

2. All fixtures in exposed ceiling areas (no T-bar or Drywall) shall be mounted on 1-5/8" unistrut, running the full length of the run of fixtures. The unistrut is to be suspended from the ceiling deck by 3/8" threaded rod from unistrut between the joists. Do not puncture ceiling deck.
3. All lighting feeds for suspended fixtures shall be dropped from the deck or slab straight down into the fixture or raceway. Fixture to fixture conduits will not be permitted. Conduit must go to the deck then to the next fixture.

5. Cleaning:

    1. All luminaires must be cleaned before lamping and installing lenses or louvres.
    2. Use dry, clean, soft cloths if luminaires are dusty. Use mild solvents to clean soiled luminaires.

3.2 FIELD QUALITY CONTROL

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

2. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

End of Section

SECTION 26 60 01: ELECTRICAL IDENTIFICATION.

PART I - GENERAL

1.1 Work Included:

1. Identify electrical equipment as specified herein.

1.2 Manufacturer's Nameplates:

1. Have the manufacturer's nameplates affixed to each item of all equipment showing the size, name of equipment, serial number and all information usually provided, including voltage, cycle, phase, horsepower, etc., and the name of the manufacturer and his address. Ensure that all stamped, etched or engraved lettering on plates is perfectly legible. Ensure that nameplates are not painted over. Where apparatus is to be concealed, attach the nameplate in an approved location on the equipment support or frame.
2. Ensure that panels and other apparatus which have exposed faces in finished areas do not have any visible trademarks or other identifying symbols. Mount nameplates behind doors.

PART II - PRODUCTS

2.1 Lamacoid Plates:

1. Refer to drawings for lamacoid background and text colour. Minimum size 75mm x 25mm (3" x 1") and 3.2mm (1/8") thick laminated plastic and 6.4mm (1/4") deep engraved lettering.

2.2 Conductor Markers:

1. Cable diameter less than 13 mm (1/2") - Electrovert type Z.
2. Cable diameter 13 mm (1/2") and larger - Electrovert #510 strap-on.
3. Colour - white with black markings except fire alarm and life safety system which shall be white with red markings.

PART III - EXECUTION

3.1 Conduit Services - Power:

1. Locate identification:

   - Behind each access door.
   - At each change of direction and at junction boxes.
   - At not more than 10 m (40') apart in straight runs of conduit behind removable enclosures such as lay-in type ceiling, but on both sides of sleeves through walls or floors.
   - Above each floor or platform for vertical exposed conduits, preferably 1500 m (60") above floor or platform.
   - Use stencils and stencil paint or lamacoid plates on all conduit.
   - Use minimum 25 mm (1") high letters.

- The identification shall describe system voltage and service, i.e., “120 / 208 volt lighting to panel AA”.

3.2 Conduits and outlet boxes:

1. Identify conduits and outlet boxes for the various systems by the use of the following distinctive colour paints. Apply a small area of paint to the inside of each outlet box, pull box and panel as it is being installed. Identify junction boxes in suspended ceiling areas with colour on both inside and outside.

    1. 120 / 208 volt system. -Black
    2. Fire Alarm systems. -Red
    3. 347/600 volt system. -Blue
    4. Security Alarm system -Orange

2. Use the colour coding as defined in CGSB Code 24-GP-3A and CSA Standard B53.
3. Where the existing colour coding differs from these Specifications, notify the Consultant of colours used and maintain existing colour coding.

3.3 Equipment Nameplates:

1. Identify all equipment listed below with lamacoid plates, letters 10 mm (0.4”) high, unless otherwise noted.
    1. Lighting and Power Panels - Plates to be on outsides of door. Typical identification: “Lighting Panel C 120/208 v, 3 phase, 4 W MAINS 225 AMP 18KA RMS. Supplied from Panel BB”.
    2. Disconnect switches and starters - Plates to be mounted externally on switch cover. Typical identification: “Fan S4, 208 v, 3 phase”.
    3. Transformers - Plates to be mounted externally on case. Typical identification: “Transformer TR-UPSA 225 KVA/416/120/208 v, 3 PH / 4W fed from Panel UPS A”.

2. Secure with mechanical fastening devices except on the inside of panel doors where gluing will be acceptable.

3.7 Wiring Colour Code:

1. <u>Power and Lighting Conductors:</u>

    1. Phase A - Red
    2. Phase B - Black
    3. Phase C - Blue
    4. Neutral - White
    5. Ground - Green

2. For sizes available in black only, use coloured tape markers at junction boxes and terminal points to match phase coding described above.
3. Band green isolated ground conductors with yellow tape.
4. Control conductors - Orange
5. <u>Fire Alarm System Conductors.</u>

    1. Alarm initiating devices and manual pull stations - red and blue.

2. Alarm signaling devices - black and white.

3.8 Conductor Markers:

1. For power feeders, install markers at either end of the conductors where terminated inside of equipment to match wiring diagram conductor identification or panelboard circuit numbers. Typical identification Panel AA circuits - 21; use “AA-21”. For a three phase circuit provide identification on phase A conductor only. For a single phase circuit provide identification on the phase conductor.
2. For Branch circuits supplying single phase and three phase devices such as receptacles and connections to equipment identify conductors at panel and in device outlet box. Install marker on phase conductor inside outlet box. Typical identification if device is connected to Panel B - circuit 14, marker identification “B-14”.

End of Section

SECTION 26 60 02: TESTING AND COMMISSIONING OF ELECTRICAL SYSTEMS.

PART I - GENERAL

1.1 Description:

1. Include in work of this section, the testing and commissioning of all new electrical and component systems.
2. Include any specific testing of equipment required by the Hydro Inspection or Supply Authorities.
3. The complete costs of the site, load bank and factory testing and commissioning witnessing of Electrical Equipment is to be included in the Bid price.
4. Inform manufacturers of all factory and site testing requirements and include all their costs in the Bid price.
5. At their own discretion, testing is to be witnessed by the Owner and the Electrical Consultant.

1.2 Scope:

1. Include factory testing and approved certification, where required.
2. Coordinate with the equipment manufacturer, notify the Electrical Consultant in writing, 10 (ten) days before any factory testing to confirm Consultant's desired presence, and be present for all site testing.

1.3 Completion of Work:

1. All electrical systems and equipment shall be totally commissioned and operating before date of "Substantial Completion".
2. Coordinate with other trades and the building operations staff for work which affects the operation of the electrical systems, before submitting request for testing and commissioning. Failing to comply, bear all costs including Consultant's time cost, incurred for re-testing and re-commissioning.

PART II - PRODUCTS

2.1 Materials:

1. Provide all tools, equipment, labour and materials required to perform electrical testing and commissioning as specified. Provide the test results report (s).

2.2 Temporary Load Bank:

1. For testing of the UPS systems, provide resistive variable load banks.
2. Load banks must be complete with breakers to protect generators and UPS systems from cable faults.

PART III - EXECUTION

3.1 Installation:

1. Perform site testing and commissioning only after all equipment is installed and operational.
2. Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
3. Provide 4 (four) copies of certificates of all factory and site testing in complete detail bearing in each case, the seal of the engineer responsible for the tests.
4. Submit all test results for Consultant's review.
5. All equipment or system deficiencies identified by factory or site testing procedures, to be corrected by the Contractor prior to obtaining a "Certificate of Substantial Completion".
6. Submit report, at completion of measurements, listing phase and neutral currents on panelboards, dry-type transformers and motor control centres, operating under normal load. Include hour and date on which load was measured, and voltage at time of test.
7. General operations: energize and operate electrical circuit and item. Repair, alter, replace, test and adjust as necessary for a complete and operating electrical system.
8. Test systems and obtain written confirmation from manufacturers that components have been installed correctly and system functioning as intended. Submit certification for power distribution, communications systems and emergency power to Owner's Consultant.
9. Provide labour, instruments, apparatus and pay expenses required for testing. Owner's Consultant reserves right to demand proof of accuracy of instruments used.
10. Perform the following tests on completed power systems:
    1. Supply voltage: measure line voltage of each phase at load terminals of main breakers and report results in writing to Owner's Consultant. Perform test with majority of electrical equipment in use.
    2. Motor loading: measure line current of each phase of motors with motor operating under load, and report results in writing to Owner's Consultants.
        1. Upon indications of imbalances or overloads, thoroughly examine electrical connections and rectify defective parts or wiring.
        2. If electrical connections are correct, report overloads due to defects in driven machines in writing to Owner's Consultant.
    3. Insulation resistance tests:
        1. Megger circuits, feeders and equipment up to 350V with a 500V instrument for at least one (1) minute.
        2. Megger 350-600V circuits, feeders and equipment with a 1000V instrument for at least one (1) minute.
        3. Check resistance to ground before energizing.
        4. Coordinate and carry out motor testing at same time as driven equipment is being tested. In addition to motor loading tests, provide labour and instruments to read and record motor load readings required to supplement tests on driven equipment through various load sequences, as required by driven equipment tests.
11. Immediately prior to occupancy, test entire electrical system by performing loss and return of utility power test. Demonstrate operation of:
    1. Low voltage service equipment and metering
    2. Exit and emergency lighting
    3. restabilization of systems after power return. Attach report printouts as evidence of expected operation on systems.
    4. User equipment shut-down and auto-restart.

3.2 Field Tests

1. Provide advance notice to Owner's Consultant of proposed testing schedule.
2. Perform tests at time of acceptance of work.
3. Conduct and pay for field tests:
    1. Power distribution, including phase voltage, grounding and load balancing.
    2. Circuits originating from branch distribution panels.
    3. Lighting and lighting control. Motors, heaters and associated control equipment, including sequenced operation.
    4. Emergency Power Systems
4. Perform tests in presence of Owner's Representative.
    1. Provide instruments, meters, equipment and personnel required to conduct required tests.
    2. Test systems to verify operation as specified.
5. Conduct di-electric tests, hi-pot tests, insulation resistance tests and ground continuity tests as required by nature of various systems and equipment

3.3 General Testing:

1. With the system completely connected, perform the following tests:

    1. Control and Switching - all circuits shall be tested for the correct operation of devices, switches and controls.
    2. Polarity Tests - all sockets shall be tested for correct polarity.
    3. Voltage Test - a voltage test shall be made at the last outlet of each circuit. The maximum drop in potential permitted will be 2% on 120 and 208 volt branch circuits and on 208 volt feeder circuits. Any deficiency in this respect shall be corrected.
    4. Phase Balance - measure the load on each phase at each splitter, and lighting and power panelboard and report the results in writing to the Consultant. Rearrange phase connections as necessary to balance the load on each phase as instructed by the Consultant, with the re-arrangement being restricted to the exchanging of connections at the distribution points mentioned in this paragraph. After making any such changes, make available to the Consultant drawings or marked prints showing the modified connections.
    5. General Operations - energize and put into operation each and every electrical circuit and item. Necessary repairs, alterations, replacements, tests and adjustments required shall be made for complete and satisfactory operating systems.

3.4 Sealing:

1. Ensure and verify that all penetrations of electrical equipment have been properly sealed with appropriate material and to the manufacturers' requirements.

3.5 Noise and vibration:

1. Ensure and verify that all isolation equipment has been installed where required and to the manufacturers' recommendations. Include the locations of and measurements of static deflection of spring isolators.

3.6 Coordination Study

1. For the entire electrical distribution system provided as part of this contract and for the existing high voltage base building switchgear and low voltage base building switchgear, supply a report from an independent test agency of the short circuit, protection, co-ordination study of the electrical distribution system. **An existing coordination study is not available for contractor's use.**
2. Procure (coordinate and pay for) the services of Enkompass Power & Energy Corp Rene Seipt rene@enkompass.ca to prepare the coordination study and arc flash analysis.
3. Co-ordination of Protective Devices:
   .1 Ensure circuit protective devices such as overcurrent trips, relays, circuit breakers and fuses are installed to values and settings so as to provide protection by means of opening the closest device to the fault.
   .2 Submit a short circuit protection and co-ordination study as follows:
      1. Obtain and organize all electrical protection data for all the equipment. This will consist of obtaining the relay types and settings, transformer impedances, cable sizes, fuse sizes and types, motor data, etc.., required to carry out the short circuit.
      2. Perform a short circuit analysis to determine short circuit current levels at all critical points in the distribution system, having obtained the available short circuit current available from the Hydro Supply Authority.
      3. Generate appropriate settings for all relays and protective devices from the level of the Hydro Supply Authority feeder protective devices to the largest downstream device on all the feeder secondary distribution levels.
   .3 Provide a complete, comprehensive report at the conclusion of the short circuit, protection and co-ordination study consisting of the following:
      1. A set of time current curve characteristics of all protective devices in the system plotted on log/log graph paper with corresponding short circuit current levels.
      2. Time current damage curves for all transformers, large motors and cables are also to be plotted.
      3. Provide a complete schedule of all main protective relays, fuses and other protective device listing device locations, function number, manufacturer, model number, size, range, setting, etc.
      4. The complete study will illustrate and ensure that the settings and sizes of all protective devices for each voltage level have been chosen to ensure maximum or optional protection and co-ordination during electrical fault or overload conditions.
      5. These generated settings will then be applied by "in-field" testing methods to the respective devices.

3.7 Ground Fault Protection System

1. Inspect relays visually for condition and clean where necessary.
2. Check all connections for tightness.
3. Apply settings to each relay as specified in the short circuit, protection and co-ordination study and test operation by means of a relay test set.
4. Verify each protective system by means of a primary current injection through the zero phase sequence transformer. This will provide correct operation of both the transformer and relay as well as proper functioning of the circuitry through to the breaker tripping elements.

3.8 Arc Flash Analyses

1. For the entire electrical distribution system provided as part of this contract and the existing electrical distribution system shown on the drawings, conduct an electrical arc flash hazard analysis as prescribed under NFPA 70E (CSA Z462-18) and provide a written report summarizing the findings and recommended control measures to be taken. The arc flashing analysis results must be deemed acceptable prior to the equipment purchase.
2. The power systems software utilized to perform the study must be SKM Powertools.
3. Provide appropriate labels for all equipment (including all prepurchased equipment and equipment supplied by owner). The labels shall warn a qualified worker who intends to open the equipment for analysis or work that a serious hazard exists and that the workers should follow appropriate work practices and wear appropriate personal protection equipment (PPE) for the specific hazard.
4. An existing coordination study is not available for the electrical contractor's use.
5. Procure (coordinate and pay for) the services of Enkompass Power & Energy Corp Rene Seipt rene@enkompass.ca to prepare the coordination study and arc flash analysis.

3.9 Emergency Light Level Measurements

1. As part of this scope of work procure the services of a professional engineer to measure and record emergency lighting levels in foot candles throughout all scope of work areas with a calibrated light meter. Readings shall be taken based on a minimum of one reading for every 20' center in open office areas and corridors / hallways and one reading in each closed office, meeting room, boardroom and stairwell.
2. All light level readings are to be taken during non-daylight hours.
3. Provide a sealed letter identifying light level readings and stating that the emergency lighting levels meet the requirements of the National Building Code. Notify Owner and Consultant at least ten (10) days prior to proposed testing date and schedule testing at time and date acceptable to Owner and Consultant.

3.10 Test Results

1. Submit test results to Owner's Consultant for review.
2. Testing methods and test results: to CSA, CEC and authorities having jurisdiction.
3. Remove and replace conductors found damaged with new materials.
4. Provide required labour and tools, if during testing Owner's Representative requests equipment be opened and removed from their housings to examine equipment, terminations and connections.

End of Section

Project: 17264

Panelboard: Panel PPA
Voltage (V):
Phase/Wire:
Bus and Lugs Rating (A):

CCT	Load	Breaker			CCT	Load	Breaker	
NO		Amp	Pole		NO		Amp	Pole
1	Existing CCT	15	1		2	Existing CCT	15	1
3	Existing CCT	15	1		4			
5	Existing CCT	15	1		6			
7	Existing CCT	15	1		8			
9	Existing CCT	15	1		10			
11	Existing CCT	15	1		12	Existing CCT	15	1
13	Existing CCT	15	1		14	Existing CCT	15	1
15	Existing CCT	30			16	Existing CCT	15	1
17	Existing CCT		2		18	Existing CCT	15	1
19	Existing CCT	15	1		20	Existing CCT	15	1
21	Existing CCT	15	1		22			
23	Existing CCT	15	1		24	Stove	50	
25	Existing CCT	20	1		26			2
27	Existing CCT	15	1		28	PPD	100	
29	Existing CCT	15	1		30			2
31	Existing CCT	20	1		32			
33	Existing CCT	30			34	Existing CCT	15	1
35	Existing CCT		2		36	Existing CCT	15	1
37	Existing CCT	15	1		38	Existing CCT	15	1
39	Existing CCT	30			40	Existing CCT	30	
41	Existing CCT		2		42	Existing CCT		2

Project: 17264

Panelboard: Panel PPD
Voltage (V):
Phase/Wire:
Bus and Lugs Rating (A):

CCT	Load	Breaker			CCT	Load	Breaker	
NO		Amp	Pole		NO		Amp	Pole
1	Lighting Circuit / Emergency Battery Unit	15	1		2	Washroom Sensors / EF	15	1
3	Dormitory Receptacles	20	1		4	Change Table	20	1
5	Study Area 108 Receptacle	20	1		6	Universal Washroom Receptacle	20	1
7	Lounge 114 TV Receptacle	20	1		8	Washroom 105 Receptacle	20	1
9	Locker Room	20	1		10	Duress System / Door Lock/ Door Operator	15	1
11					12	Exterior Lighting	20	1
13	Dish Washer	20			14	Parking Garage Lighting	15	1
15			2		16	Parking Garage Lighting	15	1
17	Range Hood	20	1		18	Parking Garage Lighting	15	1
19					20	HWT	15	1
21	Counter Receptacle	20	1		22	ERV-1	15	1
23	Counter Receptacle	20	1		24	EDH-1	20	1
25	Counter Receptacle	20	1		26			
27	Counter Receptacle	20	1		28			
29	Counter Receptacle	20	1		30	House Keeping	20	1
31	Counter Receptacle	20	1		32			
33	Counter Receptacle	20	1		34			
35					36			
37	Spare	20	1		38	Spare	15	1
39	Spare	20	1		40	Spare	15	1
41	Spare	20	1		42	Spare	15	1