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PART 1 GENERAL

1.1 REFERENCES

1.1.1 Comply with General Requirements and all documents referred to therein. Supplement with the following requirements.

1.2 APPLICATION

1.2.1 This Section applies to and is a part of all Sections of Division 16.

1.3 WORK INCLUDED

1.3.1 The Work of this Section shall include all labor, materials, equipment and tools required for a complete and working installation as described. Unless otherwise explicitly specified, it must not be assumed that any parts, labour, resources, tools or materials will be supplied by anyone. The Contractor will be responsible for supplying all necessary resources to complete the job as specified.

1.4 INTENT

1.4.1 Equipment and installation provided under this Division shall conform to applicable standards and regulations of the following organizations:

1.4.1.1 Canadian Standards Association (CSA)

1.4.1.2 Underwriter's Laboratories of Canada (ULC)

1.4.1.3 Ontario Electrical Safety Code (OESC)

1.4.1.4 Electrical Safety Authority (ESA)

1.4.1.5 Ontario Building Code (OBC)

1.4.1.6 Illuminating Engineering Society of North America (IESNA)

1.5 WORKMANSHIP

1.5.1 Workmanship and method of installation shall conform to the best standards and practice. Where required by local or other By-Laws and Regulations, tradesmen shall be licensed in their trade.

1.6 TEMPORARY & TRIAL USAGE

1.6.1 Temporary or trial usage of any equipment or materials shall not be construed as evidence of acceptance of same and no claim for damage shall be made for injury to or breaking of any part of such Work which may be so used.

1.7 BY-LAWS & REGULATIONS

1.7.1 Work shall conform to latest rules, regulations, and definitions of Ontario Electrical Safety Code and applicable Municipal and Provincial Codes and Regulations, and with requirements of other authorities having jurisdiction in the area where Work is to be performed. Minor changes required by an authority having jurisdiction shall be carried out at no additional cost to the Owner. Standards established by Drawings and Specifications shall not be reduced by applicable codes or regulations.

1.8 PERMITS & FEES

1.8.1 File Bid Drawings with proper authorities and obtain their approval of installation and permits for same upon acceptance of bid price and before proceeding with Work. Prepare and submit necessary detailed Shop Drawings as required by Authorities.

1.8.2 Pay all fees in connection with permits, inspections, and final certificate of approval.

1.9 CERTIFICATES

1.9.1 Furnish necessary certificates as evidence that Work installed conforms to laws and regulations of authorities having jurisdiction.

1.9.2 Provide, at no extra cost to the Bid Price, a certificate from the Manufacturer or all lighting and lighting controls system that the installation throughout the area of work has been completed as per Manufacturer's Recommendations and Instructions. The cost for such certifications shall be included in the bid price.

1.10 GUARANTEE - WARRANTY

1.10.1 Guarantee and warranty requirements of the Bid shall apply.

1.11 SPECIFICATIONS, DRAWINGS & JOB CONDITIONS

1.11.1 Electrical Drawings do not show structural and related details. Take information involving accurate measurement of building from building Drawings, or at building. Make, without additional charge to the Owner, any necessary changes or additions to electrical Work or equipment locations to accommodate structural conditions. Equipment locations may be altered by the consultant without extra charge provided the change is made before installation and does not necessitate major additional material.

1.11.2 Examine site and local conditions. Carefully examine all Drawings and complete Specifications to ensure that Work can be satisfactorily carried out as shown. Before commencing Work, examine the work of other Sections and report at once any defect or interference affecting the Work, its completion or warranty. No allowance will be made later for any expense incurred through failure to make these examinations or to report any such discrepancies in writing.

1.11.3 Relocate equipment and/or material installed but not coordinated with the Work of other Sections as directed, without extra charge to the Owner.

1.11.4 Furnish "built-in" items in ample time and give necessary information and assistance in connection with building-in of same. Notify Section concerned in writing of size and location of recesses, openings and chases at least forty-eight hours before walls are erected, floors poured and similar work.

1.12 SHOP DRAWING MATERIAL & LISTS

1.12.1 Prepare and submit shop drawings and lists of materials for review. Make submittals of more than two pages in booklet form. Individual and loose Drawings will not be accepted for review.

1.12.2 Prior to equipment fabrication, delivery or installation, submit complete lists of materials proposed, indicating manufacturer, catalogue numbers and complete performance data.

1.12.3 Reviews of Shop Drawings by Consultant are for sole purpose of ascertaining conformance with general design concept. This review shall not mean that Consultant approves detailed design inherent in Shop Drawings, responsibility for which shall remain with Contractor and such review shall not relieve Contractor of responsibility for meeting all requirements of Bid Documents. The contractor is responsible for dimensions to be confirmed and correlated at site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work with all trades.

1.13 RECORD DOCUMENTS

1.13.1 Conform to General Requirements. Maintain at least two sets of documents and clearly mark on same as job progresses, changes and deviations from Work shown so that on completion Owner will have records of exact location of ducts and equipment and record of material and equipment changes.

1.13.2 Record all homerun conduits, junction boxes for complete systems on As-Built Drawings.

1.13.3 Contractor shall ensure that as-built information is accurately recorded and shall check same. As-Built drawings shall be reviewed with Consultant at each jobsite meeting.

1.13.4 Upon completion of Work, prior to Substantial Performance inspection and after final review with Consultants, Contractor shall neatly transfer recorded information and make final As-Built submission to Consultant in the following form:

1.13.4.1 One (1) set of clean, legible prints.

1.13.4.2 Updated ACAD R2012 Drawings.

1.13.5 Consultant will review As-Built information provided by Contractor as handmade red mark-up. Revise Drawings as markup and in CAD to suit any comments until acceptable for submission to Owner.

1.14 PROTECTION

- 1.14.1 Securely plug or cap open ends of electrical raceways or equipment to prevent entry of dirt, dust, debris, or water. Clean all equipment inside and outside before testing.
- 1.14.2 Equipment stored on site shall be protected from the weather and always kept dry and clean. Take care to avoid corrosion of metal parts.
- 1.14.3 Protect Work installed from damage. Secure all unfinished or loose Work to prevent movement.
- 1.14.4 Include for heavy duty protection of all surrounding materials and systems as may be present on the Job Site. Include for daily setup and removal to facilitate continued operation by the User Group/Owner during non-working hours.

1.15 INSTRUCTIONS TO OPERATOR

- 1.15.1 Instruct the Owner's Representatives in repair, maintenance and operation of Electrical Systems and associated equipment.
- 1.15.2 Supply three (3) full Operation and Maintenance Instructions each in stiff cover, three-ring binder suitably indexed, separated and labeled. Operate each item of equipment in the presence of the Owner's Representatives to ensure understanding of working parts and function of each item of equipment. Supply one complete set of "Reviewed" Shop Drawings in separate hard cover binder suitably separated and labeled for Owner's use.
- 1.15.3 Operation and maintenance manuals shall be carefully prepared in co-operation with equipment manufacturers and include miscellaneous parts necessary for proper, efficient operation of all equipment.
- 1.15.4 Manuals shall also include a spare parts list for each type of equipment, component, control and device installed together with manufacturer's name and address so such items can be suitably identified and purchased. Include list of recommended spares.

1.16 CLEANING, LUBRICATION AND ADJUSTMENT

- 1.16.1 Immediately prior to completion of Work:
 - 1.16.1.1 Remove all dust, dirt and other foreign matter from internal surfaces of enclosed electrical apparatus and equipment.
 - 1.16.1.2 Remove all temporary protective coverings, coatings and temporary labels.

1.17 INSPECTION AND TESTING

- 1.17.1 Systems, equipment, and all major items of material shall be tested to the satisfaction of the Consultant, and as required to establish compliance with plans and Specifications, and with the requirements for the Authorities having jurisdiction. Such tests shall be paid for by the Contractor. Tests shall be conducted by a third party specializing in the work and stamped by Professional Engineer licensed to practice in the Province of Ontario.
- 1.17.2 Faulty and defective equipment shall be replaced with new materials. Conductors which are found to be shorted or grounded, or to have less than proper insulation resistance, shall be replaced with new conductors.

1.18 COMPLETION

- 1.18.1 Provide copy of final inspection certificate from the Electrical Inspection Authority.
- 1.18.2 Provide manufacturers corrected "as built" Shop Drawings for all major electrical items and systems, including all Shop Drawings returned for modifications.

1.19 ALTERATIONS TO EXISTING BUILDINGS

- 1.19.1 Bid drawings and site are to be examined to determine the extent of alterations affecting existing electrical systems.
- 1.19.2 Electrical services and auxiliary services (controls and the like) should be maintained continuously without interruption. Interruptions to services shall be confined to periods of time designated by the Owner's designated representative.
- 1.19.3 Perform removal, reinstallation, cutting and patching of ceiling and walls as required in the existing buildings.
- 1.19.4 Cutting, patching and making good (including refinishing, painting, etc.) directly related to electrical work, regardless of whether such work occurs in new or existing construction, shall be coordinated and performed by a Contractor specializing in and skilled in such work, under the supervision of the Prime Contractor.
- 1.19.5 Where existing electrical items or systems are demolished and removed from existing construction assemblies, the Contractor involved shall be responsible for infilling the entire hole left after removal of item or system with new construction assembly to match existing. Where new electrical items or systems are installed through existing construction assemblies, the Contractor involved shall be responsible for properly sized and accurate cutting of existing construction assembly to allow installation of new Work.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

1.1.1 Conform to Section 16010 - Electrical General Requirements.

1.2 MATERIALS

1.2.1 Materials shall be new, of first quality and uniform throughout.

1.2.2 Electrical materials shall be C.S.A. approved and be so labeled. Material not C.S.A. approved shall receive acceptance for installation by Electrical Safety Authority (ESA) Special Inspections Branch before delivery, and modifications and charges required for such acceptance shall be included in Work of this Section. Material shall not be installed or connected to the source of electrical power until approval is obtained.

1.2.3 Confirm capacity, ratings and characteristics of equipment items being provided to supply power to equipment provided under other Sections of the Work. Resolve discrepancies before such items are purchased.

1.3 MATERIAL ACCEPTANCE

1.3.1 Acceptance of materials installed presumes that materials have not been damaged or exposed to conditions that would adversely affect performance and life expectancy.

1.3.2 If in the opinion of the Consultant, materials have sustained damage, or have been exposed to abnormal conditions it shall be the responsibility of the Contractor to have such tests performed as deemed necessary by the Consultant to establish condition and therefore, acceptability of installed materials.

PART 2 PRODUCTS

2.1 RACEWAYS

2.1.1 Electrical metallic tubing (EMT) shall comply with CSA Specification C22.2 No. 83. Connectors and couplings to be forged steel and rain tight. Connectors to have factory-installed insulated throats. No screw type connectors or couplers allowed. Only pressed steel EMT fittings shall be used, cast fittings are not acceptable.

2.2 WIRE & CABLE

2.2.1 Branch wire and cable shall comprise copper conductors, sized as noted, rated 90 deg. C., 600-volt minimum flame retardant insulation, and CSA approved for application.

2.2.2 Branch wire and cables installed in conduit shall be RW90 - Flame retardant and comply with CSA Specifications.

2.3 DEVICES

- 2.3.1 Wiring devices unless otherwise specified herein, or noted, shall be as manufactured by Hubbell, or approved equal.
- 2.3.2 Wire and cable Switches for 120 volt branch lighting circuits, generally shall be A.C. "Quiet Type" rated 20 Ampere, 120 Volt, totally enclosed phenolic housing Hubbell 1221 Series, brown toggle handle.

2.4 DEVICE COVERPLATES

- 2.4.1 Switch and receptacle and other device faceplates for flush mounted devices, generally shall be single or multi-gang as required, type 301, stainless steel, #4 brushed finish with removable protective covering.

PART 3 EXECUTION

3.1 EQUIPMENT LOCATIONS

- 3.1.1 Approximate locations of electrical equipment, and the like, are given on the Drawings. In absence of definite detail, exact location of equipment/outlets shall be determined on site as Work progresses.
- 3.1.2 The right is reserved to alter the location of equipment and outlets up to three meters without additional cost to the owner, providing notice is given prior to installation.

3.2 MOUNTING HEIGHTS

- 3.2.1 Mounting heights of outlets, top of outlet to finished floor, except for exposed masonry construction, shall generally be as follows:

Lighting Switches – 900 mm to 1100 mm
Receptacles - 400 mm above finished floor

3.3 HOLES & DRILLING

- 3.3.1 Pneumatic hammers and percussion drills are prohibited.
- 3.3.2 Where not sleeved, make holes through concrete walls and floors by core-drill only. Obtain Consultant's approval before drilling.
- 3.3.3 Seal holes and sleeves through floors to serve as water dam.

3.4 CUTTING & PATCHING

- 3.4.1 Layout and install Work in advance of other Sections for all new Work. Bear all costs resulting from failing to comply with this requirement.

3.4.2 Pay for cutting and patching and making good as required for Work of this Division by reason of the nature of the proposed Work, faulty or late Work. Employ appropriate trades already engaged on the site to perform such cutting, patching and making good existing walls, floor, ceiling, etc. Before commencing, obtain Consultant's approval for extent and nature of cutting. Make good disturbed surfaces to the Consultant's approval.

3.5 HANGERS & INSERTS

3.5.1 Provide necessary hangers and inserts for work of this Division.

3.5.2 Fasten to cast-in place concrete by suitable drilled or cast-in inserts.

3.5.3 Fasten to structural steel using bolts or welded fasteners.

3.5.4 Do not use wood, chain, wire lashings, strap or grappler bar hangers except where noted or detailed.

3.5.5 Support fixtures independently of ceiling suspension systems. Provide additional supports as required, which shall be fastened to building structure steel members, joists, beams, etc., but not metal pan or roof decking. Material for additional supports and their installation shall comply with requirements of U.L.C. Refer to "List of Equipment and Materials" Vol. 2, and "Supplement" for application to rated assemblies.

3.5.6 Support outlet and junction boxes independently of the conduits running to them where required by electrical code and where deemed necessary by the Consultant, use steel angle brackets or steel rods to support outlets and fixtures, to the building structure.

3.5.7 Drilled fastenings to concrete shall be self-drilling concrete anchors, Phillips 'Red-Head' or approved equal. The maximum weight per fastening shall not exceed 25% of manufacturer's 'pull-out' load data.

3.5.8 Surface mounted or stem suspended fixtures fastened to non-removable ceilings, 2 hr. fire rated ceiling assemblies, or mounted between metal suspension of exposed T-grid ceilings, shall be provided with minimum of two points of attachment for each 300 mm x 1200 mm (1' x 4') luminaire, using metal 'channel-bar' fastened to building structure. Attach luminaires to 'channel-bar' by means of threaded steel rods. Channel-bar shall be adequately supported and of a construction to prevent deflection under load, as selected from manufacturer's published data, and to Architect's approval. 'Channel-bar' shall be Unistrut, Burndy, Flexibar, Cantrough or Canadian Strut Products or approved equal.

3.5.9 Use support clips (e.g. Caddy Type IDS) for suspension of fixtures attached to exposed T-grid ceilings. Clips shall be supported directly from building structure and not from suspended ceiling system.

3.5.10 Provide recessed fluorescent fixtures with support frames and plastering frames where applicable.

3.5.11 Chain where permitted and specified for the installation of fluorescent lighting fixtures shall be No. 4, 2 mm (.080") Tenso Pattern coil steel chain, plated with a strength of 82 kg (180 lbs.) as manufactured by Dominion Chain Co. Ltd. or approved equal. Where 'S' hooks are used with chain, they shall be No. 6 type with open strength of 82 kg (180 lbs.) minimum. Attachment of chain at both ends of support shall develop full strength of chain.

3.5.12 Support outlet boxes, junction boxes, conduit and the like, mounted on exposed steel deck roofing by means of self-tapping minimum #10 gauge screws, secured through bottom member of deck corrugation. Do not pierce top of steel deck.

3.6 PAINTING

3.6.1 Hangers, support framing and all equipment fabricated from ferrous metals which are not protected with zinc or other suitable corrosion-resistant finish shall have at least one coat of a corrosion-resistant paint applied before shipment or immediately on arrival at the site.

3.6.2 After installation, touch up all scratches, chips, other damage and defects in paint, using zinc chromate primer or paint or special enamels as necessary to match the original.

3.6.3 Finish and colour of all equipment shall be coordinated to provide uniform appearance.

3.6.4 Paint all interior conduits to match existing interior finish. Do not paint over nameplates.

3.6.5 See Section 16500 for additional painting requirements.

3.7 BRANCH CIRCUIT WIRING

3.7.1 Provide branch circuit wiring and conduits as required for power and auxiliary systems.

3.8 CONDUIT, RACEWAYS AND WIREWAYS

3.8.1 All wiring and cable shall be installed in conduit.

3.8.2 Electrical metallic tubing (EMT) may be used in place of rigid conduit in dry locations subject to governing regulations, embedded in masonry walls, and concealed above suspended ceilings. Connectors shall be provided with factory-installed insulated throats. Only pressed steel EMT fittings shall be used, cast fittings are not acceptable

3.8.3 Use flexible metallic conduit for connections to chain suspended and recessed fixture drops, and similar equipment. A code-gauge green grounding conductor shall be provided for all such connections.

3.8.4 Fasten every conduit and cable to structure by means of approved conduit clamps or clips. Wire lashing is not acceptable.

3.8.5 Conceal conduits and wiring except where noted. Run exposed conduits parallel to building lines and to other conduits.

- 3.8.6 Surface, exposed EMT can only be used in non-cosmetic sensitive areas such as boiler rooms, electrical rooms etc.
- 3.8.7 When surface raceways are required in areas such as classrooms, corridors office areas etc. Wiremold must be used. 700 series Wiremold is minimum size to be used and must be saddle strapped. Surface 1110 boxes are not accepted, cast boxes must be used.
- 3.8.8 Conduit and cables for electrical work in demountable type and drywall type partitions shall enter from above, from a junction box concealed in the ceiling above and shall comprise a flexible conduit connection.
- 3.8.9 All wiring shall be provided with a separate code gauge supplementary grounding conductor run in each conduit or duct, terminating at ground block at panelboards. Use of metallic conduit as ground will not be acceptable.
- 3.8.10 Run conduits exposed in mechanical equipment rooms, electrical rooms, fan rooms, and the like, and installed after mechanical and other equipment is completed. Install fixtures, outlets, etc., to clear and to suit application.
- 3.8.11 Wiring, boxes, conduit fittings, etc., in hazardous areas shall conform to Ontario Electrical Code, covering explosion-proof areas. Provide conduit seals where required by these regulations.
- 3.9 WIRE & CABLE
- 3.9.1 Wire and cable shall not be installed at temperatures below 20 deg. C unless "minus 40" type is used.
- 3.9.2 Minimum wire sizes for power wiring shall be #12 AWG gauge unless specified otherwise. Minimum wire size for "Common" neutral conductors shall be #10AWG. Control wiring shall be #14AWG red insulation. Maximum voltage drop between furthest outlet of any circuit, when fully energized, and panel to which it is connected shall not exceed two percent except for electric heating circuits which shall not exceed one percent. All wire #14AWG and larger shall be stranded.
- 3.9.3 Cables shall be terminated with moisture-proof connectors, clamped to sheet metal enclosure by a single non-ferrous locknut and grounding bushing.
- 3.9.4 Sheaths of multi-conductor cables shall be grounded at both cable ends.
- 3.9.5 Sheaths of single conductor cables shall be grounded at supply end only. Provide a code gauge grounding conductor with each feeder cable run.
- 3.9.6 Solderless connectors with nylon-jacketed "Vibration-proof" screw-on wire connectors ideal "Wing Nuts", rated 600 volts shall be used for joints in branch wiring.
- 3.9.7 Use compression joints and terminals for all control wiring; and all conductors #4 AWG and larger. Mechanical connections are acceptable at panelboards and circuit breakers where these are part of factory-assembly.

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- 3.9.8 Wire or cables shall be colour-coded in accordance with Ontario Electrical Safety Code. Each end of feeder terminations (e.g. in SERVICE, panelboards, switches, splitters and the like) Code Phase A - Red, Phase B - Black, Phase C - Blue, Neutral - White.
- 3.9.9 Include in each conduit, tubing and raceway, a code gauge green supplementary grounding conductor which shall be connected to suitable ground bus in equipment.
- 3.9.10 BX is only acceptable above T-bar ceilings, in demountable walls (concealed) etc. and minimal length (2 meters) shall be used for fixture drops etc. in open ceiling areas. No length of BX greater than 2 meters will be permitted under any circumstances.
- 3.9.11 All light fixtures shall be wired in star wired topology from homerun conduit system and junction boxes.
- 3.9.12 Only black Marrette wire connectors are to be used.
- 3.10 OUTLET, JUNCTION & PULL BOXES
- 3.10.1 Use suitable electrical boxes for terminations and junctions on conduit work. Install pull boxes where necessary to permit installation of conductors. Support pull boxes, outlet boxes, panels and other cabinets independently of conduit.
- 3.10.2 Provide each light switch, and other device with an outlet box of suitable dimensions and a faceplate. Outlet boxes shall be adapted to their respective locations.
- 3.10.3 "Thruwall" and "Utility" type boxes shall not be used.
- 3.10.4 Electrical boxes and panels shall be CSA approved, code-gauge sheet metal, galvanized or with suitable protective treatment in unfished and above ceiling areas. Secure covers with screws or bolts. In finished areas, surface 1110 boxes are not accepted , cast boxes must be used.
- 3.10.5 Outlet boxes shall not be installed "Back-to-Back" in walls; separate by a minimum of 150 mm.
- 3.10.6 Use "Masonry Type" outlet boxes for flush installation in masonry walls as detailed on Drawings. Standard sectional boxes, 1004, 1104 and the like shall not be used.
- 3.10.7 Install surface mounted devices, in cast conduit fittings, with threaded hubs and suitable stainless steel faceplates.
- 3.10.8 Main pull and junction boxes (excluding obvious outlet boxes) shall be clearly identified.
- 3.10.9 In addition, each box shall be identified with a system and service designator of logic reference to the service.

3.11 ACCESS DOORS & ACCESS MARKERS

- 3.11.1 Supply access doors for installation under the Work of other Divisions where electrical equipment requiring maintenance or adjustment or inspection is located above ceilings, within walls or behind furring; except ceilings of lay-in removable panel type.
- 3.11.2 Access doors shall be 12 gauge hinged metal Acudor or equal #UF-5000 flush type, minimum size 300 mm x 300 mm (12" x 12") "Reach-in" 300 mm x 600 mm (12" x 24") "Crawl-in", with prime coat finish, concealed hinges, screwdriver lock and plaster key. Access doors in finished masonry or drywall construction shall be #DW-5040 less plaster key.
- 3.11.3 Access doors in fire rated ceiling assemblies, all fire rated walls, duct shaft or in corridor walls shall be UL, ULC or WHI listed 1-1/2 hour fire rated access doors equal to Acudor #FB Series to suit wall and ceiling construction.
- 3.11.4 Where lay-in removable panel ceilings requiring hold-down clips are used, access doors are not required but panels shall be secured with accessible hold-down clips and marked with Buildemup #6 or approved equivalent RH brass paper fasteners inserted through acoustic panel and bent over. Paint heads with blue enamel before installation.

3.12 GROUNDING - GENERAL

- 3.12.1 Ground all electrical systems in accordance with provisions of the Ontario Electrical Code.
- 3.12.2 Install grounding conductors to permit the shortest and most direct path from equipment to ground. Install grounding conductors in electrical metallic tubing (EMT) & rigid galvanized conduit with both conductor and conduit bonded at both ends. Provide bonding jumpers with approved clamps to maintain ground continuity of metallic raceway systems at all expansion joints.
- 3.12.3 Ground connections to grounding conductors shall be accessible for inspection and made with approved solderless connectors bolted to the equipment of structure to be grounded. Clean contact surface prior to making connections to ensure proper metal to metal contact. Connections shall be of the type that grounds both conduit and conductor, and cap screws, bolts, nuts and washers shall be silicon bronze.

3.13 FIREPROOFING & SEALING

- 3.13.1 Provide firestopping protection for all new and existing openings through floors and fire rated walls. Firestopping work shall comply with all applicable OBC and ULC requirements.
- 3.13.2 Caulk spaces between conduit, cables, raceways, with "Cerafibre" 2300 F packing or approved equivalent to Consultant's approval. Pack and seal both sides of openings with Electrovert "Flameseal" or approved equivalent putty, minimum thickness 25 mm (1"). Install in accordance with the manufacturer's instructions.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED INSTRUCTIONS

- .1 Refer to Section 16010 - Electrical General Requirements.

1.2 WORK INCLUDED

- .1 Provide electrical lighting fixtures and systems scheduled, complete with lamps, drivers and necessary accessories required for their installation and performance. All mounting hardware required to suit the installation – whether or not explicitly specified on the drawings – it's required to be supplied and installed under this RFQ.
- .2 Obtain and review all information with regards to the proper installation of all lighting systems from the Manufacturer. No installation shall be completed without a thorough review of the Manufacturer's recommendations and guidelines for installation. All installations shall comply with these recommendations and guidelines as well as any other requirements mandated by Authorities having Jurisdiction and local governing codes. Furnish a letter from the Manufacturer confirming the same if required and requested by the Owner or Consultant at no cost to the RFQ. This requirement shall be included in the pricing.

1.3 LAMP AND DRIVER CONDITIONING

- .1 Upon first energizing all LED fixtures shall remain energized for a stabilizing period as recommended by manufacturer.

1.4 SHOP DRAWINGS

- .1 Conform to requirements of Section 16010.
- .2 Submit for review an electronic submission of shop drawings containing illustrations of each fixture. Illustrations to be complete showing dimensions, light distribution and mounting requirements. Illustrations to be noted to indicate special features and finishes. A copy is to be retained by the Contractor on the site, to ensure co-ordination of installation requirements. Shop drawings shall show selection of all parameters/options available on the cut sheet.
- .3 LED fixture shop drawings must indicate Driver Manufacturer and Model No. for each fixture.
- .4 No light fixtures shall be ordered without the general review of shop drawings by the Electrical Consultant. Shop drawings should indicate the proposed mounting method and hardware required to facilitate a complete and safe installation.

PART 2 - PRODUCTS

2.1 REFERENCE NUMBERS

- .1 Catalogue reference numbers given for individual fixture types are intended as a guide when read with the description and the fixture as finally applied. Verify catalogue references with description and coordinated with installation conditions, with particular regard to ceiling construction details, type and finish before ordering fixtures.

2.2 DRIVERS

- .1 Light fixtures shall be c/w LED Drivers from reputed manufacturer that has been in business for making such products for minimum of 5 years and successfully completed projects. Equip light fixtures with a 0-10V continuous dimming driver that works with any standard 0-10V control/dimmer.

2.3 LENSES

- .1 Plastic lenses in lighting fixtures shall be acrylic with minimum thickness of 3 mm (.125 inches) and, providing flame spread and smoke density ratings, complying with applicable Federal and Provincial Codes; Ontario Fire Marshal's Fire Safety Design Standard; and the Ontario Building Code. Paragraph 3.1.13.1 (1).
- .2 Removable components of fixtures (louvres, lenses, wire guards, and the like) to be limited to maximum 1220 mm (48") in length.

2.4 LED LAMPS

- .1 Long-Life LED system coupled with electrical driver to deliver optimal performance. LED's available in 3000K to 4000K with typical CRI 85. Projected life shall be minimum 50,000 hours at 90% lumen output. cULus listed, or an alternate listing that is approved by the Electrical Safety Authority and all other Authorities having Jurisdiction.

2.5 FIXTURE SCHEDULE

- .1 Refer to drawings for light fixtures schedule.
- .2 The Owner and Consultant reserve the right to change the lumen package of any count of fixtures of any type to either one lumen package lower or one lumen package higher than that specified at no extra cost to the RFQ. Include for any upcharges in the bid price – no extra will be permitted during construction.

2.6 LIGHTING HARDWARE

- .1 The Contractor must supply and install all light fixtures as per the Manufacturer's recommendations as well as to the satisfaction of all Authorities having Jurisdiction, Code requirements, the Owner and the Electrical Consultant.

- .2 Include, in the bid price, for all lighting hardware required for a complete and safe installation.
- .3 Lighting hardware includes, but isn't limited to, the mounting hardware required for each fixture. The Contractor is responsible for reviewing architectural finishes in all areas and providing lighting and mounting hardware to suit.
- .4 All parts used as a part of the installation must be of the same manufacturer as the respective light fixture. Wherever available, all parts must be unique to the respective fixture and purchased with the light fixture from the same supplier and manufacturer.

2.7 PHOTOMETRIC

- .1 The Electrical Contractor and its supplier/manufacturer representative is responsible for obtaining a complete photometric of the entire scope and area of lighting upgrade, both interior and exterior, prepared by a professional, third-party specializing in such work. All fixtures of all makes shall be depicted on one layout. Obtain architectural details such as room dimensions, ceiling heights, and finishes with reflectance from site. Submit a copy of the interior and exterior photometric with the shop drawing submittal for the light fixtures. The Electrical Contractor in conjunction with the Manufacturer remains responsible for the accuracy of the photometric results and acceptance of fixtures based on this. Non-compliance upon installation will be corrected/upgraded as required at no cost to the project and/or Owner.
- .2 Photometric statistics shall be prepared for each zone/room. Statistics such as max/min and average foot-candle readings shall be included in the photometric submittal.
- .3 Photometric shall consider site condition impacts such as partitions, washroom stall partitions, suspended ceilings, reflectance's, etc.

2.8 APPROVED EQUAL PRODCUTS

- .1 All proposed alternate fixtures of equal or superior to the base bid product shall be submitted at the recommended site meeting only. Respondents submitting alternate make other than listed as approved shall provide cut sheets to Electrical Engineer or Owner to determine acceptability. Acceptance of these equal or superior products shall be at the sole discretion of the Electrical Engineer or Owner and shall be final. Notification of approved equal or superior products will be indicated in an addenda prior to the submission deadline. No fixtures of makes other than those listed or approved is permitted.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Do not install or energize lamps until directed by Consultant which generally shall be just prior to occupancy of the building by the Owner. Read 'Temporary and Trail Usage'.

- .2 Provide new safety chains for all recessed/surface/pendant mounted light fixtures throughout the building. Secure safety chains from the building structure. Mounting directly from the roof-deck is not permitted. Provide uni-strut supports throughout where structure members are spaced apart or ductwork/piping present for straight run of safety chains/aircraft cables etc. Ensure light fixtures and safety chains/hangers are installed such that weight of light fixtures is NOT born by the ceiling system and/or its hanging system.
- .3 Remove existing wiring to homerun conduit system entering the room. Provide all new power and control wiring in conduit for complete operational system. Ensure wiring for light fixtures is run star-wired topology from homerun conduit junction boxes. NO daisy chain wiring method shall be used. Provide new junction boxes as boxes on the ceiling.
- .4 Where fixtures are suspended, the fixture shall be mounted to match the mounting height of the existing fixtures – measure prior to removal. The Consultant and Owner reserve the right to modify the height of the fixtures at no extra cost to the bid price, provided the specified mounting hardware would permit the alternate mounting height and if instructed so prior to commencing installation of the new fixtures.

3.2 RECESSED FIXTURES

- .1 Provide plaster and/or framing rings for recessed fixtures (except for 'Lay-in Tee-Bar' types) the installation of which shall be the responsibility of this Section.

3.3 SUSPENSION STEEL

- .1 Provide angle-iron channels welded to the top side of bottom-chord of the L.S.S.J.'s in the Gymnasium for securing light fixtures.
- .2 Provide support for light fixtures from separate uni-strut members attached and/or secured to building structure. No support shall be attached to metal deck.

3.4 SITE AIMING

- .1 Position and aim adjustable lighting equipment as directed on the site. Provide labour and materials necessary to accomplish this.

3.5 COMPLETION

- .1 Fixtures shall be cleaned from construction dust at the time of final acceptance.

3.6 REPLACEMENT OF EXISTING FIXTURES WITH NEW

- .1 This project involves replacement of existing light fixtures with new light fixtures. As a result, the Contractor shall fully understand that refinishing/modification of existing surfaces may be required. At all locations where the footprint of the new fixtures is less than 12" x 48" (in any one or both dimensions), the Contractor shall allow for painting of the existing drywall surface, if present, to finish the surface such that it blends with the remainder of the ceiling. Paint to the extent required for a visually appealing and consistent finish. Patch ceiling and any visible holes prior to painting. Paint color and finish shall match that of the existing. Provide paint samples to the Owner for approval prior to ordering. Ensure fire rating is maintained to match existing and/or made better.
- .2 Where 1'x4' recessed fixtures are being installed, provide a new half ceiling tile (to match the appearance of the existing in the Classroom) with the grid style is 2'x4'. Where tiles are damaged, have holes and/or blackened due to demolition scope, include in bid price replacement of affected tiles. Ensure fire rating is maintained to match existing and/or made better.
- .3 All existing chain supports shall be removed from the existing fixtures and replaced with new.

3.6 INCENTIVE APPLICATION

- .1 The Owner will be pursuing rebates and incentives as a part of the lighting retrofit, specifically through the Prescriptive process. The Electrical Contractor and its supplier/manufacturer representative are responsible for providing all documentation and calculations as required for the completion of the Incentive Application. Both parties shall be familiar or shall retain the services of a third-party specializing in such field, with the Application and procedure.

END OF SECTION

PART 1 - GENERAL

1.1 Work Included

- 1.1.1 Contractor's work to include all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described herein.
- 1.1.2 Contractor/Supplier shall examine all general specification provisions and drawings for related electrical work required as work under Division 16.
- 1.1.3 Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to wiring, conduit, fixtures.

1.2 Equipment Qualification

- 1.2.1 Products supplied shall be from a single manufacturer that has been continuously involved in the manufacturing of occupancy sensors for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.
- 1.2.2 All components shall be U.L. listed, offer a three (3) year warranty, and meet all state and local applicable code requirements.
- 1.2.3 Wall switch products must be capable of withstanding the effects of inrush current. Submittals shall clearly indicate the method used.

1.3 System Description

- 1.3.1 The objective of this section is to ensure the proper installation of the occupancy sensor-based lighting control system so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.
- 1.3.2 The occupancy sensor-based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.
- 1.3.3 Contractor shall warrant all equipment furnished in accordance to this specification to be undamaged, free of defects in materials and workmanship, and in conformance with the specifications. The supplier's obligation shall include repair or replacement, and testing without charge to the owner, all or any parts of equipment which are found to be damaged, defective or non-conforming and returned to the supplier. The warranty shall commence upon the owner's acceptance of the project. Warranty on labor shall be for a minimum period of one (1) year.

1.4 Submittals

- 1.4.1 Manufacturer shall substantiate conformance to this specification by supplying the necessary documents, performance data and wiring diagrams. Any deviations to this specification must be clearly stated by letter and submitted.

- 1.4.2 Submit a lighting plan clearly marked by manufacturer showing proper product, location and orientation of each sensor. The Manufacturer shall be responsible for providing an engineered layout with the optimal sensor location based on the site conditions. The Manufacturer/Supplier shall include for a mandatory visit during the Shop Drawing Stage to review existing conditions and advise of any improvements/alterations to product specifications required to suit the existing conditions. The Manufacturer/Supplier shall include for three (3) visits during Construction to review site conditions and field-direct the Contractor for optimal mounting locations of all sensors.
- 1.4.3 Submit any interconnection diagrams per major subsystem showing proper wiring.
- 1.4.4 Submit standard catalog literature which includes performance specifications indicating compliance to the specification.
- 1.4.5 Catalog sheets must clearly state any load restrictions when used with electronic ballasts.
- 1.5 System Operation**
- 1.5.1 It shall be the manufacturer's responsibility to verify all proper adjustments and train the owner's personnel to ensure owner's satisfaction with the occupancy system.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- 2.1.1 See Lighting Controls Schedule on the drawing for approved Manufacturers.
- 2.1.2 The listing of any manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the electrical contractor to ensure that any price quotations received, and submittals made are for sensors which meet or exceed the specifications included herein.

2.2 Products

- 2.2.1 See Lighting Controls Schedule on the drawing for approved products and requirements.
- 2.2.2 Passive infrared sensors shall utilize Pulse Count Processing and Digital Signature Analysis to respond only to those signals caused by human motion.
- 2.2.3 Passive infrared sensors shall utilize mixed signal ASIC which provides high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line), superior performance, and greater reliability.
- 2.2.4 Passive infrared sensors shall have a multiple segmented Lodif Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.
- 2.2.5 Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
- 2.2.6 Ultrasonic operating frequency shall be crystal controlled at 25 kHz within $\pm 0.005\%$

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- tolerance, 32 kHz within $\pm 0.002\%$ tolerance, or 40 kHz $\pm 0.002\%$ tolerances to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.
- 2.2.7 All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.
- 2.2.8 Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
- 2.2.9 All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.
- 2.2.10 In the event of failure, a bypass manual override shall be provided on each sensor. When a bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
- 2.2.11 All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
- 2.2.12 All sensors shall have UL rated, 94V-0 plastic enclosures.
- 2.3 Circuit Control Hardware - CU**
- 2.3.1 Control Units - For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to a minimum of two (2) sensors.
- 2.3.2 Relay Contacts shall have ratings of:
- 13A - 120 VAC Tungsten
 - 20A - 120 VAC Ballast
- 2.3.3 Control wiring between sensors and controls units shall be Class II, 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.
- 2.3.4 Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.

PART 3 - EXECUTION

3.1 Installation

- 3.1.1 It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have ninety (90) to one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall include for the supply and installation of an additional 5% sensors of each type in his/her pricing if such sensors are deemed to be required to cover the respective room properly and completely.
- 3.1.2 It is the contractor's responsibility to arrange a pre-installation meeting with the Manufacturer's factory authorized Representative, at the owner's facility, to verify placement of sensors and installation criteria in all locations. Arrange and pay for all such services under this RFQ.
- 3.1.3 Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. The contractor shall also provide, at the owner's facility, the training necessary to familiarize the owner's personnel with the operation, use, adjustment, and problem-solving diagnosis of the occupancy sensing devices and systems.
- 3.1.4 All sensors shall be set to delay timing as advised by Owner.

3.2 Factory Commissioning

- 3.2.1 Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustments and sensor placement to ensure a trouble-free occupancy-based lighting control system.
- 3.2.2 The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days' written notice of the scheduled commissioning date. Upon completion of the system fine tuning the factory authorized technician shall provide the proper training to the owner's personnel in the adjustment and maintenance of the sensors.
- 3.2.3 The Manufacturer, Supplier and Contractor shall allow for field modification of all sensor parameters after installation to best suit the Owner's requirements. Such modifications shall be done at no cost to the Owner provided the notification is provided prior to demobilization of the Contractor from site.

END OF SECTION