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END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, and Division 01 – General Requirements.

1.2 SUMMARY

- .1 This Section specifies requirements and instructions that are common to Electrical Division of the Specification and it is a supplement to each section and is to be read accordingly.
 - .1 Any item or subject which is shown, mentioned, or reasonably implied on either drawings or in the specifications, is considered to be properly and sufficiently specified and shown; and must be provided. Provide all material, labour, equipment, tools, consumables, etc. required to complete all the work of the Electrical Division
 - .2 These common works relate to all scope of work related within the Electrical Divisions which incorporates:
 - .1 Electrical Drawings
 - .2 Division 26 Electrical specification
 - .3 Division 27 Communications specifications
 - .4 Division 28 Electronic Safety and Security specifications
 - .3 These common works also have the following Sections which are applicable to all Sections within this Division and supplement this Section:
 - .1 26 05 02 – Firestopping and Smoke Seal Systems
 - .2 26 05 03 – Electrical Work Testing
 - .3 26 05 05 – Demolition and Revision Work
 - .4 26 05 53 – Identification for Electrical Systems
 - .2 Products furnished/supplied but not installed under this Section:
 - .1 Supply to Division 09 installer the access doors. Provide location where these doors and orientation these doors should be installed.
 - .3 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Division 02 Existing Conditions
 - .2 Division 03 Cast-in-Place Concrete

- .3 Division 09 Finishes
- .4 Division 26 Electrical
- .5 Division 27 Communications
- .6 Division 28 Electronic Safety and Security

1.3 PRICE AND PAYMENT PROCEDURES

- .1 Separate Prices:
 - .1 Under Separate Prices on the Bid Form, identify in the applicable space, costs for the following work. Refer to the Instructions to Bidders and Bid Form for further pricing instructions and details and price title definitions.
 - .1 Panel Relocation
 - .1 The cost for the relocation of existing panel RP-2RD located in second floor Multipurpose room L2-19 as shown on the Drawings, inclusive of all additional wiring, conduits, splice boxes, pullboxes, accessories, all miscellaneous mounting/fixing hardware for the complete re-installation, and reconnection of all feeder and branch circuit wiring.
- .2 Measurement and Payment:
 - .1 If a change to the work is requested, the Contractor to submit pricing for the change including an itemized list of the associated material and labour changes and costs. Apply mark-up as indicated in the Contract.
 - .2 A change must be approved by the Contractor before the work is to proceed. If work is performed without such approval, it is performed at the Contractor's or Sub-Contractors' risk.
 - .3 In the event of a disagreement by the Contractor over valuation of the change in work, resolution will follow the procedure outlined below:
 - .1 Labour hours are derived using the RSMeans Electrical Costing Book.
 - .2 Labour rates are as stated in the Instructions to Bidders.
 - .3 Material prices are "Trade" prices provided by a local supplier or distributor.
 - .4 Material requirements are obtained from field measurements.
 - .5 Major equipment prices are reasonably negotiated.
- .3 Progress Payment Breakdown:
 - .1 Submit, prior to submittal of the first progress payment draw, a breakdown of the cost of the electrical work to assist the Consultant in reviewing and approving monthly progress payment claims.

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- .2 The payment breakdown is subject to the Consultant's approval and progress payments will not be processed until an approved breakdown is in place. The breakdown is to include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning, and project closeout submittals.
 - .3 Breakdown to include the following line items as a minimum:
 - .1 Job costs (permits, bonds, mobilization, supervision, and job foreman)
 - .2 Demolition and relocation
 - .3 Distribution and service (panels and feeders)
 - .4 Mechanical equipment wiring (to include starters, motor control centres, disconnect switches, and wiring)
 - .5 Branch wiring (to include devices, cover plates, installation, and wiring)
 - .6 Lighting (to include fixtures, mounting, installation, and wiring)
 - .7 Lighting control system
 - .8 Extra-low voltage pathways (to include cable tray, wireways, conduits, sleeves, ductbank, and firestopping)
 - .9 Structured Cabling System (to include cabling, outlets, patch panels, racks, and telecommunication grounding)
 - .10 Rough-ins for audio-visual system
 - .11 Video surveillance system
 - .12 Access control system
 - .13 Fire alarm system modifications
 - .14 Miscellaneous equipment, systems, and associated wiring

1.4 REFERENCES

- .1 Definitions:
 - .1 The following are definitions of words found in electrical work Sections of the Specification and on associated drawings:
 - .1 "concealed" – means work hidden from normal sight in furred spaces, shafts, tunnels, ceiling spaces, walls and partitions
 - .2 "exposed" – means work normally visible, including work in electrical and equipment rooms and similar spaces
 - .3 "provide" (and tenses of provide) – means supply and install complete

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- .4 "install" (and tenses of install) – means install and connect complete
 - .5 "supply" – means supply only
 - .6 "finished area" - means any area or part of an area which receives a finish such as paint, or is factory finished
 - .7 "governing authority" and/or "regulatory authority" and/or "Municipal authority" – means all government departments, agencies, standards, rules and regulations that apply to and govern the electrical work and to which the work must adhere
 - .8 "Consultant" – means the Architect or Consulting Engineer who has prepared the Contract Documents on behalf of the Owner
- .2 Wherever the words "indicated", "shown", "noted", "listed", or similar words or phrases are used in the specification they are understood, unless otherwise defined, to mean that the product referred to is "indicated", "shown", "listed", or "noted" on the drawings.
 - .3 Wherever the words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected" or similar words or phrases are used in the specification or on the drawings they are understood, unless otherwise defined, to mean that work or product referred to is "approved by", "inspected by", etc., the Consultant.
 - .4 In the electrical specification, singular may be read as plural, and vice-versa.
- .2 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Division. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American National Standards Institute (ANSI):
 - .1 ANSI/ASHRAE/IES 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings
 - .2 Canadian Standards Association (CSA):
 - .1 CSA Standard Z320, Building commissioning
 - .3 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S1001 – Standard for Integrated Systems Testing
 - .2 CAN/ULC-S524 – Standard for Installation of Fire Alarm Systems
 - .3 CAN/ULC-S537 – Standard for Verification of Fire Alarm Systems

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Plan work well in advance to eliminate delivery, installation and co-ordination difficulties. Be held equally responsible with other Sections or Divisions to resolve interferences and to co-operate with other Sections to satisfactorily complete the project. Being there first will not be accepted as a legitimate reason.
- .2 Examination of site and documents:
 - .1 When estimating the cost of the work and prior to submitting a bid for the work carefully examine all the bid documents and visit the site to determine and review all existing site conditions that will or may affect the work and include for all such conditions in the bid price.
 - .2 Report to the Consultant, prior to bid submittal, any existing site condition that will or may affect performance of the work as per the drawings and specifications. Failure to do so will not be grounds for additional costs.
- .3 Drawings and Specification:
 - .1 Read the electrical work drawings in conjunction with all work drawings including but not limited to civil, landscaping, structural, architectural, sprinkler, and mechanical.
 - .2 The electrical drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of the building is to be taken at the site. Do not scale the drawings, and do not use the drawings for prefabrication work.
 - .3 The drawings are intended to convey the scope of work and do not show architectural and structural details. Include cost for all offsets, fittings, transformations, and similar products required as a result of obstructions and other civil, architectural and structural details but not shown on the drawings.
 - .4 The locations of equipment and materials shown may be altered, when reviewed by the Consultant. Include cost to meet requirements of the equipment and/or materials, other equipment or systems being installed, and of the building.
 - .5 Sections of the Electrical Division are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and the Sections are to be read as a whole.
 - .6 The electrical specification does not generally indicate the specific number of items or extent of material required. The specification is intended to provide product data and installation requirements. It is necessary to refer to drawing schedules, layouts, schematic diagrams, riser diagrams, and details to determine correct quantities.

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- .7 The electrical drawings and specification are intended to be cooperative. Perform all work that is shown, specified, or reasonably implied on the drawings but not mentioned in the specification, or vice-versa, as though fully covered by both.
 - .8 When the scale and date of the drawings are the same, or when the discrepancy exists within the specification, the costliest arrangement will take precedence.
 - .9 In the case of discrepancies between the drawings and specifications, the documents will govern in the order specified in the General Conditions, however, when the scale and date of the drawings are the same, or where the discrepancy exists within the specification, the costliest arrangement will take precedence.
- .4 Coordination:
- .1 Relation to other sections:
 - .1 Provide all cutting and patching required for the Section work by the appropriate trade at the expense of the Electrical Division, unless otherwise specified or shown. Refer to the Architectural Specifications and drawings for details of cutting and patching provisions and requirements.
 - .2 Provide all sleeves, inserts, hangers and core drilling of slabs, etc., required for completion of the Section work. Coordinate the location of inserts, sleeves, hangers, holes, back boxes, tubs, junction boxes, etc., with the respective Section into whose materials they are being installed. Extend all floor and roof sleeves 100 mm (4 in) above the finished levels, unless noted otherwise. Complete all roof sleeves with roof flashing and rain shields to ensure a weatherproof seal.
 - .3 Cut holes and install sleeves for electrical installations piercing fire, smoke, thermal, exterior, and acoustic separations to minimum sizes.
 - .1 Install firestopping and smoke seals in accordance with Section 26 05 02 – Firestopping and Smoke Seals.
 - .2 Seal all gaps on both sides of the separation by a qualified tradesman using materials and methods described in the applicable specification section, to maintain the appropriate rating, acoustic, thermal bridge, or water resistance. All costs for such will be paid for by the Electrical Division.
 - .3 If an existing penetration is not properly sealed to these standards, either provide new penetration for work and seal appropriately, or seal entire opening including existing penetrations. Where multiple Divisions are penetrating the same separation, group services and share sealing costs where appropriate.

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- .4 Provide all reinforcing required for electrical equipment housekeeping pads inside the building by Division 03 unless otherwise shown or specified at the expense of the Electrical Division. Accurate templates, dimensions, detail, etc., will be provided by the Electrical Division for proper location and size. Provide all other cast-in-place concrete and reinforcing required for work of the Electrical Division, such as fixture bases, by the Electrical Division, unless otherwise indicated. Provide all cast-in-place concrete and reinforcing of the Electrical Division will be provided in accordance with Division 03 – Cast-in-place Concrete.
 - .5 Where access doors are required for electrical installations, supply types with self opening screwdriver lock and positive latching mechanism to the appropriate Division 09 subtrade for installation by them in the walls or ceiling. Pay all cost for installation by Division 09. Access doors are required where electrical equipment is located behind non-accessible surfaces and where access to, or servicing of the equipment is necessary. The access door size and fire rating must be approved by the Contractor. Refer to the Architectural Specifications for details of access door installation requirements. Provide installations to avoid the need for access doors where indicated.
 - .6 Deliver all electrical equipment and fixtures to the site with the specified finish. Provide touch up painting of electrical equipment scratched on site. Finish painting of primed electrical equipment and all concealed or exposed conduit, boxes, etc., as required will be provided by Division 09. Where finish painting and priming is within existing exposed ceiling, cost to be carried by this Division.
 - .7 Immediately wrap and seal in plastic “bubble” wrap all fixtures, equipment, and system components delivered to the site and not contained in sealed cardboard cartons. Following installation, the items will be protected from dirt, dust, and damage with similar plastic wrap or protective enclosures until energized and put into full operation.
 - .8 Coordinate installation of switches, thermostats, and other devices together at one common location with installing Sections and obtain approval on site from the Contractor of exact arrangement.
- .2 Work in existing building:
- .1 Complete all demolition and revision work in accordance with Section 26 05 05 – Demolition and Revision Work.

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- .2 Visit the site to examine the existing conditions and make necessary allowances in bid price for demolition, removal, relocation, re-routing and reconnection of existing electrical equipment and wiring as required for the execution and completion of this project. In general, relocate existing services as required to accommodate new work and architectural changes. In areas being totally renovated, provide all remaining electrical demolition work and replace existing installations with new as shown. Remove all existing redundant installations prior to final acceptance. Include in the bid price extra charges for premium time and temporary provisions, if required, to complete the work as described and according to the schedule provided.
 - .3 Install all conduit and feeders through the existing building along routes shown on the drawings or approved on site by the Owner and Contractor. New installations will not necessarily be allowed along shortest routes but should follow routes indicated or corridors or routes of other services where possible if not shown.
 - .4 Unless noted otherwise, all existing electrical equipment and cabling which has not been removed or identified to be turned over to the Owner will become the property of the Division (for disposal or removal from the site as applicable) and have an appropriate salvage value included in the bid amount.
 - .5 Clean and paint, as appropriate, existing electrical equipment removed and indicated for re-use on this project. Refurbish or replace as required before re-installation.
 - .6 Re-routed as required wiring location in areas being altered or demolished, by re-feeding outlets or equipment required to remain in service to maintain the continuity of these services.
 - .7 Coordinate sequence of removal and relocation of existing equipment and wiring with the other Sections and conform to the requirements and conditions outlined.
 - .8 Provide adequate protection to existing cabling and equipment throughout the project and particularly where cabling and electrical equipment have become exposed to mechanical injury or moisture in the course of alterations or new construction.
 - .9 In some instances, new outlets and equipment are shown in the same location as the existing outlets, these may be fed through the existing conduits provided that the conduits and cabling are in good condition and are acceptable to the Electrical Authority as reusable. All unused conduit entrance openings will be sealed.
- .3 Power Interruptions:

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- .1 Keep service and distribution system power interruptions to a minimum. Coordinate power interruptions with the Owner and all other Subcontractors. Provide to the Owner written application for electrical interruptions from the Electrical Division indicating the date, time, and estimated duration of the interruption. Submit application for approval of the power interruptions to the Owners and Contractor at least two (2) weeks prior to the requested shut-down date.
 - .2 Prior to each shutdown or interruption, again inform the Owner in writing seventy-two hours in advance of the proposed shutdown or interruption and obtain written approval to proceed. Do not shutdown or interrupt any system or service without such written approval.
 - .3 Perform work associated with shutdowns and interruptions as continuous operations to minimize the shutdown time and to reinstate the systems as soon as possible and prior to any shutdown, ensure that all materials and labour required to complete the work for which the shutdown is required are available at the site.
- .5 Pre-purchased Electrical Equipment Contract:
- .1 It will be understood by the Electrical Division that they will be assigned the pre-purchased equipment contract, initiated by the Contractor in its entirety and be responsible for its execution and warranty.
 - .2 It remains the Electrical Division's responsibility to contact the indicated supplier and/or manufacturer prior to submitting their bid price to determine the exact provisions included with this equipment and the on-site installation, set-up, assembly, etc., requirements of the equipment.
 - .3 Submission of a Bid for the Electrical Division is a statement of obligation to satisfactorily complete all of the work of the Electrical Division. The exclusion in their Bid price of a fixed purchase amount from a specific supplier for pre-purchased items in no way relieves the Electrical Division of any responsibility for completion of the work in total.
 - .4 The Electrical Division will include in their bid price the value of any additional costs or mark-ups deemed appropriate by them for co-ordinating and arranging delivery, installation, set-up, assembly, etc., of the equipment and for assuming total responsibility for the installations including warranty requirements.
 - .5 The pre-purchased equipment package is as follows:
 - .1 Panel RP-2RB
 - .2 Panel RP-2RC
 - .3 Panel TPP-1 with isolated ground
 - .4 Isolation Transformer TX-TPP

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- .6 The Electrical Drawings do not generally show any Structural or Architectural details. Take any information involving accurate measurements of the building and site from the dimensional drawings.
 - .7 Dimensioned details and elevations generally take precedence over other conflicting details. However, where a conflict exists, clarify before starting installation. Make changes required to equipment or the installation, due to the Architectural or Structural details, without additional charges or expense to the Owner.
 - .8 Sequencing:
 - .1 Phasing of the Work:
 - .1 Phasing of the work is required to maintain the existing building in operation, all as specified in Division 01. Include all costs for phasing the work including all required "off hours" premium time labour costs.
 - .9 Planning and layout of the work, and associated drawings:
 - .1 Properly plan, coordinate, and establish the locations and routing of services with all subcontractors affected prior to installation such that the services will clear each other as well as any obstructions, including structural components of the building. Unless otherwise specified, the order of right-of-way for services is to be as follows:
 - .1 piping requiring uniform pitch
 - .2 piping 100 mm (4 in) diameter and larger
 - .3 large ducts (main runs)
 - .4 electrical cable tray and bus duct
 - .5 conduit 100 mm (4 in) diameter and larger
 - .6 piping less than 100 mm (4 in) diameter
 - .7 smaller branch ductwork
 - .8 conduit less than 100 mm (4 in) diameter
 - .2 Unless otherwise shown or specified, conceal all work in finished areas, and conceal work in partially finished or unfinished areas to the extent made possible by the area construction. Install conduit, raceway, and similar services as high as possible to conserve headroom and/or ceiling space. Install cable tray used for extra-low voltage cables as low as possible where removable finished ceilings are installed. Notify the Consultant where headroom or ceiling space appears to be inadequate prior to installation of the work.

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- .3 Revise or alter the arrangement of work that has been installed without proper coordination, study and review, even if it was completed in accordance with the Contract Documents, in order to conceal the work behind finishes, or to allow the installation of other work, at no additional cost. In addition, pay for the cost of alterations in other work required by the alterations to your work.
 - .4 All junction boxes, equipment and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.
- .10 Permits, Fees, And Certificates:
- .1 Apply for, obtain and pay for all permits required to complete the electrical work.
 - .2 Submit to the Consultant, all approval/inspection certificates issued by governing authorities to confirm that the work as installed is in accordance with the rules and regulations of the governing authorities. Pay any costs associated with issue of the certificates.
- .11 Workplace Safety:
- .1 Comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage, and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for all products where required and maintain one copy at the site in a visible and accessible location available to all personnel.
 - .2 Comply with all requirements of Occupational Health and Safety Regulations and all other regulations pertaining to health and safety, including worker's compensation/ insurance board and fall protection regulations.
 - .3 Asbestos, Mould, Lead Paint, PCBs, or other hazardous material: If at any time during the course of the work asbestos containing materials, black mould, lead paint, or any other such materials are encountered or suspected, immediately report the discovery to the Contractor and cease all work in the area in question. Do not resume work in affected areas until the material is properly identified as non-hazardous or the situation has been properly corrected with written approval from the Owner.

1.6 SUBMITTALS

- .1 Submittals under this Division to be in accordance with Division 01 – Submittal Procedures.
- .2 Regulatory Communications:
 - .1 Forward to the Contractor copies of all correspondence and instructions from the Electrical Authority or any other Authority having Jurisdiction for clarification and action.
- .3 Shop Drawings/Product Data:

- .1 Shop drawings are those prepared specifically for the Project. Product data sheets are copies of manufacturer's standard catalogue or literature.
- .2 Shop drawings and product data sheets must confirm that the product proposed meets all requirements of the Contract Documents.
- .3 Submit for review Shop Drawings and Product Data sheets, in electronic PDF format, covering all items or equipment to be installed under the Contract (faxed and generic documents are not acceptable). Shop drawings and product data sheets to show all physical properties, relevant performance, and installation information. The drawings and data required to generally be as outlined under each Section of the Specification but will not be restricted to the items listed. Distribute reviewed Shop Drawings and data sheets to other relevant Sections as required for completion of their related work.
- .4 All submitted Shop Drawings and data sheets must have been reviewed in detail by the Contractor and must bear their stamp. Should the drawings not have been reviewed and stamped, they will be rejected immediately.
- .5 Each shop drawing or product data sheet is to be properly identified with the project name and the product drawing or specification reference, for example "Lighting Fixture F1", and all shop drawing or product data sheet dimensions are to be either metric or imperial to match dimensions on the drawings.
- .6 Equipment will not be accepted on site until review of shop drawings and data sheets is complete. shop drawings or data sheets marked "Reviewed as Modified" are conditionally approved such that the Contractor to ensure equipment satisfies all Contract requirements. Delivery of equipment may proceed but final, corrected shop drawings and data sheets must be submitted prior to close of Contract.
- .7 This review is for the sole purpose of ascertaining conformance with the general design concept. This review will not mean that the reviewer approves the detail design inherent in the shop drawing, responsibility for which will remain with the Section submitting same, and such review does not relieve the Electrical Division of their responsibility for efforts or omissions in the Shop Drawings and data sheets or of their responsibility for meeting all requirements of the Contract Documents. The Electrical Division is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to the fabrication processes or to techniques of construction and installation, for all quantities indicated and for co-ordination of the work of all Sections.

1.7 CLOSEOUT SUBMITTALS

- .1 Submittals under this Section shall be in conformance with Division 01 – Closeout Procedures.
- .2 Operation and Maintenance Manuals:
 - .1 Forward to the Contractor "Maintenance and Instruction Manuals" within four (4) weeks of substantial completion of the project.

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- .2 Provide all closeout submittals in a digital format. Organize all individual electronic documents in directories similar to the tabs in a binder and filenames in plain English describing of the contents within each file. Provide all documents in unsecured PDF format with searchable text. Provide all audio and video content encoded in a format that can be viewed using standard codecs freely available on the most current version of Microsoft Windows operating system.
 - .3 Each manual will contain, but not be restricted to, the following information:
 - .1 each shop drawing (revised as per the reviewed drawings)
 - .2 each product data sheet (revised as per the reviewed drawings)
 - .3 equipment parts list
 - .4 recommended list of spare parts
 - .5 operating and maintenance instructions
 - .6 equipment installation details, construction and performance data
 - .7 summary of all training provided including full training documents and audio-visual content
 - .8 list of all manufacturing and equipment service depots including address, email and telephone numbers
 - .9 Electrical Authority final inspection certificate
 - .10 emergency lighting test results
 - .11 fire alarm verification certificate and test report
 - .12 fire alarm audibility report
 - .13 integrated systems testing report
 - .14 lighting recycling certificate
 - .15 cybersecurity reports
 - .16 telecommunications cabling test results including summary and comprehensive full results
 - .17 any other certificates, approval letters, etc.
 - .4 Provide qualified technicians to instruct the Owner's Representatives in the operation and maintenance of the systems and equipment included in the Electrical Division.
 - .3 Warranty Documents:
 - .1 Provide warranty documents in conformance with Division 01.

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- .2 Provide to the Consultant, all specified warranties, extended warranties, and free manufacturer extended warranties as applies to each individual section.
 - .3 The warranty period(s) commences on the date of Substantial Performance of the Work and shall be valid for the full duration specified.
 - .4 Submit warranties to the Consultant prior to Final Payment Certification.
- .4 Record Documents:
- .1 As-Built Drawings:
 - .1 During the progress of the work the Electrical Division will always keep on the site, a complete and separate set of prints and will note thereon clearly, neatly, accurately and promptly all Architectural, Structural, Mechanical and Electrical changes, revisions and additions to the work and deviations from the Contract Documents.
 - .2 Include accurate locations, depth, size, content, and type of all below grade pathways in these as-built drawings.
 - .3 Indicate also on the as-built drawings the location of access panels or removable ceiling tiles which cover equipment or junction boxes which may require future access or where conduit or wiring for future use is located.
 - .4 Prepare the final as-built drawings by a qualified draftsman in AutoCAD at the contractor's expense as an electronic copy and one hard copy to be submitted to the Contractor at the completion of the project with an application for a Certificate of Total Performance.
 - .5 Submit as-built drawings in electronic format. All documents will be in both AutoCAD and unsecured PDF format.
 - .5 Software:
 - .1 Submit copies of all software and licences required for operation and maintenance of equipment provided. Work with owner's representative to install, set up, and configure provided software on designated workstations or servers. Install, set up, and configure provided firmware or operating systems on designated equipment.
 - .2 Provide to Owner's representative all configuration requirements prior to installation including temporary credentials with level of administration access required, operating system, list of IP addresses required with mapping to tag or unique description, firewall configurations, and any other information to successfully install software or equipment.
 - .3 Pay for any software, firmware and operating system subscription fees for the warranty period and setup online accounts in conjunction with Owner's representative.

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- .4 Provide all software, firmware, and operating system user guides, installation manuals, cybersecurity certificates, and documentation in unsecured searchable PDF format.
 - .5 Prior to warranty completion, update or upgrade all installed software to most current version compatible with equipment installed. During warranty period if any cybersecurity threats or known vulnerabilities to software are provided by the equipment manufacturer or relevant third-party software company, send immediate notification to Owner with instructions to patch or update software, firmware, or operating system.

1.8 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 All work carried out under this Contract will comply with, but not be limited to the requirements of the latest edition of the following codes and regulations:
 - .1 Ontario Electrical Safety Code complete with Bulletins and Amendments.
 - .2 Ontario Building Code complete with Supplemental Bulletins and its referenced standards.
 - .3 Applicable Standards from CSA, ULC, and from other standards organizations indicated herein.
 - .4 All applicable Federal, Provincial, Municipal and Industry standards and regulations.
 - .2 All electrical items are to be certified and bear the stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, or bear a stamp to indicate special electrical authority approval.
 - .3 Requirements of the Contract Documents are to take precedence when they are more stringent than codes, ordinances, standards, and statutes.
- .2 Qualifications:
 - .1 Installer's:
 - .1 Installer/Applicator/Erector to have a minimum of 5 years' continuous Canadian experience successfully completing projects similar in size and complexity as the Work of this Division. Submit proof of experience upon Consultant's request.
 - .2 Provide all work for Division 26 Electrical by qualified journeyman electricians or apprentices, holding valid provincial Certificates of Qualification, and be supervised by a competent foreman.

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- .3 Provide all work for Division 27 Communications and Division 28 Electronic Safety and Security by qualified technicians with documented certifications by manufacturers of equipment being installed and be supervised by a competent foreman.
 - .4 The work of the Electrical Division will be reflected in the quality of installations - any unsatisfactory installations will be removed and replaced accordingly.
 - .5 Provide all changes or alterations to the installations of this project required by an authorized Inspector of an Authority Having Jurisdiction in accordance with the terms and conditions of Contract.
- .3 Certifications:
 - .1 Obtain all permits and certificates bearing upon this Trade and pay all fees and charges for same.

1.9 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials of this Division in accordance with Division 01 – Common Product Requirements.

1.10 PROJECT CONDITIONS

- .1 Existing Conditions:
 - .1 Visit the site of the building and examine the existing conditions in relation to the work to be done. The Electrical Division to be responsible to allow for any requirements which could have been revealed during such examinations.
 - .2 Prepare a complete set of Interference drawings in co-ordination with other Sections for all typical or critical locations to indicate site installation conditions where space is limited. Use field measurements to indicate accurate dimensions and configurations of all Electrical services in relation to Structural and Architectural conditions as well as Mechanical services. Coordination with other Sections in the preparation of Drawings and layout of the related work is imperative. Submit these interference drawings to the Contractor for review prior to proceeding with any related work, according to normal Shop Drawing procedure.

1.11 WARRANTY

- .1 All materials and installations of the Electrical Division will be guaranteed for a period of one year (or as specified in the Owner requirements, whichever is longer) from the date of final acceptance of the work unless otherwise specified, regardless of the extent of equipment manufacturer's warranties.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Alternate Manufacturers:

- .1 In some sections of this specification, materials and equipment are specifically described and named by manufacturer for the purpose of establishing a minimum standard of materials, product quality and other specified requirements.
- .2 The project systems design as per the Drawings and Specifications is based on the specified manufacturer's equipment but is intended to be appropriate for equivalent equipment of all other manufacturers contained listed in the Approved Manufacturers list within each Section.
- .3 Products of manufacturers listed as "Alternates" are subject to product data and shop drawing review to ensure that they are equivalent to the products of the specified manufacturer. Alternate manufacturer's equipment will conform to the space limitations imposed by the project and the intent as outlined in this Specification and Drawings.
- .4 The Electrical Division is encouraged to submit alternative proposals of manufacturers not listed in the Approved Manufacturers List of proposals or modified design with appropriate costs, delivery, and system design adjustments which they feel may be advantageous considerations for the project.

3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions:

- .1 Examine all work of other Sections upon which the Work of each Section depends.
- .2 Do not proceed with installation until all wet work such as concrete and painting has been completed and thoroughly dried.
- .3 Report in writing to the Consultant/Project Manager any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work of each Section.
- .4 Do not proceed with Work of each Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.
- .5 Commencement of work implies acceptance of existing conditions and work by other Sections.

3.2 PREPARATION

.1 Protection of in-place conditions:

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- .1 Provide temporary protection of adjacent areas and surfaces by means of masking (enclosures) where necessary to prevent contamination by Work of each Section.

3.3 INSTALLATION

- .1 Installation of equipment:
 - .1 Unless otherwise specified all equipment is to be installed in accordance with the equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations. Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions.
 - .2 Ensure that proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Remove and replace any equipment which does not meet this requirement.
- .2 Scaffolding, Rigging, And Hoisting:
 - .1 Unless otherwise specified or directed, supply, erect and operate all scaffolding, rigging, hoisting equipment and associated hardware required for your work. Immediately remove from the site all scaffolding, rigging, and hoisting equipment when no longer required.

3.4 CONTRACT DRAWINGS

- .1 The drawings of this Division are performance drawings and indicate general arrangement of the work. They are diagrammatic except where specific details are given.
- .2 Obtain accurate dimensions from the architectural and structural drawings, or by measurement. Location and elevation of services are approximate. Verify them before construction is undertaken.
- .3 Make changes where required to accommodate structural conditions, beams, columns, etc. Obtain Consultant's approval before proceeding.
- .4 Adjust the location of materials and/or equipment as directed without adjustment to Contract Price, provided that the changes are requested before installation and do not affect material quantity. **Note that equipment, devices and/or conduit/wiring may be relocated up to 10 feet (3 m) in any direction without a change to the contract price.**
- .5 Note that the layout and orientation of the electrical equipment/devices on the architectural reflected ceiling drawings may differ from that shown on the Drawings. Make the installation in accordance with the latest architectural ceiling drawings. Provide the equipment as specified and/or shown on the documents of this Division.

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- .6 The drawings of this Division are intended for tender pricing. The quantities and quality to be included in the bid price shall be based on the layout and specifications as shown on the documents. If there is a difference in quantity between the architectural and drawings of this Division, base the contract price on the greater quantity.
 - .7 Prepare installation (construction) drawing to reflect the latest architectural ceiling layout.

3.5 SITE QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 Conduct field inspection and testing as specified in Division 01
- .2 Non-Conforming Work:
 - .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight or errors.
 - .2 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to the satisfaction of the Consultant at no additional cost to the Owner.
- .3 Manufacturer Services:
 - .1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for the equipment/system manufacturer's authorized representative to visit the site to examine the installation, and when any required corrective measures have been made, to certify in writing to the Consultant that the equipment/system installation is complete and in accordance with the equipment/system manufacturer's instructions.

3.6 SYSTEM STARTUP

- .1 Perform all testing in accordance with Section 26 05 03 – Electrical Work Testing.
- .2 Conduct acceptance tests to demonstrate that the equipment and systems meet the specified requirements. Conduct tests as soon as conditions permit. Make all changes, adjustments or replacements required as the preliminary tests may indicate.
- .3 Operate all the equipment under normal conditions for a minimum period of five days as a start-up test. Defects disclosed must be repaired and tests repeated until pronounced satisfactory.
- .4 Conduct final acceptance tests in the presence of the Contractor. Invite Consultant and Owner to attend with a minimum of one week's notification.
- .5 Provide the services of one journeyman electrician and all ladders, tools, consumables, and associated equipment to assist the Contractor in carrying out the test.

3.7 ADJUSTING

- .1 Adjust moving or operating parts to operate/function smoothly and properly.

3.8 CLEANING

- .1 Clean work area daily in accordance with Division 01 – Cleaning and Waste Management.
- .2 Remove all excess materials from site as Work proceeds and at completion.
- .3 On completion of the Work remove all tools, containers, surplus materials, equipment, waste, etc.; and leave site neat, clean, and tidy to the satisfaction of the Owner.
- .4 Clean and make good surfaces soiled or otherwise damaged because of Work of each Section at no additional cost to the Owner.
- .5 Leave surfaces clean and ready for subsequent Work.

3.9 CLOSEOUT ACTIVITIES

- .1 Equipment and System Commissioning:
 - .1 After successful start-up and prior to Substantial Performance, commission the electrical work in accordance with requirements of CSA Z320, Building Commissioning. Use commissioning sheets included with the CSA Standard, and any supplemental commissioning sheets required. Submit final commissioning data sheets, project closeout documents, and other required submittals.
- .2 Equipment and system Operation and Maintenance (O&M) demonstration and training:
 - .1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.
 - .2 Train the Owner's designated personnel in all aspects of operation and maintenance of equipment and systems as specified in electrical work Sections of the Specification. All demonstrations and training is to be performed by qualified technicians employed by the equipment/system manufacturer/supplier.
 - .3 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Operating and Maintenance Manuals are to be used during the training sessions, and training modules are to include:
 - .1 Operational Requirements and Criteria: requirements and criteria are to include but not be limited to equipment function, stopping and starting, safeties, operating standards, operating characteristics, and limitations
 - .2 Troubleshooting: troubleshooting is to include but not be limited to diagnostic instructions, test and inspection procedures

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- .3 Documentation: documentation is to include but not be limited to equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like
 - .4 Maintenance: maintenance requirements are to include but not be limited to inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any special tools
 - .5 Repairs: repair requirements are to include but not be limited to diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory
 - .4 Assemble the training modules into a training manual and submit a copy to the Consultant for review prior to scheduling training. Ensure that each participant in each training session has all required training material.
 - .5 Schedule demonstrations and training at mutually agreed to times with a minimum of 7 working days' notice.
 - .6 Demonstration and Training Confirmation: Obtain a list of personnel to receive demonstration and training from the Consultant, and have each participant sign the list to confirm that they understood the demonstration and training session.

3.10 PROTECTION

- .1 Protect installed materials to prevent damage by other trades for the duration of the construction period. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 01 and Section 26 05 00 Common Work Results for Electrical.

1.2 SUMMARY

- .1 This Section specifies fire stopping and smoke seal requirements that are common to electrical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.3 REFERENCES

- .1 Acronyms/Abbreviations:
 - .1 MSDS: Material Safety Data Sheet
- .2 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S101 Standard Method of Fire Endurance Tests of Building Construction and Materials
 - .2 CAN/ULC-S115 Standard Method of Fire Tests of Firestop Systems

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 26 05 00 Common Work Results for Electrical.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets and MSDS for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements

1.5 CLOSEOUT SUBMITTALS

- .1 Submittals under this Section shall be in conformance with Section 26 05 00 Common Work Results for Electrical.
- .2 Test and Evaluation Reports:

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- .1 Submit a letter of proper firestopping and smoke seal certification as specified in Part 3 of this Section.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer:
 - .1 Installer shall have a minimum of 5 years' continuous Canadian experience successfully completing projects similar in size and complexity as the Work of this Section. Submit proof of experience upon Consultant's request.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .2 A/D Fire Protection Systems "FIREBARRIER"
 - .3 Tremco Fire Protection Systems "TREMstop"
 - .4 3M "Fire Barrier"
 - .5 Hilti Firestop Systems
 - .6 Specified Technologies
 - .7 Comparable Products from manufacturers listed herein will be accepted provided they meet requirements of this Specification.
- .2 Requests for substitutions shall be made in conformance with Section 26 05 00 Common Work Results for Electrical.

2.2 MATERIALS

- .1 Firestopping and Smoke Seal System Materials
 - .1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN4-S115, Standard Method of Fire Tests of Firestop Systems and CAN/ULC-S101, Standard Method of Fire Endurance Tests of Building Construction and Materials for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than the fire resistance rating of surrounding fire rated construction.

- .2 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with the firestopping manufacturer's recommendations and the ULC tested assembly.

3 EXECUTION

3.1 PREPARATION

- .1 Abide by the following requirements:
 - .1 examine substrates, openings, voids, adjoining construction and conditions under which the firestop and smoke seal system is to be installed, and confirm compatibility of surfaces
 - .2 verify penetrating items are securely fixed and properly located with the proper space allowance between penetrations and surfaces of openings
 - .3 report any unsuitable or unsatisfactory conditions to the Contractor and Consultant in writing, prior to commencement of work, and note that commencement of work will mean acceptance of conditions and surfaces
 - .4 mask where necessary to avoid spillage and over coating onto adjoining surfaces, and remove stains on adjacent surfaces

3.2 INSTALLATION

- .1 Where electrical work penetrates fire rated construction, provide ULC listed and labelled firestopping and smoke seal materials installed in accordance with requirements of CAN4-S115 (ratings F, FT, FH, and FTH as required), CAN/ULC-S101, and all other governing authorities to seal the penetrations.
- .2 Application: Conform to the following application requirements:
 - .1 use an experienced applicator approved by the manufacturer of the firestopping material manufacturer
 - .2 prime substrates in accordance with the product manufacturer's written instructions
 - .3 provide temporary forming as required and remove only after materials have gained sufficient strength and after initial curing
 - .4 tool or trowel exposed surfaces to a neat, smooth, consistent finish
 - .5 remove excess compound promptly as work progresses and upon completion
 - .6 at all cable transit locations, seal the perimeter of the angle iron framing on both sides of the wall or slab with ULC listed and labelled sealant materials to provide a positive smoke seal
- .3 Inspection:

.4 Certification:

3.3 SITE QUALITY CONTROL

.1 Site Tests and Inspections:

.1 Notify the Consultant when the work is complete and ready for inspection, and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies. Arrange for final inspection of the work by the Municipal Building Inspector prior to concealing or enclosing work. Make any corrections required.

.2 Non-Conforming Work:

.1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight or errors.

3.4 CLOSEOUT ACTIVITIES

.1 Certification:

.1 On completion of the firestopping and smoke sealing installation submit a letter of assurance to the Consultant certifying that the firestopping and smoke sealing installation has been carried out throughout the building to all electrical service penetrations and that the installation has been done in strict accordance with the requirements of the Provincial Building Code, any applicable local Municipal Codes, ULC requirements, and the manufacturer's instructions.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide electrical work testing, including but not limited to the following:
 - .1 General Electrical Work Testing
 - .2 Distribution Short Circuit, Protection Coordination and Arc Flash Study

1.3 SUBMITTALS

- .1 Submit as part of shop drawing submission, copies of:
 - .1 electrical distribution system protective device coordination study and short circuit calculations;
 - .2 system and equipment testing reports;
 - .3 arc flash analysis report;
 - .4 copies of certificate of approvals from local governing inspection authorities.
- .2 Submit electrical distribution system protection coordination study and short circuit calculations reports prior to or with proposed shop drawings of major electrical distribution equipment. Allow in shop drawing process, sufficient time for Consultant to review and make comments and for Contractor and equipment vendors to incorporate Consultant comments, necessary revisions and results of reports into equipment shop drawings. Do not order equipment until shop drawings have been reviewed with Consultant and Consultant's comments have been addressed. Time for this shop drawing review process will be at Consultant's discretion, but typically allow for 15 working days for initial review submission with additional 10 working days added to accommodate each resubmission.
- .3 The Engineer completing the study shall allow for a minimum of two (2) revisions and/or adjustments. These revisions and/or adjustments do not refer to complete re-designs of the electrical distribution system. The Engineer completing the study shall work with the Owner and the Consultant to ensure that all details are captured in the review process. The completion of the study is expected to be an iterative process, in which the Engineer completing the study will receive comments back that require clarification or adjustments to the report.

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- .4 If formal completion of studies and reports may cause delay in equipment manufacture, direction from Consultant may be obtained for preliminary submittal of sufficient data to ensure that selection of device ratings and characteristics will be satisfactory. Subsequently, provide formal studies and reports to verify preliminary findings.
 - .5 Submit after completion of factory testing, copies of completed product testing reports.
 - .6 Submit after installation and testing, copies of:
 - .1 completed testing reports with completed test results sheets;
 - .2 certificate of approvals from local governing authorities, manufacturers' of systems and equipment and testing companies.

2 PRODUCTS

2.1 NOT APPLICABLE

3 EXECUTION

3.1 INSTALLERS

- .1 Testing Organization List:
 - .1 Distribution Short Circuit, Protection Coordination and Arc Flash Study of the electrical distribution system equipment is to be performed by one of the following companies:
 - .1 GT Wood
 - .2 EnKompass Power & Energy
 - .3 Brosz
 - .4 Spark Power
 - .5 Other companies approved by the Owner

3.2 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Provide temporary protection of adjacent areas and surfaces by means of masking (enclosures) where necessary to prevent contamination by Work of this Section.

3.3 SITE QUALITY CONTROL

- .1 General Electrical Work Testing Requirements

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- .1 Satisfactorily perform all testing required by governing authorities, Codes, Regulation and the Specification, including general testing specified below. Prepare and sign test reports to confirm satisfactory completion of testing and submit as specified in Part 1 of this Section.
 - .2 Perform testing to suit phasing of the work, as applicable. Phasing shall be clearly marked at both the origin and destination end of the conductors. Where required, use a rotation meter/instrument to determine and confirm rotation is clockwise or counter-clockwise. This information shall be noted on the as-built drawings.
 - .3 Leaks, Grounds, and Crosses: After luminaries, switches, receptacles, motors, signals, and similar equipment has been installed, whether or not the work has been installed as part of the work of this Division of the Specification or by other Divisions (telephone system excepted), test the work to ensure that there are no leaks, grounds, or crosses.
 - .4 Motor Operation: Test and establish proper motor rotation, measure full load running currents, and check overload elements. Report to the Consultant any discrepancies that are found. Existing motors that have been disconnected and reconnected as part of the electrical work must be checked with rotation meter, and be responsible for any damage caused by reverse rotation.
 - .5 Branch Circuit Voltage Drop: Demonstrate to the Consultant that branch circuit voltage drop is within specified limits.
 - .6 Spares: Every fused protection shall provided with a minimum of 3 spares (one for each phase) and clearly marked for the device specific to the coordination study to ensure the proper fuse will be used if a replacement is needed.
- .2 Distribution Short Circuit, Protection Coordination and Arc Flash Study
 - .1 **Preliminary** Short Circuit and Protection Coordination Study
 - .1 Immediately after award of Contract liaise with local electrical supply authority for information on relays and other protective devices installed on their system and substations which affect co-ordination of site electrical distribution system.
 - .2 Immediately after award of Contract liaise with proposed manufacturer of electrical distribution equipment to obtain appropriate information and recommended devices to obtain co-ordination of electrical distribution system.

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- .3 Review and survey existing systems and/or obtain where available, coordination study of existing systems to use in ensuring proper protective device coordination and suitable withstand rating for entire existing, additional and revised distribution equipment/systems. Where existing studies are not available, survey existing systems and prepare additional studies as required to provide full and proper coordination and suitable withstand rating of entire existing, revised and additional distribution equipment/systems.
 - .4 Prepare preliminary protection coordination and arc flash study, and calculate available fault currents of the system. Combine into preliminary report and submit electronic copy to Consultant for review.
 - .5 Prepare report to typical standards as specified in respective protection coordination study and short circuit calculation report articles in this Section.
- .2 Final Short Circuit, Protection Coordination and Arc Flash Study**
- .1 Prepare the final short circuit, protection coordination and arc flash study based on the installed equipment, wiring and infrastructure
 - .2 Ensure all comments from the preliminary study are incorporated in the final study.
 - .3 Submit reports as part of shop drawing submission as specified in Part 1 - Submittals. Ensure that results and Consultant's reviewed comments from these reports are incorporated into electrical distribution equipment shop drawings. Check for selective coordination of devices and confirm withstand ratings of equipment meet results from reports.
 - .4 The electrical distribution system protective devices have been selected such that protection is adequate and proper coordination is possible, however, since differences do exist between manufacturers of equipment, some changes in trip ratings or relay settings may be necessary and are to be performed as part of the work, prior to energizing the electrical distribution system.
 - .5 Short Circuit and Protection Coordination Study: Immediately upon notification of award of Contract, arrange for the testing company to perform the following:
 - .1 cooperate with and obtain from manufacturers of the distribution system equipment a list of equipment requiring protective devices to be used, and along with the manufacturers, ensure that proper control and protective devices are selected such that they can be properly coordinated
 - .2 prepare, as soon as possible, a set of coordination curves on proper time current characteristic graph paper and submit to the Consultant, accompanied by supporting symmetrical as well as asymmetrical fault current calculation data with tabulations to verify protection of the various distribution system elements under maximum and minimum fault conditions at the various points in the system

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- .3 plot the time current characteristic curves for the following:
 - .1 main and feeder protective devices at voltage levels used in the distribution system
 - .2 protective devices associated with the largest motor in each motor control centre, the refrigeration machine compressors (as applicable), and the largest lead fed from each distribution panelboard
 - .3 emergency power engine generator set protective devices, damage curves, and current decrement curves
 - .4 where relays, breakers, etc., do not perform to approved coordination curves they are to be revised at no cost as part of the work
 - .6 Review the existing distribution equipment and, where possible, obtain the existing distribution system coordination study to determine the best coordination between the existing and new equipment. If an existing coordination study is not available, survey the existing equipment and prepare calculations of proper coordination between the new and existing equipment. Where defective or incorrectly applied relays or breakers are found, clearly identify the problem on curves submitted with the report and suggest a recommended course of action.
 - .7 The on-site test and coordination study of distribution system protective devices is to include, as applicable:
 - .1 testing, cleaning when necessary, and calibrating relays and circuit breaker trip devices (calibration) of protective devices is to conform to requirements of approved coordination (curves).
 - .2 a function test of associated control device
 - .3 replacement of any fuses destroyed during tests
 - .4 an acceptance test in the presence of and to the satisfaction of the Consultant
 - .5 the presence at the site, for the length of time required, of qualified equipment manufacturer's representatives
 - .6 an insulation resistance test of "load" side feeders with respect to ground
 - .7 testing of motor control centres, motor starters, and where supplied as part of the electrical work, viable speed drives

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- .8 Arc Flash Hazard Analysis: Perform an arc hazard analysis and prepare and submit a report with calculations to determine the flash protection boundary and the incident energy at locations in the electrical distribution system (switchboards, switchgear, motor control centres, distribution panelboards, bus duct, splitters), and other equipment where work could be performed on energized equipment. Include significant locations in systems fed from transformers 125 kVA and greater, and specify safe working distances for calculated fault locations based on the calculated arc flash boundary considering an incident energy of 1.2 cal/cm². Provide minimum 90 mm x 125 mm (3½ in x 5 in) thermal transfer type high adhesion polyester warning labels at each work location and piece of equipment analyzed. Labels are to have an orange header with machine printed wording warning, ARC FLASH HAZARD, and the following information:
- .1 nominal voltage
 - .2 flash protection boundary
 - .3 hazard risk category
 - .4 incident energy
 - .5 working distance

3.4 TRAINING

- .1 The Engineer completing the studies and Contractor shall include for two (2) training sessions (minimum of 4 hours each) for the Owner's representatives on the protective device settings and the Arc Flash risk of the equipment in the building.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 01 and Section 26 05 00 Common Work Results for Electrical.

1.2 SUMMARY

- .1 This Section specifies requirements, criteria, methods and execution for electrical demolition work that are common to one or more electrical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Canadian Standards Association (CSA):
 - .1 CSA S350 Code of Practice for Safety in Demolition of Structures

1.4 CLOSEOUT SUBMITTALS

- .1 Submit documentation to confirm that all PCB material and/or equipment containing PCB material has been properly removed and disposed of as applicable.
- .2 Test and Evaluation Reports:
 - .1 Submit documentation to confirm that all PCB material and/or equipment containing PCB material has been properly removed and disposed of as applicable.

2 PRODUCTS

2.1 NOT APPLICABLE

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine all work of other Sections upon which the Work of this Section depends.
 - .2 If hazardous materials and/or waste not listed in the Specification is found, stop the associated work and notify the Owner and Consultant immediately and await directions.

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- .3 Report in writing to the Consultant/Project Manager any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work of this Section.
 - .4 Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.
 - .5 Commencement of work implies acceptance of existing conditions and work by others.

3.2 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Provide temporary protection of adjacent areas and surfaces by means of masking (enclosures) where necessary to prevent contamination by Work of this Section.
- .2 Disconnection and Removal of Existing Electrical Work
 - .1 Where indicated on the drawings, disconnect and remove existing electrical work, including hangers, supports, etc. Disconnect at the point of supply, remove obsolete connecting services and make the system safe. Cut back obsolete conduit behind finishes and cap unless otherwise specified.
 - .2 The scope and extent of the demolition or revision work is only generally indicated on the drawings. Estimate the scope, extent and cost of the work at the site during the bidding period scheduled site visit(s).
 - .3 Where deemed necessary by the Owner and Consultant, existing shafts, walls, and inaccessible ceilings will be opened by the Owner to permit site visit inspection of services to be removed/revised as part of the work but usually concealed behind such construction.
 - .4 Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at the site during bidding period site visits will not be allowed.
 - .5 If any re-design is required due to discrepancies between the electrical drawings and site conditions, notify the Consultant who will issue a Site Instruction. If, in the opinion of the Consultant, discrepancies between the electrical drawings and actual site conditions are of a minor nature, the required modifications are to be done at no additional cost.
 - .6 Where existing electrical services extend through, or are in an area to serve items which are to remain, maintain the services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during the renovation work, so as to be concealed behind new or existing finishes.
 - .7 Unless otherwise specified, remove from the site and dispose of all existing materials which have been removed and are not to be relocated or reused.

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- .8 Under no circumstance shall bare or unprotected conductors be left exposed in any area of removal or re-work. If temporary feeds are necessary, they shall meet ESA code regulations and be protected from contact and traffic during the period of transition or time left for re-working.
 - .3 Interruption to and Shut-Down of Electrical Services and Systems
 - .1 Co-ordinate all shut-down and interruption to existing electrical systems with the Owner. Generally, shut-downs may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday morning.
 - .2 Upon award of contract, submit a list of anticipated shut-down times and their maximum duration.
 - .3 Prior to each shut-down or interruption, inform the Owner in writing seventy-two hours in advance of the proposed shut-down or interruption and obtain written approval to proceed. Do not shut-down or interrupt any system or service without such written approval.
 - .4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.
 - .4 Roofing Work
 - .1 Where roof revisions and/or replacements are part of the project, include for disconnecting, lifting, or temporarily removing electrical equipment and electrical connections to other roof mounted equipment as required to permit completion of the roofing work, and for re-installing/re-connecting the equipment when the roofing work is complete.

3.3 CLEANING

- .1 Complete cleaning of this Section in accordance with Section 26 05 00 Common Work Results for Electrical.

3.4 PROTECTION

- .1 Protect installed materials to prevent damage by other trades for the duration of the construction period. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide wire and cable, including but not limited to the following:
 - .1 This Section, "Wire and Cable", shall apply to all systems of this Contract. Variations or alterations of the requirements for a system, will be specified in that system section.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 26 05 53 – Identification for Electrical Systems
 - .2 Section 26 05 33 – Raceway and Boxes for Electrical Systems
 - .3 Section 27 10 00 – Structured Cabling

1.3 QUALITY ASSURANCE

- .1 For installation of Mineral Insulated Wire, persons trained and experienced with this product will be employed in its installation.

2 PRODUCTS

2.1 MATERIALS

- .1 Distribution And Branch Circuit Conductors
 - .1 Conductors to and including 10 AWG are to be solid or stranded type. Conductors larger than 8 AWG are to be stranded. All conductors are to be constructed from 98% conductive copper and are to be approved for 600 volts. Conductors are to be colour coded, factory identified on the insulation with the manufacturer's name, conductor size and metal, voltage rating, and CSA type and designation. Conductors are to be as follows:
 - .1 "T-90 Nylon" single conductor in accordance with CSA C22.2 No. 75, Thermoplastic-Insulated Wires and Cables, 90° C (195° F) rated, PVC insulated and nylon covered.
 - .2 "RW-90" single conductor in accordance with CAN/CSA C22.2 No. 38, Thermoset-Insulated Wires and Cable, 90° C (195° F) rated, X-link polyethylene insulated.

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- .3 "AC-90" flexible cable to CSA C22.2 No. 51, Armoured Cable, with 90° C (195° F) rated, X-linked polyethylene insulated conductors, a concentric ground conductor, and an interlocking aluminium armour jacket.
 - .4 "A90 ISO-BX" flexible cable to CSA C22.2 No. 51, Armoured Cable, with 90° C (195° F) rated, X-linked polyethylene insulated conductors, a concentric bare ground conductor, an insulated ground conductor, and an interlocking aluminium armour jacket.
 - .5 Equal to Nexans Canada "Corflex" II RA90 flexible cable in accordance with requirements of CSA C22.2 No. 123, Aluminium Sheathed Cable, consisting of single or multiple copper conductors with X-link polyethylene insulation enclosed in a liquid and vapour-tight solid corrugated aluminium sheath and, as required, an overall PVC jacket.
 - .6 Equal to Nexans Canada "Firex II" TECK 90 cable in accordance with requirements of CSA C22.2 No. 131, Type TECK 90 Cable, consisting of single or multiple copper conductors with X-link polyethylene insulation enclosed in a liquid and vapour-tight solid corrugated aluminium sheath and, where required, an overall PVC jacket.
- .2 Low Voltage (24 Volt) Conductors
 - .1 "T-90" or "RW90" stranded copper conductors as specified above.
 - .2 Equal to Nexans Canada "Securex II" FAS/LVT/FT1300 volt wire to CSA C22.2 No. 208, Fire /Alarm and Signal Wire, 105° C (220° F) rated, consisting of solid copper conductors (stranded for control wiring), flame retardant PVC insulation, an aluminium/Mylar optional shield with a #22 AWG tinned copper insulation and a drain wire, and, if required for the application, interlocking aluminium armour with or without an overall jacket.
 - .3 Communications Cable:
 - .1 All cabling used for Ethernet, Telephone, or other IP-based systems shall follow cabling requirements as outlined in 27 10 00 Structured Cabling.
- .3 Connectors
 - .1 Conductors in Conduit: Except as noted, CSA certified flame resistant thermoplastic, colour coded twist type connectors to suit the system voltage and wire gauge.
 - .2 Conductors 3/0 AWG and Larger: Long barrel, double crimp, compression type lug connectors, unless otherwise specified.
 - .3 Armoured Cable: Except as noted, proper squeeze type connectors and plastic anti-short bushings at terminations in accordance with requirements of CSA C22.2 No. 18.3, Conduit, Tubing and Cable Fittings.
 - .4 Corflex/Teck Cable: Connector and termination hardware supplied by the cable manufacturer to suit the application.

.4 Conductor Pulling Lubricant

- .1 Equal to Ideal Industries "Yellow 77" or "ClearGlide", as required.
- .2 French Chalk or Talcum Powder conductor pulling lubricant.

3 EXECUTION

3.1 INSTALLATION

.1 Conform to the following conductor installation requirements:

- .1 Conductor Routing: Conductor routing indicated on the drawings is schematic and approximate. Determine exact routing and conductor lengths at the site. Route conductors to avoid interference with other work. Unless otherwise specified or shown install conductors parallel to building lines.
- .2 Conductor Pulling: When pulling conductors into conduit or duct use lubricant and ensure that the conductors are kept straight and are not twisted. For isolated power centre "load" side power wiring, use only French Chalk pulling lubricant.
- .3 Securing/Supporting Conductors: Conform to the following requirements:
 - .1 neatly secure exposed conductors in equipment enclosures with proper supports and/or ties
 - .2 support flexible armoured cable in ceiling spaces and stud walls with steel two hole cable straps to Code requirements
- .4 Conductor Splicing: Generally, conductor splicing is not permitted unless otherwise approved by the Consultant, and if approved splicing is subject to the following conditions:
 - .1 splicing is permitted to extend existing conductors
 - .2 for thermoplastic insulated conductors, splices are to be made within an approved electrical box with mechanical compression connectors to suit the type and size of conductors, and the box(es) are to be properly identified and locations are to be indicated on "as-built" drawings.
 - .3 where multiple conductors are spliced:
 - .1 use properly sized Wing Nut connectors, or approved equal, for up to two 8 AWG or three 10 AWG conductors
 - .2 use pressure type sleeve cable connectors, splices, tee's, etc. for all larger size connections and terminations
 - .4 insulate all bare surfaces of splices with Scotch No. 33 tape, heat shrink sleeving, or equivalent.

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- .5 conductors connected to ground rods for service or equipment grounding or to building structural or architectural elements to be terminated, connected and spliced using:
 - .1 a thermoweld process
 - .2 an approved non-mechanical compression type connectors where serviceable
 - .6 install service and feeder conductors as continuous lengths without breaks, measured and cut based on field-measured dimensions.
 - .7 do not splice mineral insulated "MI" cable
 - .8 do not splice "Corflex" cable unless justified by cable pulling tension calculations and when approved by the Consultant, and, if approved, locate splices where directed by the Consultant
 - .5 Conductor Termination:
 - .1 Where a single solid conductor is terminated in a device under one screw or clamping mechanism, no additional terminating hardware is required.
 - .2 Where multiple or stranded conductors are terminated in a device under one screw or clamping mechanism, self insulated crimpon cable ends or approved equal shall be used up to and including 10 AWG sized conductors. Approved compression lugs shall be used for larger conductor sizes.
 - .6 Grounding and bonding conductors:
 - .1 Insulated grounding or bonding conductors shall be the same type as the line conductors.
 - .2 Each feeder and branch circuit shall be provided with a separate ground conductor sized in accordance with Electrical Code regulations. All 120 V or 347 V (single phase) branch circuits shall be provided with a separate neutral conductor for each circuit.
 - .2 Installation of distribution and branch circuit conductors
 - .1 Install all required conductors.
 - .2 Non-Fire Rated Conductors: Unless otherwise specified herein or on the drawings, non-fired rated conductors are to be used as follows:
 - .1 unless otherwise specified, conductors in accessible ceiling spaces, and in furniture systems to luminaries and wiring devices – AC90 flexible armoured cable, maximum 6 m (20 ft) run permitted
 - .2 for isolated power system wiring – RW90.

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- .3 for conductors except as specified above or elsewhere in the Specification or on the drawings – T90 Nylon or RW90
 - .3 “Corflex” Cable Installation Requirements: Install “Corflex” cable in accordance with the manufacturer’s instructions, including the following requirements:
 - .1 support and secure overhead suspended “Corflex” cable on a system of cable tray where indicated
 - .2 secure individual cables to cable tray, or where shown, directly to building surfaces by means of single screw non-ferrous clamps
 - .3 ground and bond single conductor cable at both ends where the sheath currents do not affect the cable ampacity
 - .4 for certain areas, where the sheath currents will reduce the cable ampacity, ground and bond the cable at the supply end and isolate the cable at the load end as recommended by the cable manufacturer, and provide a 3/0 AWG green TW ground conductor for each cable, all as per Section 10 of the Electrical Code
 - .4 “Teck” Cable Installation Requirements: Install “Teck” cable in accordance with the manufacturer’s instructions, including the following requirements:
 - .1 support and secure overhead suspended “Teck” cable tray where indicated
 - .2 secure individual cables to cable tray or, where shown, directly to building surfaces by means of single screw non-ferrous clamps
 - .3 terminate cable with lugs and termination kits supplied with the cable
 - .5 Conductor Sizing:
 - .1 do not use conductors smaller than 12 AWG in systems over 30 volts.
 - .2 conductor sizes indicated on the drawings are minimum sizes and must be increased, where required, to suit length of run and voltage drop in accordance with the voltage drop schedule found at the end of this Section.
 - .3 all branch circuit wire feeding a 20 A protected lighting circuit to be minimum 10 AWG wire.
 - .4 all branch circuit wiring feeding a 15 A protected circuit which is over 45 m (150 ft) in length to be minimum 10 AWG wire.
 - .5 do not use conductors smaller than 8 AWG for exterior luminaire wiring.
 - .3 Voltage Drop:
 - .1 Voltage drop in power and control conductors shall be in accordance with the requirements of the Electrical Code. Size conductors, splicing kits, and termination lugs accordingly when sizes are not identified.

.2 Maximum branch wiring distance from panel to load in metres for 120 V single-phase system at 2% voltage drop based on indicated wire size:

Breaker Size (A)	15	20	30	40	50
Max load at 80% (A)	12	16	24	32	40
12 AWG	16.8	12.2	----- ---	----- ---	----- ---
10 AWG	25.9	19.0	----- ---	----- ---	----- ---
8 AWG	39.6	30.4	12.9	----- ---	----- ---
6 AWG	62.4	47.2	32.0	23.6	19.0
4 AWG	99.0	73.1	50.2	38.1	30.4
2 AWG	----- -	114. 3	77.2	57.9	47.2
1 AWG	----- -	----- -	96.0	73.1	57.9
1/0 AWG	----- -	----- -	----- -	85.3	68.5
2//0 AWG	----- -	----- -	----- --	102. 8	80.7
3/0 AWG	----- -	----- -	----- ---	----- ---	95.2

.3 Maximum branch wiring distance from panel to load in metres for 120 V single-phase system at 3% voltage drop based on indicated wire size:

Breaker Size (A)	15	20	30	40	50
Max load at 80% (A)	12	16	24	32	40
12 AWG	24.4	18.3	----- ---	----- ---	----- ---
10 AWG	38.1	29.0	19.1	----- ---	----- ---
8 AWG	59.4	44.2	30.5	22.9	----- ---
6 AWG	91.4	70.1	47.2	35.1	28.2
4 AWG	----- -	109. 7	73.2	54.9	42.7
2 AWG	----- -	----- ---	114. 3	85.3	68.6
1 AWG	----- -	----- -	----- --	103. 6	85.3
1/0 AWG	----- -	----- -	----- -	128. 0	102. 9
2//0 AWG	----- -	----- -	----- --	----- --	122. 9

3.2 SITE QUALITY CONTROL

.1 Site Tests and Inspections:

- .1 Feeders and branch circuits rated 100 amperes or greater shall be checked with a 1000 V Meggar for 15 seconds before energization.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide raceway and boxes for electrical systems, including but not limited to the following:
 - .1 Electrical conduit system throughout the project unless indicated otherwise. The conduit systems shall consist of all the necessary conduit, fittings, fastenings, boxes, special supports, etc.

1.3 REFERENCES

- .1 Abbreviations and Acronyms:
 - .1 EMT: Electrical Metallic Tubing
 - .2 FRE: Fibreglass Reinforced Epoxy
 - .3 PVC Polyvinyl Chloride
- .2 Definitions:
 - .1 Conduit - The definitions of "Conduit" (Rigid Metal, Rigid PVC, Rigid FRE, Flexible, and Electrometallic Tubing) as defined in the Electrical Safety Code. Other definitions shall be as follows.
 - .2 Slabbed Conduit - Conduit which is installed within a monolithic concrete floor slab.

2 PRODUCTS

2.1 MATERIALS

- .1 Conduit, Connectors and Fittings:
 - .1 Use conduit, connectors, and fittings as standard in the trade, unless noted herein or on the drawings to be of a specific type, manufacturer, trade name, series or catalogue number.
- .2 Galvanized Rigid Metal Conduit (GRC):
 - .1 All fittings to be threaded type. Supply bushings with insulated plastic lining for all conduit terminations.
 - .2 Electric Metallic Tubing (EMT):

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- .3 All fittings to be steel set screw or raintight type. Supply bushings with insulated plastic lining for all conduit terminations.
 - .3 Flexible Conduit:
 - .1 All box connections to have either a nylon lined connector or be provided with an insuliner sleeve. Include sealing ring for fully sealed connection for liquid tight type.
 - .2 Supply metallic liquid tight type for all exposed flexible conduit.
 - .3 Supply non-metallic type flexible conduit for inside concrete block walls.
 - .4 Concealed flexible conduit to be approved galvanized steel or aluminum (where approved) interlocking type, minimum size 19 mm (3/4 in).
 - .4 Rigid PVC:
 - .1 Use approved rigid PVC fittings with solvent cement connections for all joints.
 - .5 Outlet Boxes:
 - .1 Use outlet boxes, junction boxes, etc. of the types approved for the application. Use the following types for the noted applications:
 - .1 Recessed boxes in concrete or masonry - Type MBD or MBS boxes.
 - .2 Surface mounted with EMT conduit - Type FS or FD boxes.
 - .3 Surface mounted with rigid conduit - Type FS or FD boxes.
 - .6 Miscellaneous:
 - .1 Rigid Metal Expansion Joint - Crouse Hinds "XJ" series with bonding strap or equivalent.
 - .2 Rigid PVC Expansion Joint - Scepter "O" Ring expansion joint "EJ" series or expansion coupler "EC" series, to suit expected length of movement.

3 EXECUTION

3.1 INSTALLATION / APPLICATION

- .1 Application
 - .1 Galvanized Rigid Metal Conduit (GRC):
 - .1 Raceway sizes larger than 103 mm (4 in) diameter above grade.
 - .2 Where installed as an exterior branch circuit above finished grade.
 - .3 In hazardous locations (complete with sealing type fittings) as classified by the Electrical Code or the Electrical Authority.

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- .2 Electric Metallic Tubing (EMT):
 - .1 Conduit sizes 103 mm (4 in) and less, where not specified or required to be otherwise due to special applications or conditions.
 - .2 To carry branch circuit wiring from local distribution or lighting panels to area circuit junction boxes above ceiling systems.
 - .3 Provide EMT in all concealed walls, including stud walls.
 - .3 Flexible conduit:
 - .1 As branch circuit wiring from area circuit junction boxes above ceiling systems to light fixtures and from outlet boxes to suspended fixtures.
 - .2 Restrict flexible conduit to less than 3600 mm (12 ft) in length. Suitably clip and support every 900 mm (3 ft) in length the flexible conduit used above ceiling systems.
 - .3 Flexible conduit shall not be used within concealed walls, including stud walls.
 - .4 Do not use flexible conduit where conduit is run exposed.
 - .4 Liquid tight flexible conduit:
 - .1 As the raceway between the distribution conduit and equipment terminal boxes of vibrating and rotating equipment.
 - .2 Restrict length to be less than 600 mm (24 in).
 - .5 Rigid PVC conduit
 - .1 As a slabbed conduit where approved.
 - .6 Use corrosion resistant conduit where indicated on the drawings.
 - .7 Do not use aluminum conduit on this project.
 - .2 Installation
 - .1 Unless specified otherwise on the drawings, provide minimum 3/4 inch trade size for all conduits.
 - .2 Where more than one type of product or method of installation could apply, the most restrictive products and methods of installation shall take precedence.
 - .3 All conduit connections to be as tight as possible. Failure to tighten any conduit connections in block, tile or concrete elements will result in the element being removed and reinstalled at this Section's expense.

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- .4 Do not use the conduit system as the ground path for the building wiring system. Supply all wiring systems with a separate copper ground conductor sized accordingly to ensure ground path continuity.
 - .5 Conceal conduit in all finished wall areas but may be run exposed in service and equipment rooms.
 - .6 Where conduit is run exposed, run parallel to the building lines. Supply grouped concentric bends where two or more conduits are installed.
 - .7 Do not install conduit horizontally in masonry walls.
 - .8 Lay out all conduits and install to avoid the proximity of heating pipes and ducts. Do not run conduit within 900 mm (3 ft) of such pipes and ducts.
 - .9 Plug conduit ends during construction with plastic push pennies. Cap conduits stubbed for future use with conduit caps and seal, if below grade.
 - .10 Rigidly and securely support conduit systems with conduit straps to the building structure. Support multiple conduit runs, if not easily attached to the building structure directly, by Unistrut hanger assemblies. Bailing wire or flexible metal strapping will not be accepted.
 - .11 Extend conduits stubbed through equipment bases a minimum of 38 mm (1½ in) above the base.
 - .12 Install two 32 mm (1¼ in) spare empty conduits stubbed into the ceiling space from the top of all recessed panelboards. Terminate in suitable junction box with blank cover labelled accordingly.
 - .13 Install a nylon pull cord in all empty conduits. Adhere tags at both ends indicating system and destination. Maintain a pull cord in systems conduits used only to partial capacity.
 - .14 Colour code all conduit systems throughout the building during installation with a patch of paint at all junction and pull boxes and points of concealment as follows:
 - .1 Black – Power Distribution (also indicate specific source/panel)
 - .1 Black/Green – 600/347 V Normal
 - .2 Black/Blue – 208/120 V Normal
 - .2 Red – Fire Alarm System (also indicate circuits)
 - .3 Orange – Emergency/Standby Power System (also indicate specific source/panel)
 - .1 Orange/Green – 600/347 V Emergency/Standby
 - .2 Orange/Blue – 208/120 V Emergency/Standby
 - .3 Orange/Purple – Uninterruptible Power

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- .4 Yellow – Public Address/Intercom/Audio-Visual Systems
 - .5 Green – Security System
 - .6 Purple - Controls
 - .7 Blue – Telecommunications System
- .3 Rigid PVC Conduit:
- .1 Bend on site using a non-flame type heat source to accommodate the required contours.
 - .2 Use conduit fittings, couplings, etc. that are watertight type, fastened with an approved cement.
 - .3 Do not penetrate fire rated walls, floors, or ceilings.
- .4 Partition Walls:
- .1 Feed all conduit in demountable, prefabricated or standard stud partition walls into the wall from the ceiling. Make no connections from the floor or walls unless shown on drawings. Terminate conduit in a junction box in the ceiling space within 900 mm (3 ft) of the ceiling system penetration point.
 - .2 Restrict flexible conduit in demountable or prefabricated partitions to a maximum 25 mm (1 in) size.
- .5 Outlet Boxes:
- .1 The location of outlets, fixtures, panels, etc., as shown on the drawings, are approximately correct, but the Consultant reserves the right to alter the location of any number of them up to 3000 mm (10 ft) without incurring extra cost, if altered before installation is commenced on any individual item.
 - .2 In general, Use 100 mm (4 in) octagon boxes for light fixture outlets.
 - .3 In concrete slabs or walls, use boxes greater than 50 mm (2 in) deep.
 - .4 In general, in fire rated partitions, install outlet boxes with openings no larger than 160 cm² (25 in²) in area. Install outlet boxes on opposite side or same side of a fire rated partition offset at least one stud space to maintain the integrity of the fire separation.
 - .1 Refer to code plans indicating fire rated partitions
 - .2 Where openings exceed this criteria, install intumescent material that comply with ULC fire rated assemblies.
 - .5 Use watertight with screw fittings and watertight gaskets to install outlet boxes outside of the building.

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- .6 In general, install outlet boxes of adequate size and required dimensions for all outlet and conduit junctions.
 - .7 Rigidly secure all outlet boxes in position by approved methods. For those intended for hanging fixtures, supply with fixture studs, self aligning type for sloping ceilings.
 - .8 Outlet boxes designated for future use, install with blank-metal coverplates. Install coverplates, on outlet boxes designated for other than future wiring devices, in time to be painted over by the painting Section.
 - .9 Place all pull boxes and terminal boxes in inconspicuous but accessible locations.
 - .10 Centre all outlets, panelboards, lighting control, panels and equipment on construction panels, wood paneling or boarding, ceiling tile, etc.
 - .11 Install components or devices such as lighting controls and receptacles or thermostats, etc., which occur one above the other in the same general location, in the same vertical line.
 - .12 Install adjacent items such as panels and fire hose cabinets, etc., with the tops of their trims in line.
 - .13 Locate clocks, bells, horns, speakers, etc. as shown or specified. However, mount these items symmetrically in paneling or tiles, and bear proper relationship to doors, ventilation grilles, etc. Where specific heights are not covered, discuss the relation with, and approved by, the Consultant.
 - .14 In no case shall luminaires, pipes, ducts or other elements be allowed to obstruct clocks, grilles, exit lights, etc.
 - .15 Mount recessed or surface ceiling mounted components to replace full tiles where possible or be centred on the tile or grid intersections.
 - .16 Locate lighting controls on the latch side of door or primary leaf within 150 mm (6 in) of the jamb or sidelight. Where light controls are shown on hinge side of single doors, in cases where glazing makes placing the controls on the latch side not possible, ensure that lighting controls are within 150 mm (6 in) beyond door in fully open position and no part extends behind the open door. Verify door swings and primary leaves on double doors before proceeding with installation of the control box and associated conduit/wiring.
 - .17 Ensure all outlet boxes are installed with vapour barrier protection integral with specific wall or ceiling construction. For each outlet box installed which pierces a vapour barrier, supply an appropriately sized vapour barrier box surrounding outlet box to seal all air leaks and maintain vapour barrier continuity.

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- .18 In finished areas of the building, conceal as much conduit/wiring as possible. Where in this Section's opinion it is necessary or advantageous to run wiring on the surface, obtain approval from the Consultant before proceeding. Install all surface raceways as metal and manufactured by Wiremold unless otherwise indicated. Install surface raceways at size to suit conductors being carried. Use only approved components, fittings, and methods of securing, joining and supporting surface raceways and outlet boxes. Where surface mount raceways and outlet boxes are used, paint to match the specific wall or ceiling finish by the painting Section.
- .6 Mounting Height:
- .1 Where receptacles or other devices interfere with heating equipment, mount horizontally in the toospace below the heating unit unless otherwise noted.
 - .2 For mounting heights of the various system devices not indicated herein refer to the specific system Section or drawing detail.
 - .3 Verify mounting heights of outlet boxes in special or decorative wall systems prior to rough-in.
 - .4 For exact mounting heights and requirements of outlets and devices built into millwork or architectural furnishings, refer to elevations and details shown on the architectural drawings. Verify with millwork Section prior to rough-in.
- .7 Conduit Seals:
- .1 In areas where conduits pass through walls or other building surfaces in which different temperatures exist (i.e. refrigerated spaces or exterior walls and insulated ceilings or roofs, etc.), seal off the conduits with appropriate materials and methods to prevent breathing and subsequent condensation. Complete the sealing such that moisture is not trapped at the seal.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 01 (and Division 20 or 26).

1.2 SUMMARY

- .1 Section includes: Provide identification for electrical systems, including but not limited to the following:
 - .1 Identification nameplates for all electrical apparatus; i.e. panels, motor starters, switchgear, transformers, disconnect switches, breakers, contactors, system control panels, telephone panels, etc.
 - .2 Directory cards for all panelboards; i.e. power, lighting, low voltage systems, communications, etc. All power and systems wiring shall be colour coded in accordance with this Section and be provided with appropriate wire markers identifying panel circuits.

2 PRODUCTS

2.1 MATERIALS

- .1 Lamicoid Nameplates:
 - .1 All identification nameplates and nametags unless otherwise specified shall be engraved white letters on black lamicoid stock with bevelled edges. The lamicoid stock shall be 1.5 mm (1/16") minimum thickness.
 - .2 The nameplates shall be engraved with the following information:
 - .3 Nameplates for panel and cabinet identification shall typically include the following:
 - .1 LP-"A" 13 mm (1/2") high lettering
 - .2 120/208 VOLT 8 mm (5/16") high lettering
 - .3 FED FROM "MCC-1" 8 mm (5/16") high lettering
 - .4 All other electrical equipment shall be typically identified as follows:
 - .1 SUPPLY FAN "SF-1" 8 mm (5/16") high lettering
 - .2 208 VOLT - 3 PHASE 8 mm (5/16") high lettering
 - .3 FED FROM "MCC-1" 8 mm (5/16") high lettering
 - .5 The final wording of all nameplates shall be reviewed and approved by the Owner and <CP> prior to fabrication.

.2 Panel Directories

.1 Each panel circuit directory card shall have clearly typed information as with the following example:

- .1 PANEL NAME LP-"A"
- .2 PANEL VOLTAGE 120/208 VOLT
- .3 PANEL SUPPLY 150 AMP

<u>Circuit Number</u>	<u>Load</u>	<u>Room No. or Locations</u>
1	lighting	143
2	Receptacles	029
2	Supply fan SF-4	Roof

.2 All systems distribution cabinets shall be complete with a directory card showing circuit numbers, room locations, and a blank column for "REMARKS".

.3 Wire and Cable Colour Coding

.1 All power and systems wiring shall be colour coded as follows:

- .1 Power
 - Phase A - Red
 - Phase B - Black
 - Phase C - Blue
 - Neutral - White
 - Ground - Bare or Green
- .2 Motor Control
 - Yellow

.2 Provide suitable clip-on or stick-on wire markers for all wires at points of termination and interconnection. Wire markers shall identify panel and circuit number in a clear and logical manner.

3 EXECUTION

3.1 INSTALLATION

- .1 Lamicaid nameplates shall be mounted behind the panel door, fastened with contact cement.
- .2 Temporary panel directory cards shall be provided and filled in as the circuits are installed. The temporary directory card shall be replaced with a typed permanent directory at job completion.
- .3 The panel directory card shall be inserted in the card holder on the inside of the panel door and be protected by a clear plastic sheet.

- .4 Feeder cables shall be colour coded in each terminal panel and junction box with a minimum 75 mm (3") taped band.
- .5 All power and systems junction and terminal box covers shall be marked with permanent black marker as to system installed (i.e. "F.A." for Fire Alarm) and other details such as circuit numbers, detection zone, etc. Exposed boxes shall have marking on inside face of cover.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide electrical work commissioning.

1.3 REFERENCES

- .1 Definitions:
 - .1 Commissioning: the process of demonstrating to the Owner and Consultant, for the purpose of final acceptance, by means of successful and documented functional performance testing, that all systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of the Contract Documents, all as further described below
 - .2 Start-Up and Adjusting: the process of equipment manufacturer's/supplier's technical personnel, with the Contractor, starting and operating equipment and systems, making any required adjustments, documenting the process, and submitting manufacturer's/supplier's start-up reports to confirm that the equipment has been properly installed and is operational as intended, and a pre-requisite to operational performance testing
 - .3 Operational Performance Testing: testing, adjusting and operating of components, equipment, systems and/or subsystems, by the Contractor, after start-up but before functional performance testing, to confirm that all components, equipment, systems and/or subsystems operate in accordance with requirements of the Contract Documents, including all modes and sequences of control and monitoring, interlocks, and responses to emergency conditions, and including submittal of pre-functional performance testing documentation sheets
 - .4 Functional Performance Testing: a repeat of successful operational performance testing by the Contractor, validate and verify that the equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance
 - .5 Commissioning Documentation Sheets: prepared sheets for operational performance testing and for functional performance testing for each piece of equipment/system to be commissioned, each sheet or set of sheets complete with the Project name and number, date of commissioning, equipment/system involved, equipment/system name and model number, equipment tag as per the drawings, and, for each commissioning procedure listed, a column giving the expected data as per the Contract Documents, a column to fill in the observed data during commissioning, and space for signatures of the Contractor

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- .6 BAS: building automation system
 - .7 Systems Operating Manual: a manual prepared by the Contractor to present an overview of the building electrical systems and equipment to be used by building maintenance personnel to assist them in daily operation of the systems
 - .8 Validate: to confirm by examination and witnessing tests the correctness of equipment and system operation
 - .2 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .3 Commissioning work is to be in accordance with requirements of the following:
 - .1 CSA Standard Z320, Building commissioning

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 26 05 00.
- .2 Product Data and Shop Drawings:
 - .1 Submit to the Consultant, 1 copy of each shop drawing or product data sheet associated with equipment or systems to be commissioned.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Objectives of the commissioning process are as follows:
 - .1 to support quality management by means of monitoring and checking the installation
 - .2 to verify equipment/system performance by means of commissioning of the completed installation
 - .3 to move the completed equipment/systems from the "static completion" state to the "dynamic" operating state so as to transfer a complete and properly operating installation from the Contractor to the Owner

2 PRODUCTS

2.1 NOT APPLICABLE

3 EXECUTION

3.1 SITE QUALITY CONTROL

- .1 Commissioning

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- .1 Commission the electrical work in accordance with requirements of this Section of the Specification.
 - .2 Prerequisites to Commissioning: Prerequisites to successful completion of commissioning are as follows:
 - .1 Submittal of signed start-up and test reports.
 - .2 Completion by the Contractor of system testing reports as per the Electrical Work Testing Section.
 - .3 Successful completion and documentation of operational performance testing.
 - .4 Submittal of letters to the Consultant certifying that the systems and subsystems have been started, tested, adjusted, successfully operationally performance tested, are ready for functional performance testing, and are in accordance with requirements of the Contract Documents.
 - .2 Phasing Of Commissioning
 - .1 The Project will be constructed in phases as described in the Specification. Commissioning must be phased to suit the progress and phases of the work.
 - .3 Deficiencies Listed During Commissioning
 - .1 Deficiencies listed by the Consultant during the commissioning process are to be corrected by the Contractor within 10 calendar days unless agreed otherwise with the Consultant, and when deficiencies have been corrected, notify the Consultant at once.
 - .4 Systems To Be Commissioned
 - .1 Electrical systems to be commissioned include, but are not to be limited to, the following:
 - .1 Electrical distribution systems
 - .2 Emergency power systems
 - .3 Communication systems
 - .4 Lighting control systems
 - .5 Access controls system
 - .6 Surveillance system
 - .5 Commissioning Process
 - .1 The commissioning process is to be performed in stages and is to include, but not be limited to, the following:

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- .1 Stage 1: Commissioning of electrical equipment/systems as listed in this Section, which is a prerequisite to an application for Substantial Performance and includes supervising and validating results of functional performance testing, and submittal of the reviewed Systems Operating Manual.
 - .2 Stage 2: Commissioning work to be performed 12 months after issue of a Certificate of Substantial Performance and which includes supervision of the Contractor's "fine tuning" of equipment/systems.
 - .3 Stage 3: Successful completion of satisfactory equipment/system operation during the first month after issue of a Certificate of Total Performance of the Work.
 - .4 Stage 4: Successful completion of satisfactory equipment/system operation during the 3rd month after issue of a Certificate of Total Performance of the Work.
- .6 Responsibilities of the Consultant
- .1 Construction Phase: Responsibilities of the Consultant are as follows:
 - .1 Review the Contractor's shop drawing/product data submissions for general conformance requirements of the Contract.
 - .2 Review the Contractor's delivery schedule and installation program to ensure that the installation sequences have been coordinated with the construction schedule.
 - .3 Monitor and inspect the electrical work throughout the construction stages to ensure that the work is in accordance with requirements of the Contract, note deficient work, and ensure that deficient work is corrected.
 - .4 When informed by the Contractor that work is essentially complete, inspect the equipment and systems, issue deficiency reports, and ensure that deficiencies are corrected in a timely manner.
- .7 Responsibilities of the Contractor
- .1 Construction Phase: Responsibilities of the Contractor during the construction phase are as follows:
 - .1 Prepare and submit an installation schedule which is to include the time schedule for each activity with lead and lag time allowed and indicated, shop drawing/product data and working detail drawing submissions, and major equipment factory testing and delivery dates.
 - .2 Prepare and submit a commissioning schedule which is to include a time schedule coordinated with the installation schedule referred to above, and allowances for additional time for re-tests as may be required and update the schedule on a monthly basis as required.

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- .3 Arrange site commissioning meetings with the applicable subcontractors present.
 - .4 Promptly correct all reported deficient work, and report when corrective work is complete.
 - .5 Where required by Codes and/or the Specification, retain equipment manufacturers/suppliers or independent third parties to certify correct installation of equipment/systems.
 - .6 Under the supervision of equipment manufacturers/suppliers, start-up and adjust all equipment to design requirements, and submit start-up sheets which include all equipment data such as manufacturer and model number, serial number where applicable, and performance parameters, all signed by the equipment manufacturer/supplier and the Contractor.
 - .7 In accordance with the updated commissioning schedule and actual progress at the site, certify in writing to the Consultant that equipment and/or systems are complete, have been checked, started and adjusted, successfully operationally performance tested and documented, and are ready for functional performance testing and the commissioning procedures, giving the Consultant a minimum of 5 working days notice.
 - .8 Perform system and subsystem functional performance testing and submit to the Consultant, completed and signed functional performance testing and commissioning data sheets.
- .2 Post Construction Phase: Responsibilities of the Contractor during the post construction phase are as follows:
- .1 Optimize system operation in accordance with the building's occupant's needs and comments using the System Operation Manual.
 - .2 Complete all commissioning procedures, activities, and performance verification procedures that were delayed or not concluded during the construction phase.
 - .3 Complete system checks and "fine tuning" with signed documentation as follows:
 - .1 Once during the 1st month of building operation.
 - .2 Once during the 3rd month of building operation.
 - .3 Once between the 4th and 10th months in a season opposite to the 1st and 3rd month visits.
 - .4 Correct all deficiencies revealed by the system checks described above, and, where required, involve equipment manufacturer's/supplier's during corrective actions, and report completion of corrective work.

- .5 Schedule for 3 months after Substantial Performance and conduct question and answer session(s) at the building with the Owner's operating and maintenance personnel, with the duration of the session(s) dictated by the number of questions and concerns that have to be addressed.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Work to include all labour, materials, tools, appliances, control hardware, sensors, wiring, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational standalone lighting control system, as described herein.
- .2 All lighting controls shall meet or exceed all locally-enforced energy codes including all mandatory control requirements for Ontario Building Code.
- .3 All spaces shown within the building and all exterior lighting shall be controlled using the installed lighting control system.
- .4 Examine all general specification provisions and drawings for related electrical work required as work under this section.
- .5 Coordinate all work described in this section with all other applicable plans and specifications, including but not limited to wiring, conduit, fixtures, HVAC systems and building management systems.
- .6 All lighting control is subject to functional testing. Lighting control devices and control system shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with this section and the manufacturer's installation instructions.

1.3 REFERENCES

- .1 Division 25 Integrated Automation
- .2 Section 26 05 00 Common Work Results for Electrical
- .3 Section 26 50 00 Lighting
- .4 Section 26 52 00 Emergency Lighting
- .5 Ontario Building Code

1.4 DEFINITIONS

- .1 A Passive Infrared sensor (PIR sensor) is an electronic device that measures infrared (IR) light radiating from objects in its field of view.

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- .2 An Ultrasonic sensor work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor.
 - .3 A Microphonic sensor is a microphone that picks up ambient sounds and detects sounds that are typical for human occupancy. Unlike ultrasonic, no sound is transmitted from the unit and is therefore a passive technology. Unit will not record sounds or have any method to transmit sounds to any other device. Microphonic sensor may be used in locations where ultrasonic sensors are specified herein.
 - .4 Dual Technology sensors combine both passive infrared and ultrasonic/microphonic technologies into one sensor.
 - .5 A Photosensor is an electronic device that detects the prevailing light level and sends the information either as an analog or a stepped digital output as a relative representation of the light level.

1.5 QUALITY ASSURANCE

- .1 All sensors, accessories and components must have a recognized certification mark (such as CSA or ULC) or a recognized field evaluation mark (such as CSA or ESA) as designated by the Ontario Electrical Safety Code.
- .2 All components (and associated re-installation) shall be warrantied against defective manufacturing and installation for minimum of 2 (two) years from substantial completion.

1.6 SUBMITTALS

- .1 Complete sets of shop drawings shall be submitted indicating the following:
 - .1 Product component cut sheets.
 - .2 Wiring/Wireless schematics for typical and standalone room types in this project. (i.e. classroom, private office, lobby, open office, boardroom, etc.).
 - .3 Functional testing sheets with room-by-room requirements table.

2 PRODUCTS

2.1 APPROVED MANUFACTURERS

- .1 Acceptable manufacturers are:
 - .1 Crestron (no substitutions)
- .2 If any manufacturer requires additional components, wiring, space requirements, structural, etc. over that of the indicated manufacturer in these specifications; then those items and costs shall be included. Any additional installation requirements shall employ the trades and consultants already on site to provide a complete and working lighting control system and paid for by the manufacturer.

2.2 OCCUPANCY SENSORS

- .1 Wall Mount Sensors (line voltage)
 - .1 Dual Technology sensors
 - .1 For use in small conference room, break room, or similar.
 - .2 Each room shall be equipped with line voltage, dual relay, wall mounted, dual technology occupancy sensor(s).
 - .3 Wall sensor shall have features such as large activation buttons, automatic time-delays, automatic sensitivity, and walkthrough modes.
 - .4 By default, first relay shall be set to automatic on; second relay shall be set to manual on.
 - .2 Passive Infrared sensors
 - .1 For use in small utility rooms small service rooms, small storage rooms, or similar.
 - .2 Each room shall be equipped with line voltage, wall mounted, passive infrared occupancy sensor.
 - .3 Wall sensor shall have large activation button and be set to manual on.
 - .3 Ultrasonic sensors
 - .1 For use in small utility rooms, single washrooms, small multi-stall washrooms, or similar.
 - .2 Each room shall be equipped with line voltage, wall mounted, ultrasonic occupancy sensor.
 - .3 Wall sensor shall have large activation button and be set to manual on.
- .2 Ceiling / Close-to-Ceiling Mount Sensors (low voltage)
 - .1 Dual Technology sensors
 - .1 For use in offices, classrooms, training rooms, or similar.
 - .2 Each room shall be equipped with low voltage, dual-technology occupancy sensor(s), power/relay module, and digital control switch(es).
 - .3 All sensors shall work in conjunction with one another through wired or wireless connections.
 - .2 Ultrasonic sensors
 - .1 For use in corridors, stairwells, utility rooms, service rooms, small storage rooms, multi-stall washrooms, or similar.
 - .2 Each room shall be equipped with low voltage, ultrasonic occupancy sensor(s), power/relay module, and digital control switch(es).
 - .3 All sensors shall work in conjunction with one another through wired or wireless connections.

2.3 DAYLIGHTING CONTROL SENSORS

- .1 Provide daylighting control to light fixtures within floor areas substantially illuminated by daylight either through toplight or sidelight windows. The fixtures and spaces affected by the toplight or sidelight illumination are indicated on the drawings.
- .2 In addition to the occupancy based lighting control within this space, the light fixtures in these areas are required to dim or switched off if exterior sunlight levels increase beyond a programmed threshold. Switched systems shall be used in warehouses, corridors, storage, and regularly unoccupied spaces. In offices, meeting spaces, lobbies and other normally occupied spaces dimming controls shall be used with continuous-type dimming ballasts or drivers.
- .3 Lighting control manufacturer/installer shall ensure that ballast and/or drivers used by lighting manufacturer are compatible with lighting control system or shall incur all costs for replacement to a compatible unit at no additional cost to the project.
- .4 Provide photosensor capable of multi-zone switching or dimming with a minimum of 3 sensing levels and connect to room controller/relay.
- .5 Combination photosensor/occupancy sensors are not recommended and may be used only where placement of device will not degrade performance of either function.
- .6 The system shall operate with multiple users in harmony and not react adversely to manual override inputs. Daylight harvesting shall not impede personal lighting control and the ability to adjust light levels on a per fixture basis.

2.4 DIGITAL WALL SWITCHES

- .1 Low voltage momentary pushbutton switches in single or multi-button (up to 8 in single gang) configuration. Digital wall switches shall include the following features:
 - .1 Buttons shall be large enough to have room to be engraved. Manufacturer shall provide engraving service for first set of buttons on each switch.
 - .2 Dimming switches shall include bi-level LEDs to indicate load levels using multiple steps.
- .2 Digital wall switches shall be used when low-voltage power/relay modules are used and shall not be used to replace wall-mounted line voltage occupancy sensor/switches.

2.5 POWER/RELAY MODULES

- .1 Power/relay modules shall be standalone or integrated units that shall house one or multiple relays for controlling room or area lighting and shall provide control input from lighting control devices. More than one module may be required in any one area to allow for full control. Multiple modules shall be able to be mesh networked allow communication so that all modules work as one complete system.
- .2 Low voltage sensors and digital wall switches shall communicate with power/relay module(s) that will operate lighting within the room being controlled.

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- .3 Standalone modules without dimming shall have the following properties:
 - .1 Communications capability with low voltage sensors within the room.
 - .2 Minimum two relays are required for most spaces.
 - .4 Standalone modules with dimming shall have the following properties:
 - .1 Analog (0-10V) or digital (DALI or DMX) control interface to compatible with connecting devices.
 - .2 Communications capability and compatibility with other low voltage sensors or switches within room.
 - .5 The module may be incorporated or integrated into a ballast or driver.
 - .6 Module shall have additional NO/NC contact for connection to local low voltage HVAC control unit. If module does not incorporate, then the manufacturer/installer shall be responsible for an additional external relay to provide this function where required.
 - .7 Modules shall be interconnected via plenum-rated (FT-6) low-voltage network wiring or via wireless connections.

2.6 RECEPTACLE CONTROL

- .1 Receptacle control shall be used in all offices and computer classrooms as minimum requirement as per ASHRAE 90.1-2013. Other spaces in the building may indicate receptacle control and shall use the same components and installation methods.
- .2 In addition to the required room lighting control, each office or computer classroom shall be equipped with a relay/power supply to control at least 50% of the receptacle within the space.
- .3 All controlled receptacles shall be grey in colour to identify them from receptacles with other functions.
- .4 Control may be through remote relay panel serving larger spaces with multiple controls or individual local units. In each case, the relay shall be capable of switching plug loads and shall be certified by a testing authority for this function.
- .5 For individual switched circuits, Relay/controller shall be WattStopper LMPL series room plug-load controller or equivalent.
- .6 Central relay panels shall be controlled via time-of-day control and shall be schedule to shut-off during non-operational hours.
- .7 Relay designated as lighting relays are not acceptable to switch plug loads unless they have been separately certified as suitable for plug loads.
- .8 Plug-in type power bars with built-in occupancy sensors cannot be used to meet this requirement.

2.7 EMERGENCY LIGHTING CONTROL

- .1 Unless noted otherwise, all emergency lighting shall not be switched and shall provide illumination to Ontario Building Code requirements.
- .2 Where emergency lighting is required and is installed in a space where lighting control is desired, an emergency lighting control unit shall be installed. Locations shown with an emergency battery unit meeting code requirements as shown on the drawings shall not require an emergency lighting control unit.
- .3 The emergency lighting control unit shall allow control of emergency lighting fixtures in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power supplying the control device. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.
- .4 The device shall have an integral momentary test switch. Pressing and holding this switch shall instantly force the unit into emergency mode and turn on emergency lighting. Releasing the test switch shall immediately return the unit to normal operation.
- .5 The unit shall provide dedicated leads and 24 VDC source for connection to remote test switch, fire alarm system, or other external system capable of providing a normally closed dry contact closure. Breaking contact between the terminals shall force and hold the emergency lighting on until the terminals are again closed. An integral LED indicator shall indicate the unit's current remote activation status.

2.8 SPARE COMPONENTS

- .1 Provide and turn over to the owner, after six month service visit, 10% spare (rounded up) wiring devices, sensors, buttons, relay modules and relays to allow minor future expansion and ongoing maintenance of lighting control system. Installer may use spare components to adjust owner's requirements at one month and six month visits. These spare components are not a replacement for defective components covered under warranty.

3 EXECUTION

3.1 INSTALLATION

- .1 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 provide additional sensors and power supplies/relays as required to properly and completely cover the respective room and circuits.
- .2 Locate and aim sensors within each space as 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 of the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s).

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- .1 Occupancy sensors shall be placed to eliminate activation or minimize activation, in the case of multiple entries, from outside the room.
 - .2 Photosensors shall be placed close to sidelights and within toplight vertical sections, with lens facing as close to north as possible.
 - .3 It is the contractor's responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at owner's facility, to verify placement of sensors and installation criteria.
 - .4 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.
 - .5 When installing occupancy sensors with ultrasonic sensors, the unit shall be mounted on a vibration free surface and shall be installed a minimum of 1220 mm (48") away from supply ducts, minimum of 1830 mm (72") away from wall mounted discharge ducts, and minimum of 150 mm (6") from the power supply.
 - .6 When installing occupancy sensors in areas where the area is too large to cover with a sensor(s) shown on drawings or the space has obstructions that do not meet the minimum coverage requirements, then multiple sensors shall cover zones to ensure that the proper coverage is achieved without additional cost to the owner.
 - .7 When an area is served by lighting on multiple circuits, a relay or contactor shall be provided to allow all lighting to be controlled by the sensor(s).
 - .8 When serving areas with high ceilings or exterior areas, sensors should be placed at manufacturer's recommended height for coverage and spacing.

3.2 SITE QUALITY CONTROL

- .1 Field Testing
 - .1 Upon completion of the installation, the system shall be completely tested by field technician who will verify all adjustments and sensor placement to ensure a trouble-free lighting control system and compliance with ASHRAE 90.1-2010 functional testing standards.
 - .2 Each device shall be numbered, labeled and recorded. Tests shall be conducted to ensure that entering the space shall ensure that lighting shall be activated as per requirements and the vacating a space will cause the lighting to turn off within 30 minutes.

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- .3 After one month and six months of customer use, the installer and/or manufacturer shall return to the site and make any required adjustments to location, control, sensitivity and timing as required by the users based on their feedback. Provide suitable feedback forms to owner's representative two weeks prior to visit. Schedule visits with owner's representative.
 - .2 Functional Testing
 - .1 The lighting control system shall be functionally tested in accordance with ASHRAE 90.1-2013 functional testing requirements. Manufacturer or contractor shall provide lighting control narrative and room-by-room control requirements.
 - .2 At a minimum the following procedures shall be performed:
 - .1 Confirm the placement, sensitivity and time out adjustments for occupancy sensors yield acceptable performance, lights turn off only after space is vacated and do not turn on unless space is occupied.
 - .2 Confirm that time switches and programmable schedule controls are programmed to turn the lights off.
 - .3 Confirm that photosensor controls reduce electric light levels based on the amount of usable daylight in the space as specified.
 - .3 Functional tester shall provide documentation certifying that the installed lighting controls meet or exceed all documented performance criteria.
 - .4 Lighting control system shall be complete, operational and all functional testing shall be completed within 7 calendar days of full occupancy.
 - .3 Training
 - .1 Provide on-site training to owner's maintenance staff and operators to make adjustments to the system for further changes as required. Manufacturer shall provide minimum 12-month (from building occupancy) toll-free telephone support for technical questions concerning re-programming and technical issues.
 - .2 Training shall consist of one half-day session organized by manufacturer at approximately one month after owner occupancy. Training facilities shall be provided at owner's site. Contact owner representative with at 3 weeks after occupancy to appropriate schedule time appropriate. Electronic and hardcopy of all slides and handouts used in training presentation shall be turn over to the owner.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Provide low voltage distribution dry type transformers of the size and type as shown on the drawings and specified herein.
- .2 Refer to the "Power Distribution Single Line Diagram" as shown on the drawings, for details of equipment and components to be provided.

1.3 REFERENCES

- .1 Section 26 05 33 Raceway and Boxes for Electrical Systems
- .2 Section 26 05 19 Wire and Cable
- .3 Section 26 05 53 Identification for Electrical Systems

1.4 QUALITY ASSURANCE

- .1 Dry type transformers shall be manufactured and tested in accordance with the latest issue of CSA Standard C-9 for the applicable rating.
- .2 Dry type transformers sound level shall comply with the latest issue of NEMA Standard TR1.
- .3 Dry-type transformers minimum efficiency values shall comply with CAN/CSA-C802.2.
- .4 All equipment will be CSA approved and be finished in ANSI/ASA-61 light grey enamel paint.
- .5 All equipment will be manufactured in accordance with the applicable sections of CSA Specification C22.2.

1.5 SUBMITTALS

- .1 All distribution equipment for this project will have shop drawings submitted for review. Include product characteristics, performance criteria, physical size, finish, limitations, nameplate data and all other pertinent details required to complete the installation and connections.
- .2 Maintenance and operating instructions, parts lists, etc., will be provided for any special function equipment.

2 PRODUCTS

2.1 ENCLOSURES

- .1 Indoor transformer enclosures will be ventilated minimum EEMAC 1 type and be finished with light grey enamel. Provide sprinklerproof hoods for transformers installed in sprinklered areas and external neoprene vibration isolators.

2.2 SUPER ISOLATION TRANSFORMERS

- .1 Isolation transformers will be pre-purchased by the Owner. Refer to Pre-purchased Electrical Equipment Contract in Section 26 05 00.
- .2 Transformer ratings will be as indicated on the Drawings:
 - .1 Capacity (kVA)
 - .2 Primary voltage; grounded or ungrounded
 - .3 Secondary voltage; grounded or ungrounded
 - .4 1-phase or 3-phase
 - .5 3-phase Configuration (delta-delta; delta-wye; wye-wye)
- .3 Super isolation transformers will be complete with four 2½% full capacity taps, two FCAN and two FCBN, and internal core/coil vibration mounts.
- .4 Transformers will be shielded with a simple configuration and no moving parts to provide fast response, output current limiting and complete isolation from the power supply line.
- .5 Minimum super isolation transformer performance characteristics will be as follows:
 - .1 Common Mode Rejection - 146 dB
 - .2 DC Isolation - 1000 megohms input and to output and circuit to ground
 - .3 Transverse Mode Rejection - typically 60 dB
 - .4 Operating Voltages - up to 110% of nominal
 - .5 Dielectric Strength - 2500 VAC minimum
 - .6 Frequency Input Range - 57-63 Hz

3 EXECUTION

3.1 INSTALLATION

- .1 All floor mounted transformers shall be mounted on concrete housekeeping pads with external neoprene vibration pads or equivalent.
- .2 Transformers shall have flexible conduit connections or equivalent on both the high and low voltage feeders.

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- .3 Wall mounted transformers shall be mounted on a structural angle iron frame suitably attached to the masonry walls, steel structure, etc., and be set on external neoprene vibration isolators or equivalent.
 - .4 Dry type transformers up to and including 45 kVA shall be wall mounted. Transformers over 45 kVA are to be floor mounted. Exceptions to the above shall be as noted on the Drawings.
 - .5 Adjust primary voltage tap to achieve desired secondary system voltage. Provide grounding terminals and primary and secondary lugs to suit indicated feeder conductors.
 - .6 Protect installed products and components from damage during construction. Repair damage to adjacent materials caused by equipment installation
 - .7 Install equipment in accordance with manufacturer's instructions or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.
 - .8 All equipment installed in this scope will meet clearance requirements of the Electrical Code. Any equipment installed that does not meet this requirement will be reviewed with the Consultant.
 - .9 Floor mount transformers on concrete housekeeping pads. The pad will be 100 mm (4") high and have 20 mm (3/4") chamfered edges. All exposed concrete surfaces will be finished smooth and level.
 - .10 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Provide all distribution equipment required for the complete installation.
- .2 Refer to the "Power Distribution Single Line Diagram" and "Wiring for Mechanical Equipment Schedule" as shown on the drawings, for details of equipment and components to be provided.

1.3 REFERENCES

- .1 Ontario Electrical Safety Code
- .2 CSA-C17 Alternating - Current Electricity Metering
- .3 Section 26 05 33 Raceway and Boxes for Electrical Systems
- .4 Section 26 05 19 Wire and Cable
- .5 Section 26 05 53 Identification for Electrical Systems
- .6 Section 26 43 00 Surge Protection Devices

1.4 QUALITY ASSURANCE

- .1 All equipment will be CSA approved and be finished in ANSI/ASA-61 light grey enamel paint.
- .2 Comply with CSA, OESC, OBC, IEC, IEEE, ANSI, NEMA and NFPA.
- .3 All equipment will be manufactured in accordance with the applicable sections of CSA Specification C22.2.

1.5 COORDINATION

- .1 Coordinate layout and installation of existing switchboard and components with other installation and construction including conduit, piping, equipment, and adjacent surfaces.
- .2 The switchboard information is typically depicted on the drawings: bus configuration, bus ratings, interrupting ratings, component size and type, power line and feeder connections, application specific control wiring, elevation and footprint, etc. Where not shown on or able to be derived from the Drawings, the minimum requirements specified herein shall be provided.

1.6 SUBMITTALS

- .1 All distribution equipment for this project will have shop drawings submitted for review. Include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Maintenance and operating instructions, parts lists, etc., will be provided for circuit breakers, meters, ground fault detectors, or any special function equipment.
- .3 Include meter outline dimensions, panel drilling dimensions and installation cut-out template.

2 PRODUCTS

2.1 APPROVED MANUFACTURERS

- .1 Acceptable manufacturers are:

- .1 Schneider.

2.2 SWITCHBOARD

- .1 Refer to Drawings for make and model of existing switchboard.

2.3 POWER CIRCUIT BREAKERS

- .1 Moulded case circuit breakers or MCCBs are to comply with and be designed, manufactured and tested in accordance with applicable conditions of:
 - .1 C22.2 NO. 5-16;
 - .2 UL 489.

2.4 CIRCUIT BREAKER TRIP UNITS

- .1 Advanced electronic trip units shall be imbedded within the hardware of the circuit breaker. Trip unit functionality shall be upgradable through the uploading of digital modules without the need to replace or modify trip unit hardware. Trip units shall provide local and remote trip indication and reason for trip (e.g. overload, short circuit or ground fault).
- .2 Trip unit protection functions shall consist of
 - .1 Adjustable long-time pickup and delay (ANSI 49RMS/51)
 - .2 Short-time pickup and delay (ANSI 50TD/51)
 - .3 Instantaneous pickup (ANSI 50), the Instantaneous setting shall also have an OFF setting when short-time pick-up is provided
 - .4 Ground-fault pickup and delay (ANSI 50N-TD/51N)

- .3 Adjustable electronic trip units shall be used for breakers sized 100A and higher, with trip settings to 50% of the device rating. Fixed setting electronic trip units shall be used for feeder breakers less than 100A. All trip units shall be capable of being removed and replaced if needed.
- .4 Include Energy Reduction Maintenance Setting (ERMS) which shall include a switch, electronic mechanism or means to allow for reduced energy trip settings for personnel or operators who may be in proximity to or working on or near the equipment. The ERMS shall have a visual acknowledgment of operation when switched on.
- .5 CT's shall be appropriately sized for use on the main and feeders. A separate HMI and display shall be mounted on the same door as the circuit breaker. No line voltage shall be present on the breaker door for the metering components. The HMI shall be a touchscreen color display.

2.5 SWITCHBOARD CIRCUIT BREAKERS

- .1 Switchboard circuit breakers will be high interrupting capacity type of required frame size for trip settings as indicated on the drawings and be equipped with corresponding trip unit. All breakers will be bolt on type and be equipped with padlocking device and auxiliary features (shunt trip, aux. switch, ground fault relay, undervoltage trip, etc.) as indicated.
- .2 All breakers will be rated as shown on the Drawings for the minimum symmetrical interrupting capacity, voltage, phases and not less than the short circuit capacity.

3 EXECUTION

3.1 INSTALLATION

- .1 Protect installed products and components from damage during construction. Repair damage to adjacent materials caused by equipment installation
- .2 Install equipment in accordance with manufacturer's instructions or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- .3 All equipment installed in this scope will meet clearance requirements of the Electrical Code. Any equipment installed that does not meet this requirement will be reviewed with the Consultant.
- .4 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.2 FIELD QUALITY CONTROL

- .1 Prepare for acceptance tests as follows:
 - .1 Test insulation resistance for each component, connecting supply, feeder, and control circuit.
 - .2 Test continuity of each circuit.

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- .2 Perform the following field tests and inspections and prepare test reports:
- .1 Perform each electrical test and visual and mechanical inspection stated in NETA ATS (latest version), Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
 - .2 Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.3 CLEANING

- .1 On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.4 DEMONSTRATION

- .1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overcurrent protective devices, instrumentation, and accessories.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Provide all distribution equipment required for the complete installation.
- .2 Refer to the "Power Distribution Single Line Diagram" and "Wiring for Mechanical Equipment Schedule" as shown on the drawings, for details of equipment and components to be provided.

1.3 REFERENCES

- .1 Section 26 05 33 Raceway and Boxes for Electrical Systems
- .2 Section 26 05 19 Wire and Cable
- .3 Section 26 05 53 Identification for Electrical Systems

1.4 QUALITY ASSURANCE

- .1 All equipment will be CSA approved and be finished in ANSI/ASA-61 light grey enamel paint.
- .2 All equipment will be manufactured in accordance with the applicable sections of CSA Specification C22.2.

1.5 SUBMITTALS

- .1 All distribution equipment for this project will have shop drawings submitted for review. Include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Maintenance and operating instructions, parts lists, etc., will be provided for any special function equipment.
- .3 Include panel drilling dimensions and installation cut-out template.

2 PRODUCTS

2.1 APPROVED MANUFACTURERS

- .1 Refer to Pre-purchased Electrical Equipment Contract in Section 26 05 00 for list of panelboards that will be pre-purchased by the Owner.
- .2 All panelboards in this project shall be installed by the Contractor in accordance with this section, including pre-purchased equipment.

.3 Acceptable manufacturers are:

- .1 Eaton Corp.
- .2 Siemens Power.
- .3 Schneider.
- .4 ABB Inc.

2.2 DISTRIBUTION PANELS

- .1 Fusible or circuit breaker type distribution panels will be provided as required to accommodate the indicated branch fused disconnect units or circuit breakers and spaces for future use as indicated on the Drawings. Panels will be of the type with voltage and current rating as indicated on the Drawings. Bus bracing will be provided to suit the short circuit capacity rating indicated on the Drawings or minimum 10 kA at 208 Volt, 3-phase or 14kA at 600 Volt, 3-phase as applicable.
- .2 Fusible unit will have quick-make quick-break mechanism with provisions for locking in the open or closed position and door/switch interlock with override. All fusible units will be equipped for Class "J" HRC-1 fuses and include auxiliary contacts or other special features as noted on the drawings.
- .3 Moulded case circuit breakers will be of the frame size and rating as shown on the drawings and include ground fault sensing relays, shunt trip, auxiliary contacts or other special features as noted on the drawings.
- .4 Distribution panels will be complete with locking door, label, directory card and enclosure rated to suit the application.
- .5 Flush mounted distribution panels will have doors and trims finished in ANSI/ASA-61 light grey enamel paint.
- .6 Surface mounted distribution panels will have tubs, doors and trims finished in ANSI/ASA-61 light grey enamel paint.
- .7 Provide sprinkler resistant hoods and doors for distribution panels installed in sprinklered areas.

2.3 CIRCUIT BREAKER PANELBOARDS

- .1 Panels will be of the type, with voltage and current rating as indicated on the drawings. The panels will be sized to contain the specified branch breakers with space for future units as indicated.
- .2 Panels will be complete with common key locking doors, and no label, stamp, or nameplate on the exterior of the panel trim or door. Provide a directory card and suitable holder mounted on the back of the panel door. Panel enclosure rating will suit application requirement.

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- .3 Flush mounted panelboards will have doors and trims finished in ANSI/ASA-61 light grey enamel paint.
 - .4 Surface mounted panelboards will have tubs, doors and trims finished in ANSI/ASA-61 light grey enamel paint.
 - .5 Unless otherwise indicated, circuit breakers will be moulded case type, with required frame size for trip settings as shown on the Drawings. Breakers mounted in panels will be bolt-on type.
 - .6 Unless otherwise noted all breakers will be rated minimum 14 kA symmetrical interrupting capacity at 600 volts, 3-phase or 10 kA symmetrical interrupting capacity at 208 volts, 3-phase as appropriate and not less than the short circuit capacity as shown on single line diagram drawings.
 - .7 Switching breakers will be UL SWD rated for switching duty.
 - .8 The circuit breaker servicing Life Safety Loads such fire alarm control panel will be paint red and lockable.
 - .9 Provide sprinkler resistant hoods and doors for panelboards installed in sprinklered areas.

3 EXECUTION

3.1 INSTALLATION

- .1 Protect installed products and components from damage during construction. Repair damage to adjacent materials caused by equipment installation
- .2 Install equipment in accordance with manufacturer's instructions or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- .3 All equipment installed in this scope will meet clearance requirements of the Electrical Code. Any equipment installed that does not meet this requirement will be reviewed with the Consultant.
- .4 Free standing panelboards will be mounted on concrete housekeeping pads. The pad will be 100 mm (4") high and have 20 mm (3/4") chamfered edges. All exposed concrete surfaces will be finished smooth and level.
- .5 Mounting heights of wall mounted panels will generally be 2000 mm (6'-6") to the top of the panel trim.
- .6 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 01 and Section 26 05 00 Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide Wiring Devices, including but not limited to the following:
 - .1 Receptacles
 - .2 Coverplates
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 26 05 33 - Raceways and Boxes for Electrical Systems
 - .2 Section 26 09 23 - Lighting Controls
 - .3 Section 27 05 28 - Pathways for Communications Systems

1.3 REFERENCES

- .1 Abbreviations and Acronyms:
 - .1 AFCI: Arc Fault Circuit Interrupter
 - .2 GFI/GFCI: Ground Fault Circuit Interrupter
 - .3 UPS: Uninterruptible Power Supply

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 26 05 00 Common Work Results for Electrical.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements
 - .1 Special devices not listed in the Schedule of Wiring Devices.
 - .2 Flat Panel Display outlet boxes

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 Hubbell
 - .2 Legrand - Pass & Seymour
 - .3 Eaton - Arrow Hart
 - .4 Bryant
 - .5 Leviton
 - .2 Requests for substitutions shall be made in conformance with Section 26 05 00 Common Work Results for Electrical.
 - .3 Products listed here are based on products and part numbers manufactured by Hubbell and indicate a level of quality and technical specification and is not an endorsement of the manufacturer.

2.2 MATERIALS

- .1 All wiring devices and will be white in colour unless noted otherwise. Device part numbers shown represent required component series and are not meant to be exact part number or identify colour. The following special colours will be used:
 - .1 Red – Standby, Emergency or Essential Power
 - .2 Orange – UPS Power
 - .3 Green – Controlled Circuit
 - .4 Blue – Surge Suppression
 - .5 Black – Special receptacle not in CSA 5-15R or 5-20R configurations
 - .6 If an outlet exhibits more than one of the above properties, then a clear permanently-mounted label will be placed above the device stating all the other functions or properties of this wiring device.

.2 Schedule of Wiring Devices

.1 Standard Devices

Description	CSA/NEMA Configuration	Hubbell Part Number
15 Ampere, 120 Volt, Toggle Type Switch, Heavy Duty (Series includes Single pole, double pole, 3-way, 4-way, locking, pilot light, etc.)	n/a	1200 Series
20 Ampere, 120 Volt, Toggle Type Switch, Heavy Duty (Series includes Single pole, double pole, 3-way, 4-way, locking, pilot light, etc.)	n/a	1220 Series
15 Ampere, 347 Volt, Toggle Type Switch, Heavy Duty (Series includes Single pole, 3-way, and 4-way)	n/a	18200 Series
20 Ampere, 347 Volt, Toggle Type Switch, Heavy Duty (Series includes Single pole and 3-way)	n/a	18220 Series
15 Ampere, 120 Volt, Duplex Receptacle (Series includes standard, tamper resistant, isolated ground, weather resistant, corrosion resistant, etc.)	5-15R	5262 Series
20 Ampere, 120 Volt, T-Slot, Duplex Receptacle (Series includes standard, tamper resistant, isolated ground, weather resistant, corrosion resistant, etc.)	5-20R	5362 Series
15 Ampere, 120 Volt, GFCI Duplex Receptacle	5-15R	GFRST15
20 Ampere, 120 Volt, T-Slot, GFCI Duplex Receptacle	5-20R	GFRST20
15 Ampere, 120 Volt, GFCI Weather Resistant Duplex Receptacle	5-15R	GFWRST15
20 Ampere, 120 Volt, T-Slot, GFCI Weather Resistant Duplex Receptacle	5-20R	GFWRST20
30 Ampere, 120/250 Volt, Dryer Receptacle, Black	14-30R	HBL9430A

Description	CSA/NEMA Configuration	Hubbell Part Number
50 Ampere, 120/250 Volt, Range Receptacle, Black	14-50R	HBL9450A
20 Ampere, 120 Volt, Locking Single Receptacle, Black	L5-20R	2310
20 Ampere, 250 Volt, Locking Single Receptacle, Black	L6-20R	2320

.2 Standard Devices for use in light duty environments:

Description	CSA/NEMA Configuration	Hubbell Part Number
15 Ampere, 120 Volt, Decorator Duplex Receptacle	5-15R	DR15
20 Ampere, 120 Volt, T-Slot, Decorator Duplex Receptacle	5-20R	DR20
15 Ampere, 120 Volt, Decorator Duplex Receptacle, Controlled, Green (Series includes controlled, half controlled, and tamper resistant)	5-15R	DR15C Series
20 Ampere, 120 Volt, T-Slot, Decorator Duplex Receptacle, Controlled, Green (Series includes controlled, half controlled, and tamper resistant)	5-20R	DR20C Series
15 Ampere, 120 Volt, Surge Protection Duplex Receptacle, Blue	5-15R	HBL5260SA
20 Ampere, 120 Volt, T-Slot, Surge Protection Duplex Receptacle, Blue	5-20R	HBL5360SA
15 Ampere, 120 Volt, Duplex Receptacle with 5 Ampere, 5 Volt combination USB Type A and Type C charging ports.	5-15R	USB15AC5
5 Ampere, 5 Volt, 4-port USB Type A charging ports.	n/a	USB4

.3 Special mounting and accessories

- .1 Flat Panel Display Wall box – 2-gang recessed FPTV Connection Enclosure Hubbell NSAV62M. Provide steel cover. Provide standard power kit and 1-gang decorator wall plate for Audio Visual or Telecommunications. For use with surface mounted flat screen displays only.
- .2 Quad receptacle types are not permitted and will be substituted for two duplex receptacles ganged together.
- .3 Provide other special wiring devices as noted on the drawings to the same quality as those listed within the “Schedule of Wiring Devices”.

.3 Receptacle Control

- .1 Controlled receptacles should be clearly identified with green colour, controlled symbol, and the words “CONTROLLED” on the receptacle face of each receptacle being controlled. A clear permanently-mounted label will be placed above the receptacle stating “THIS OUTLET CONTROLLED BY OCCUPANCY”.
- .2 Receptacle within the following spaces must be controlled wired or wirelessly via lighting control system as detailed in Section 26 09 23 Lighting Controls: conference rooms, rooms used primarily for printing and/or copying functions, breakrooms, and classrooms.

.4 Coverplates

- .1 Coverplates for wall mounted wiring devices in finished areas will be smooth 302 stainless steel type.
- .2 Flush floor receptacles will be provided complete with a carpet flange to match floor box colour where applicable.
- .3 In unfinished areas or surface mounted devices, coverplates will be galvanized type with rounded corners and back boxes will be cast type.
- .4 Provide gasketed ‘While-in-Use’ or Extra Duty polycarbonate cover Hubbell RW58300 for all devices exposed to weather or water splashing. Cover will have ability to install padlock to restrict access and removal of installed plugs.
- .5 Provide proper ganged coverplates and backboxes for all grouped outlets. Provide internal barriers between receptacles from different panels, and between receptacles and extra low voltage outlets.

3 EXECUTION

3.1 INSTALLATION

- .1 All switches controlling a connected load in excess of 10 amperes will be 20 ampere rated type.

- .2 Mounting heights of the wiring devices will be as follows unless subject to special installation conditions, or otherwise indicated on floor plans or dimensioned interior elevations (Mounting heights refer to the centre of the outlet box):
 - .1 Light Switches and Control Devices 1100 mm (43").
 - .2 Wall Outlets and Receptacles 460 mm (18") or 150 mm (6") above countertop or back splash as applicable.
- .3 Coverplates will be installed flush and level.
- .4 Install wiring devices after wall construction and painting is complete.
- .5 All wiring devices shown as being relocated on drawings will be replaced with new device and coverplate and will be connected to the existing circuit.
- .6 Install all wall switches with the OFF position down. All CSA 5-15R and 5-20R configuration receptacles will be installed so the ground is in the bottom position.
- .7 Where electrical outlets and wall mounted heating units occur at the same height and location, the outlets will be mounted below or beside the heater, unless noted otherwise.
- .8 Work top mounted outlets will be above floor monument type securely fastened to work surface using a threaded connection to conduit system. Provide all required fittings, inserts and accessories required for approved mounting and connection.
- .9 Outlets installed in millwork will be standard wall mounted versions, flush mounted into face of the appropriate vertical surface. Refer to millwork elevations and sections for further details.
- .10 Ensure that for receptacles marked as isolated ground that the bond wire is connected to the serving panels isolated ground bus.
- .11 Receptacles not on isolated ground will have a green bond wire bonded to the device grounding terminal, the back box it is located in, and bonded to the branch circuit panelboard ground bus.
- .12 Prior to rough-in for wall outlets for flat screen displays, coordinate mounting height such that flat screen mounting bracket is not interfering with wall outlet. Care should be taken to ensure wall outlet is completely behind flat screen display when mounted. If outlet is completely behind flat screen cover will not be installed.
- .13 All outlets installed in exterior locations will be weather resistant type and will be protected with an Extra Duty or while-in-use cover for allowing outlet to be covered even while in use.

3.2 SITE QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 When installation is complete, test operation of all devices. All defective devices shall be replaced and all defective wiring shall be repaired.

- .1 Switches should be operated to ensure load is switching as expected.
 - .2 For CSA 5-15R and 5-20R configuration receptacles should be tested with handheld plug-in receptacle tester for open circuits, and reversed wiring. GFCI test shall be completed on all GFCI receptacles and circuits.
 - .3 For receptacles of other configurations, a multimeter shall be used to preform similar tests.
- .2 Non-Conforming Work:
- .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight or errors.
 - .2 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to the satisfaction of the Consultant at no additional cost to the Owner.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 01 (and Division 20 or 26).

1.2 SUMMARY

- .1 Section includes: Provide fuses, including but not limited to the following:
 - .1 HRC Fuses

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Canadian Standards Association (CSA):
 - .1 CAN/CSA C22.2 No. 106 – HRC – Miscellaneous Fuses
 - .2 CSA 248 – Fuses for Supplementary Overcurrent Protection (600 Volts, Maximum)

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 01 33 00 - Submittals.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements

1.5 MAINTENANCE MATERIALS SUBMITTALS

- .1 Spare Fuses:
 - .1 Supply a complete set of spare fuses in original packaging for all fused secondary distribution equipment. Quantity of spare fuses to match fuses installed.
 - .2 Unless otherwise specified, store the spare fuses in fuse storage cabinets.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Single source responsibility: Obtain each type of product in this Section from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

2.2 MATERIALS

- .1 General

- .1 Fuses are to be CSA certified and marked in accordance with the following Standards:

- .1 HRC fuses – CAN/CSA C22.2 No. 106.
- .2 Plug and cartridge fuses – CSA 248.

- .2 HRC fuses are to have an interrupting capability of 200,000 A symmetrical.
- .3 Unless otherwise specified, fuses are to be the products of one manufacturer.
- .4 Fuse type references L1, L2, J1, R1, etc., have been adopted for use in this Specification.

- .2 Fuse Types:

- .1 Fuse types are to be as follows:

- .1 HRC-J fuses (formerly Class J):

- .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
- .2 Type J2, fast acting.

- .2 HRC-L fuses (formerly Class L):

- .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
- .2 Type L2, fast acting.

- .3 HRCI-R fuses (formerly Class R – for UL Class RK1 fuses, peak let-through current and 12t values are not to exceed limits of UL 198E table 10.2):

- .1 Type R1 (UL Class RK1, time delay, capable of carrying 500% of its rated current for 10 s minimum to meet UL Class RK1 maximum let-through limits.
- .2 Type R2, time delay, capable of carrying 500% of its current for 10 s minimum.

.3 Type R3 (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.

3 EXECUTION

3.1 INSTALLATION

.1 Fuses:

- .1 Install fuses for secondary distribution equipment in accordance with equipment specifications and drawing requirements. Ensure that the correct fuses are assigned to each electrical circuit.
- .2 Generally, fuses are to be as follows:
 - .1 Motor loads, elevators & transformers: type J1 for up to and including 600 amperes and type L1 for ratings above 600 A.
 - .2 Other service and equipment: a type either indicated on the drawings, specified with the equipment, or required for the purpose.
- .3 Ensure that circuit fuses are fitted to physically matched mounting devices. Provide Class R rejection clips for HRCI-R fuses.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide disconnect switches.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 26 28 13 Fuses

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Canadian Standards Association (CSA):
 - .1 CSA – C22.2 No. 4 – Enclosed and Dead-Front Switches

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 01 33 00 - Submittals.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for disconnect switches and accessories proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules, and Specification:
 - .1 Acceptable manufacturers are:
 - .1 Rockwell Automation/Allen-Bradley

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- .2 Eaton
 - .3 Siemens
 - .4 Schneider Electric
- .2 Requests for substitutions shall be made in conformance with Section 26 05 00
 - .3 Single source responsibility: Obtain each type of product in this Section from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

2.2 MATERIALS

- .1 All disconnect switches are to be in accordance with requirements of CSA – C22.2 No. 4.
- .2 Disconnect Switches:
 - .1 Heavy-duty front operated switches each in accordance with CSA – C22.2 No. 4, each complete with a red handle suitable for padlocking in the “off” position, and a NEMA/ EEMAC enclosure.
 - .2 Fusible units are to be complete with fuse clips in accordance with CSA-C22.2 No. 39, Fuseholder Assemblies and to suit fuse types specified below.
 - .3 Unless otherwise scheduled or specified fuses are to be equal to English Electric Ltd. HRC fuses, Form I Class “J” for constant running equipment and Form II Class “C” for equipment that cycles on and off.
 - .4 Provide viewing window that will allow visibility of the position of the blades.
 - .5 Enclosures: Unless otherwise specified, contactor enclosures are to be in accordance with the following NEMA/EEMAC ratings:
 - .1 All enclosures located in sprinklered areas – Type 2.
 - .2 All enclosures exposed to the elements – Type 3R, constructed of stainless steel.
 - .3 All enclosures inside the building in wet areas – Type 3R, constructed of stainless steel.
 - .4 All enclosures except as noted above – Type 1.

3 EXECUTION

3.1 INSTALLATION

- .1 Disconnect Switches:
 - .1 Install all required disconnect switches in accordance with drawing plans, schedules, details, and requirements of the Specification.

- .2 Install fuses for fusible disconnects.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide contactors, including but not limited to the following:
 - .1 Contactor
 - .2 Enclosure

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction.
 - .1 Canadian Standards Association (CSA):
 - .1 CSA C22.2 No. 14 – Industrial Control Equipment
 - .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS2 – Controllers, Contactors and Overload Relays

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 26 05 00
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements
 - .2 Product data is to include:
 - .1 Enclosure rating
 - .2 Short circuit withstand rating
 - .3 Nameplate information and schematic wiring diagram

.3 Manufacturer Reports:

- .1 Start-Up and Site Certification Reports: Submit start-up and site certification reports as specified in Part 3 of this Section.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
- .1 Acceptable manufacturers are:
- .1 Rockwell Automation/Allen-Bradley
 - .2 Eaton
 - .3 Siemen
 - .4 Schneider Electric
- .2 Requests for substitutions shall be made in conformance with Section 26 05 00
- .3 Single source responsibility: Obtain each type of product in this Section from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

2.2 MATERIALS

- .1 Contactors:
- .1 Supply in accordance with the requirements of CSA C22.2 No. 14 and NEMA ICS2.
- .2 Modular design, factory assembled, electrically held (unless otherwise noted), full size contactors in accordance with requirements of CSA C22.2 No. 14 and NEMA ICS2. Unless otherwise shown or specified each contactor is to be complete with a nameplate, and the following:
- .1 A padlockable enclosure with conduit knockouts and mounting screw holes conforming to requirements specified below.
 - .2 Enclosed contacts with closed contact indication.
 - .3 Unless otherwise indicated, two NC and two NC auxiliary plug-in contacts.
 - .4 A continuously rated interchangeable coil.
 - .5 Side access, finger-safe field wiring terminals to suit conductors indicated.
 - .6 A manual operator.

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- .7 Optional factory installed accessories consisting of:
 - .1 A hand-off-selector switch.
 - .2 2 identified pushbuttons, 1 green for power on, and 1 push-to-test.
 - .3 A fuse and transformer kit.
 - .4 a fused door interlock disconnect switch.
 - .3 Enclosures: Unless otherwise specified, contactor enclosures are to be in accordance with the following NEMA/EEMAC ratings:
 - .1 All enclosures located in sprinklered areas – Type 2.
 - .2 All enclosures exposed to the elements – Type 3R, constructed of stainless steel.
 - .3 All enclosures inside the building in wet areas – Type 3R, constructed of stainless steel.
 - .4 All enclosures except as noted above – Type 1.

3 EXECUTION

3.1 INSTALLATION

- .1 Installation Of Contactors
 - .1 Provide contactors where shown and secure in place.
 - .2 Connect each contactor with wiring in conduit in accordance with drawing requirements.
 - .3 Do all required interlocking work in accordance with drawing control diagrams and control sequence requirements.

3.2 SITE QUALITY CONTROL

- .1 Manufacturer Services:
 - .1 When contactor installation is complete, arrange and pay for the manufacturer to visit the site to check the installation, and to supervise all required testing and adjusting. Submit a copy of a report from the manufacturer which certifies that each contactor has been properly installed and connected, and has been checked and adjusted, as specified in Part 1 of this Section.

END OF SECTION

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Provide surge protection devices (SPDs) of the types as shown on the drawings and specified herein.
- .2 Refer to the "Power Distribution Single Line Diagram" as shown on the drawings, for details of equipment and components to be provided.

1.3 REFERENCES

- .1 Section 26 05 19 Wire and Cable
- .2 Section 26 05 53 Identification for Electrical Systems

1.4 QUALITY ASSURANCE

- .1 Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction.
 - .1 CSA C22.2 No.269 – Surge Protection Devices
 - .2 UL 1449 – Standard for Surge Protection Devices
- .2 All equipment will be manufactured in accordance with the applicable sections of CSA Specification C22.2.

1.5 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements.
 - .2 Product data sheets must indicate that the SPDs are in accordance with the relevant Codes and Standards, and include certified wiring diagrams to indicate field connections, documentation to verify the following:
 - .1 short circuit current rating
 - .2 voltage protection rating for all modes
 - .3 maximum continuous operating voltage rating

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- .4 I-nominal rating
 - .5 device UL Type listing
 - .3 Maintenance and operating instructions, parts lists, etc., will be provided for any special function equipment.
 - .2 Site Quality Control Submittals:
 - .1 Field Inspection Report: Submit a manufacturer's field inspection and test report.

2 PRODUCTS

2.1 APPROVED MANUFACTURERS

- .1 Acceptable manufacturers are:
 - .1 Schneider Electric
 - .2 Siemens
 - .3 Eaton
 - .4 Leviton
 - .5 GE Industrial Solutions
 - .6 Phoenix Contact
 - .7 Spectrum Power Systems
- .2 Obtain each type of product in this Section from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

2.2 MATERIALS

- .1 Each SPD is to be listed and labelled in accordance with requirements of the relevant Codes and Standards:
- .2 All Surge Suppressors shall have the following:
 - .1 Maintenance free, 20 kA nominal discharge current rated, in accordance with CSA C22.2 No. 269 and listed and labelled to indicate compliance with the latest edition of UL 1449, capable of operating without the need for an external or replaceable internal overcurrent device, capable of protecting all modes of the electrical system, each with a maximum continuous operating voltage of minimum 115% of the system nominal operating voltage, and equipped with:
 - .1 For externally mounted units, a NEMA/EEMAC 4 enclosure with, as required, internal safety barriers with lockout facilities to prevent contact with energized components.

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- .2 A balanced suppression platform to equally distribute the surge current to all thermally protected metal-oxide varistors which are the core surge suppression component
 - .3 Soldered internal components, hardwired with connections utilizing low impedance conductors.
 - .4 Protected status indicators consisting of red/green solid-state lights that report the status of the protection on each phase, designed such that the absence of a green light and the presence of a red light will indicate that damage has occurred on the respective phase or mode, and if power is removed from any phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes.
 - .5 In addition, for wye configured units, status indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes, as well as an additional green/red light that reports the status of the protection elements and circuitry in the N-G mode.
 - .6 In addition, for delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
- .2 Optional items to be provided are as follows:
- .1 Fault condition audible alarm and alarm silence pushbutton.
 - .2 LCD to indicate how many surges events with a peak current magnitude of a minimum of 50 ± 20 amperes have occurred, complete with reset button containing a mechanism to prevent accidental resetting of the counter via a single short duration button press, and if power is lost, the ongoing surge count is to be stored in non-volatile memory and displayed after power is restored.
- .3 Type 2 Surge Suppressors
- .1 UL Type 2, multi-stage parallel connected, branch panelboard surge suppressor of compact non-modular design, each with a UL "in" rating (nominal discharge) of 20 kA, and the following:
 - .1 Per phase status indicators on the front of the enclosure to monitor and indicate whether suppression capabilities have been comprised.
 - .2 Protective components that utilize thermally protected metal oxide varistors per mode.
 - .3 Form C dry contacts for remote monitoring capabilities.
 - .4 A high-performance EMI/RFI noise rejection filter such that noise attenuation for electric line noise is up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220AS insertion loss test method.
 - .5 In addition to the UL 1449 listing, a UL 1283 listing.

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- .6 A NEMA/EEMAC 4 enclosure for external mounting, and a proper back box with hardware for flush or semi-flush mounting in the panelboard enclosure.

3 EXECUTION

3.1 INSTALLATION

- .1 Where new distribution equipment is being installed, integrate the surge suppression device into distribution equipment with the ability to safely service or replace components without equipment shutdown.
- .2 Where the surge suppression device is shown on existing distribution equipment or indicated external to the equipment it protects, install the devices as close as possible to the distribution equipment, but confirm exact location prior to installation. Ensure adequate space for inspection and maintenance.
- .3 Where surge suppression devices are integral with the equipment they protect, supply the device(s) to the manufacturer of the distribution equipment for installation by the distribution equipment manufacturer.
- .4 Review all SPD manufacturer's installation information and verify all voltages prior to installation. Where the SPD is to be installed by the distribution equipment manufacturer, supply installation instructions with the SPDs.
- .5 Ensure that each SPD is installed with the shortest lead length possible and avoid any unnecessary or sharp bends.
- .6 Ground resistance is to be 25 Ω or less.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes lighting fixtures complete with lamps, drivers, lenses, etc.
- .2 Equipment shall be compatible with the various building elements that affect the installation and operation of the units.

1.3 REFERENCES

- .1 Provide fixtures that will meet the requirements of the various active government incentive programs such as Save-on-Energy, High Performance New Construction prescriptive path, etc.

1.4 SUBMITTALS

- .1 Shop drawings for luminaires indicating lighting performance details, fixture construction details, air control and ductwork connection details, etc., and pictures of each type of lighting fixture shall be submitted for review.
- .2 Shop drawings shall be submitted for LED drivers, and bulbs for all fixtures to be installed. These shall be submitted separately from the lighting fixtures being installed and should indicate each fixture the product is installed.
- .3 Fixtures which have been specially designed or altered shall have a full scale mock-up built and submitted for co-ordination and design review when requested by the Consultant.
- .4 Mock-up fixtures must have engineering drawings submitted for approval, after the mock-up has been approved.
- .5 Fixtures shall not be released prior to review of the shop drawings. Cancellation charges will not be paid for changes to fixtures made before the fixture cuts have been reviewed.
- .6 Submittals under this Section shall be in accordance with Division 1 Submittals.

1.5 QUALITY ASSURANCE

- .1 All lighting fixtures and components must be CSA approved, ULC approved, or approved by Special Inspection from the Electrical Safety Authority.
- .2 Where stated, LED fixtures shall be DLC and/or Energy Star listed.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Light fixtures must be shipped in individual containers. The fixtures must be stored in a dry area protected from the elements and physical damage.

1.7 WARRANTY

- .1 LED lamps and drivers shall be warranted for minimum 5 years from date of final acceptance, all other lamps and ballasts for a minimum 1 year warranty period.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable manufacturers are:
 - .1 Acuity
 - .2 Signify
 - .3 Cooper
 - .4 Hubbell
 - .5 Current
 - .2 Single source responsibility: Obtain each type of product in this Section from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

2.2 LED LIGHT FIXTURES

- .1 LED monochrome lighting fixture shall have lighting that shall a minimum CRI of 85 for regularly occupied spaces, a minimum CRI of 70 for exterior, and a minimum of 75 for all other spaces. The fixture shall have a minimum L70 of 50,000 hours. All lighting shall have IESNA LM-79 and LM-80 testing reports and life calculations based on TM-21. Exterior and interior area lighting shall have a minimum efficiency of 80 lumens per watt.
- .2 LED drivers shall have minimum lifespan equal or better than the lifespan of the L70 lifespan of the LED lamps it serves. Drivers shall be integrated into the fixture if serving only that fixture or remote if the driver serves more than one fixture. All drivers shall be dimmable using 0-10V dimming technology unless noted otherwise. LED drivers shall have high power factor. All LED lighting and drivers used in exterior or unheated applications shall provide start-up and operation in temperatures from -30 °C to +50 °C.

2.3 LENSES

- .1 All flat plastic lenses shall be a minimum 3.2 mm (1/8") thick acrylic type with no mid-span sag.
- .2 All metal parabolic louvres shall be fabricated from low iridescent, semi-specular aluminum sheet with cell size, depth and quantity as indicated on fixture schedule. All parabolic louvres shall be shipped assembled in fixtures to prevent damage and be enclosed in a clear plastic wrap all around to prevent dust or dirt contamination. Plastic wrap shall not be removed until space is fully cleaned and approval to do so is granted by the Consultant.
- .3 All special lenses shall be as specified in fixture schedule.

2.4 ACCESSORY PRODUCTS

- .1 Air control and slot provision where applicable shall be fully co-ordinated with the Mechanical Trade for a fully compatible installation. Set dampers to fully blank of air slots where instructed.

2.5 SOURCE QUALITY CONTROL

- .1 Lighting fixtures shall be provided with all auxiliary components and mounting hardware required for installation in the building as intended. Verify all catalog numbers with descriptions given including mounting, lamp type and quantity.

3 EXECUTION

3.1 INSTALLATION

- .1 Ensure that both recessed and surface mounted light fixtures mounted as part of a suspended ceiling system are adequately supported. Fixtures shall not be suspended directly from the ceiling system supporting grid, but must be supported directly from the building structure.
- .2 Surface mounted fixtures on T-Bar ceilings may be supported using a minimum of two "Caddy" IDS clips from the ceiling suspension grid and which are also separately connected to the building structure.
- .3 Co-ordinate the requirements of the ceiling system supports with the Ceiling Contractor prior to fixture installation. Fixture safety chains or wires shall also be provided as required by regulatory agencies. The method of attaching suspension wires and safety chains or wires to fixtures and building elements, shall be discussed with and approved by the Consultant prior to installation. Where the structural system is to have a fireproofing material applied, attach all structural system fasteners in advance of the fireproofing.
- .4 Pendant mounted fixtures shall have a deep canopy cover to fully cover the supporting outlet box and render it inconspicuous. Provide a self-aligning type cover and support for fixtures mounted to sloped surfaces.

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- .5 Electrical wiring or components shall not be attached to the ceiling system suspension wires.
 - .6 For exact details of fixture installation in valances, bulkheads, millwork, etc., refer to the Architectural Drawings.
 - .7 All electrical fixtures are to be delivered to the site with the specified finish. Where required colour or finish is not available from the fixture manufacturer, obtain such from an approved paint shop.

3.2 FIELD QUALITY CONTROL

- .1 Check all lighting fixtures prior to their installation to ensure that they are the specified and approved fixtures for the project. Check the fixture catalogue number, frame and mounting arrangement, lens type, reflector type, lamp socket position, lamp type, fixture operating voltage, etc.
- .2 The locations of fixtures are shown generally on the electrical drawings. For accurate locations refer to the architectural reflected ceiling plans.

3.3 CLEANING

- .1 Clean all lenses and interior of all fixtures.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Designated emergency lighting fixtures shall be provided directly from the essential power source with the use of UL924 relays to disable all lighting controls during normal power interruption.

1.3 REFERENCES

- .1 Reference Codes and Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction.
 - .1 CSA C22.2 No. 141 Emergency lighting equipment
 - .2 Ontario Building Code
 - .3 Ontario Electric Safety Code
 - .4 Section 26 50 00 Lighting

1.4 SUBMITTALS

- .1 Complete sets of shop drawings will be submitted indicating the following:
 - .1 System components, specifications, and dimensions.
 - .2 Wiring schematics.
- .2 For Closeout submittals provide the following:
 - .1 Emergency lighting runtime test report

1.5 QUALITY ASSURANCE

- .1 All lighting fixtures and components must be CSA approved, ULC approved, or approved by Special Inspection from the Electrical Safety Authority.

1.6 STORAGE AND HANDLING

- .1 The fixtures must be stored in a dry area protected from the elements and physical damage.

1.7 SPARES

- .1 Provide the following quantity of spare devices:
 - .1 Two (2) complete UL924 relays
- .2 Include labour for the installation of the spare fixtures/devices if directed by the Authority Having Jurisdiction.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable manufacturers are:
 - .1 Aimlite
 - .2 Beluce
 - .3 Emergi-lite
 - .4 Lumacell
 - .5 Stanpro
- .2 Single source responsibility: Obtain each type of product in this Section from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

3 EXECUTION

3.1 INSTALLATION

- .1 Install UL924 relays in accordance with manufacturer's recommendations to suit lighting requirements.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide pathways for communications and other extra low voltage systems, including but not limited to the following:
 - .1 Internal building horizontal pathways, service provider pathways, and exterior pathways.
 - .2 Outlet boxes, cover plates, conduits, cable trays, pull boxes, sleeves, backboards, telecom rooms, shafts, fish wires, innerduct, cable hooks, firestopping, cable managers, service fittings, and direct buried ducts.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Division 21 - Fire Suppression
 - .2 Division 22 - Plumbing
 - .3 Division 23 - Heating, Ventilating, and Air Conditioning (HVAC)
 - .4 Section 26 05 02 - Fire Stopping and Smoke Seal Systems
 - .5 Section 26 05 19 - Wire and Cable
 - .6 Section 26 05 33 - Raceway and Boxes for Electrical Systems
 - .7 Section 26 05 36 - Cable Tray
 - .8 Section 26 27 26 - Wiring Devices

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American National Standards Institute (ANSI)/ Telecommunications Industry Association (TIA):
 - .1 ANSI/TIA 569 – Telecommunications Pathways and Spaces

.2 ANSI/TIA 606 – Administration Standard for Telecommunications Infrastructure

.2 Ontario Building Code

.3 Ontario Electrical Safety Code

1.4 SUBMITTALS

.1 Submittals under this Section shall be in accordance with Section 26 05 00.

.2 Product Data:

.1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements

.1 Fire Rated Pathways

2 PRODUCTS

2.1 MANUFACTURERS

.1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:

.1 Acceptable Manufacturers:

.1 Fire-rated Pathways:

.1 STI EZ-Path

.2 Hilti Firestop Speed Sleeve

.2 Requests for substitutions shall be made in conformance with Section 26 05 00.

2.2 MATERIALS

.1 Internal Distribution:

.1 Interior conduit to be EMT unless specifically noted or required to be otherwise.

.2 Conduit not indicated as to size to be 25 mm (1 in) minimum.

.3 LB fittings are not allowed under any conditions.

.2 Distribution Terminations:

.1 Provide 19 mm (3/4 in) fire retardant painted (all six sides) plywood wall mounted equipment mounting backboards as shown for telecommunications rooms.

.2 Provide conduits terminated with an insulated bushing to area ceiling spaces and telecom rooms as shown for zone conduit or sleeve installations.

.3 Outlets:

- .1 Wall outlets consist of standard deep single gang outlet boxes unless otherwise indicated. Provide blank coverplates for all un-used outlets.
- .2 Coverplates complete with appropriate jacks are provided by extra low voltage systems providers.

.4 Fire-Rated Cable Pathways:

- .1 Fire-Rated Pathway device modules are comprised of steel pathway with self-adjusting intumescent foam pads allowing 0% to 100% cable fill without removal of intumescent material.
- .2 Quantity and size of pathway are based on the fill area listed on the drawings or minimum sizes listed below. Provide uniform sized of devices where more than one device is required at same location.
- .3 Unless noted on the drawings, the minimum clear space sizes are:
 - .1 160 cm² (25 in²) for telecommunications rooms
 - .2 for cable tray penetrations, provide minimum size equal to cross-sectional area of cable tray
 - .3 80 cm² (12.5 in²) in corridors without cable trays
 - .4 8 cm² (1.25 in²) for room penetrations

.5 Wire Basket Trays:

- .1 Provide wire basket cable tray of types and sizes indicated with support assemblies and accessories.
- .2 All straight section longitudinal wires shall be constructed with a straight and rigid top wire. In no case shall the top wire be bent or kinked either before or after installation.
- .3 All fittings for changes in direction and/or elevation shall be factory complete parts and shall be "Listed and Labeled" ("Classified") in the same manner and by the same Agency as the straight sections. In no case shall a straight section be modified in the field to change direction or elevation.
- .4 Wire basket cable tray shall be made of high strength steel wires and formed into a minimum 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. All mesh sections must have at least one bottom longitudinal wire along entire length of straight section.
- .5 Wire basket cable tray sizes shall conform to the following nominal criteria:
 - .1 Straight sections shall be furnished in standard lengths of up to 10 feet.
 - .2 Wire diameter shall be 0.187" (3/16") minimum on all mesh sections.

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- .3 Tray shall have a minimum usable loading depth as specified on the drawings.
 - .6 Material and Finishes: Material and finish specifications are as follows:
 - .1 Black Powder Coat: Straight sections, fittings, supports, and accessories shall be powder coated Black with an average paint thickness of 1.2mils (30microns) to 3.0mils (75microns).
 - .7 Special accessories shall be furnished as required to protect, support and install a wire basket cable tray system:
 - .1 Divider Strips shall be installed by the manufacturer, welded into the cable tray and powder coated (or manufactured of stainless steel or hot-dipped galvanized) and shall be of the same height as the usable height specified for the cable tray.
 - .2 Covers shall be no longer than 5' for handling safety and shall be finished in the same manner as the cable tray, fittings, supports, and other accessories. Covers shall "snap on" to cable tray and shall provide holes for imposition of "lock-out tag-out" security.
 - .3 Dropouts shall be manufactured of the same material and finish as the cable tray and fittings.
 - .4 Supports shall be manufactured of .25" (1/4") diameter wire or other material as supplied by manufacturer of cable tray. Supports shall be finished in the same manner as cable tray, fittings, and accessories with powder coat, hot-dipped galvanizing, or stainless steel.

3 EXECUTION

3.1 INSTALLATION

- .1 Install empty raceway system, including distribution system, fish wire, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves, cable tray, service poles, miscellaneous and positioning material to constitute complete system.
- .2 Run parallel to building lines all horizontal and vertical pathways. Do not route diagonally for extended distances.
- .3 Since cabling for communications is subject to many add/moves/changes in future, install pathways in locations that are readily accessible in future and route below ductwork and piping in ceiling spaces. Coordinate installation of pathways with Division 21, Division 22, and Division 23 to minimize interference and maximize accessibility to pathways.
- .4 Horizontal data cables from telecommunications rooms patch panels have limitation of cable length of 90 m (297 ft). Optimize pathways to minimize cable length.
- .5 Protect installed products and components from damage during construction.

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- .6 Repair damage to adjacent materials caused by pathways for communications systems installation
 - .7 Restrict installation of conduits as follows:
 - .1 60 m (200 ft) maximum no bends
 - .2 45 m (150 ft) maximum with equivalent of one 90° bend
 - .3 30 m (100 ft) maximum with equivalent of two 90° bends
 - .4 20 m (65 ft) maximum with equivalent of three 90° bends
 - .5 No more than three 90° bends are allowed in any section of conduit run
 - .8 Install all conduits with large radius bends. Minimum bending radii is 10 times the diameter.
 - .9 Mounting heights of the communications outlets unless otherwise noted are as follows:
 - .1 Standard wall outlet 460 mm (16 in) or 150 mm (6 in) above countertop or splash back
 - .2 Wall mounted telephones outlets 1100 mm (43 in) to centre of backbox
 - .3 When mounting adjacent to other devices at same location, communications outlet box to match installation height of adjacent outlet box used for wiring device
 - .10 Refer to the systems conduit diagrams for details of distribution and outlet conduit, cabinet and backboard requirements and to floor plans for component and outlet locations.
 - .11 Install nylon pull cords in all empty conduits and tag and identify both ends appropriately. Maintain a pull cord in all conduit systems used only to partial capacity.
 - .12 Firestopping
 - .1 Install at all fire separations Fire-Rated Pathway device modules to allow future cables to be installed through fire separation. Prepare and install device module as per manufacturer's instructions.
 - .2 Use Fire-Rated Pathway device module only for extra low voltage systems cabling and do not use for line voltage applications.
 - .13 Wire Basket Trays
 - .1 Install cable tray level and plumb according to drawings, original design, and referenced standards.
 - .2 Install wire basket cable tray in accordance with NEMA VE 2 to ensure that the cable tray equipment complies with the requirements of the OESC.

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- .3 All trays should be supported using a minimum of ¼" All Threaded Rod (ATR) or Gripple No 3 Y-Fit Cable Support. Verify Rod or Cable support capacity is adequate for cable tray, supports, cabling, and future growth.
 - .4 Special accessories shall be furnished as required to protect, support and install a wire basket cable tray system.
 - .5 Coordinate wire basket cable tray with other electrical work as necessary to properly interface installation of wire basket cable tray with other work.
 - .6 Support trays and fasten to structure. Install supports at each connection point, at end of each run, and at other points to maintain spacing between supports of 6' maximum.
 - .7 Install expansion connectors where recommended by manufacturer and/or as indicated on drawings.
 - .8 Install firestopping to sustain ratings when passing wire basket cable tray through fire-rated elements.
 - .9 Bond and ground metal cable tray in accordance with OESC requirements.
 - .1 Provide continuity between wire basket cable tray components.
 - .2 Make connections to tray using bonding loops built into tray and carriage bolt/nut assembly supplied by cable tray manufacturer.
 - .3 Ground cable trays using grounding lug attached to open bonding loop on last section of tray or fitting.
 - .10 If required, install warning signs along wire basket cable tray, located to be visible.
 - .11 Provide sufficient space encompassing wire basket cable tray to permit access for installing and maintaining cables.
 - .12 Test wire basket cable tray systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide complete structured cabling systems, including but not limited to the following:
 - .1 Telecommunications cabling
 - .2 Outlet jacks and plugs
 - .3 Patch panels and termination blocks
 - .4 Racks and cabinets
 - .5 Grounding busbars and bonding
 - .6 Labelling
 - .7 Firestopping
 - .8 Testing and certification.
- .2 Products furnished/supplied but not installed under this section:
 - .1 Patch cord and line cords
- .3 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 26 05 19 Wire and Cable
 - .2 27 05 28 Pathways for Communications Systems

1.3 REFERENCES

- .1 Abbreviations and Acronyms:
 - .1 “MPTL” is defined as Modular Plug Terminated Link.
 - .2 “U” is defined as a rack unit of measure for rack mounted equipment and is equivalent to 44.45 mm (1.75 in) as defined in EIA-310. This term is preceded by an integer without a space indicating the multiplier of the rack unit height (for example 3U is equivalent to 133.35 mm (5.25 in) or three rack units).
 - .3 “WAP” is defined as Wireless Access Point.

.2 Definitions:

- .1 "Category 3" or "Cat 3" is defined as a 4-pair unshielded twisted pair cable with cable performance defined to 16 MHz to meet or exceed the ANSI/TIA-568.2 Category 3 Specifications. This term applies to cable and connecting hardware for component, link and channel performance.
- .2 "Category 5", "enhanced Category 5" and "Category 5e" or "Cat 5e" is defined as a 4-pair unshielded twisted pair cable with cable performance defined to 100 MHz to meet or exceed the ANSI/TIA-568.2 enhanced Category 5 Specifications. This term applies to cable and connecting hardware for component, link and channel performance.
- .3 "Category 6" or "Cat 6" is defined as a 4-pair unshielded twisted pair cable with cable performance defined to 250 MHz to meet or exceed the ANSI/TIA-568.2 Category 6 Specifications. This term applies to cable and connecting hardware for component, link and channel performance.
- .4 "Category 6A" or "Cat 6A" is defined as a 4-pair unshielded twisted pair cable with cable performance defined to 500 MHz to meet or exceed the ANSI/TIA-568.2 Category 6A Specifications. This term applies to cable and connecting hardware for component, link and channel performance.
- .5 "OM3" is defined as a laser-optimized 50/125 μm Multimode fibre optic cable with cable performance to meet or exceed the ANSI/TIA-568.3 OM3 Specifications. This term applies to cable and connecting hardware for component, link and channel performance. Jacket colour is aqua.
- .6 "OM4" is defined as a laser-optimized 50/125 μm Multimode fibre optic cable with cable performance to meet or exceed the ANSI/TIA-568.3 OM4 Specifications. This term applies to cable and connecting hardware for component, link and channel performance. Jacket colour is aqua.
- .7 "OM5" is defined as a wideband 50/125 μm Multimode fibre optic cable with cable performance to meet or exceed the ANSI/TIA-568.3 OM5 Specifications. This term applies to cable and connecting hardware for component, link and channel performance. Jacket colour is lime green.
- .8 "OS2" is defined as a loose tube 8/125 μm Singlemode fibre optic cable with cable performance to meet or exceed the ANSI/TIA-568.3 OS2 Specifications. This term applies to cable and connecting hardware for component, link and channel performance. Jacket colour is yellow.
- .9 "PoE" is defined as Power over Ethernet and delivers data communications and power up to 100 W to meet or exceed requirements of IEEE-802.3af (15 W), IEEE-802.3at (30W), and IEEE-802.3bt (60 W and 100 W).

- .3 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction

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- .1 University of Guelph Design Standard DSE-04 IT & Communications Systems
 - .2 American National Standards Institute (ANSI)/ Institute for Electrical and Electronics Engineering (IEEE):
 - .1 ANSI/IEEE 802.3 Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications.
 - .2 ANSI/IEEE 802.3z Gigabit Ethernet Specifications over Fibre Optic Cabling
 - .3 ANSI/IEEE 802.3ab Gigabit Ethernet Specifications over UTP Cabling
 - .4 ANSI/IEEE 802.3ae Media Access Control Parameters, Physical Layers and Management Parameters for 10 Gb/s Operation
 - .5 ANSI/IEEE 802.3af Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)
 - .6 ANSI/IEEE 802.3at Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI) Enhancements
 - .7 ANSI/IEEE 802.3bt DTE Power via MDI over 4-Pair
 - .3 American National Standards Institute (ANSI)/ Telecommunications Industry Association (TIA):
 - .1 ANSI/TIA 568.0 – Generic Telecommunication Cabling for Customer Premises
 - .2 ANSI/TIA 568.1 – Commercial Building Telecommunications Infrastructure Standard
 - .3 ANSI/TIA 568.2 – Balanced Twisted-Pair Telecommunications Cabling and Components
 - .4 ANSI/TIA 568.3 – Optical Fiber Cabling and Components
 - .5 ANSI/TIA 568.4 – Broadband Coaxial Cabling and Components
 - .6 ANSI/TIA 569 – Commercial Building Standard for Telecommunications Pathways and Spaces
 - .7 ANSI/TIA 570 – Residential Telecommunications Wiring Standard
 - .8 ANSI/TIA 606 – Administration Standard for the Telecommunications Infrastructure
 - .9 ANSI/TIA 607 – Commercial Building Grounding/Bonding Requirements
 - .10 ANSI/TIA 758 – Customer-Owned Outside Plant Telecommunications Infrastructure Standard

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- .11 ANSI/TIA 862 – Structured Cabling Infrastructure Standard for Intelligent Building Systems
 - .12 ANSI/TIA 942 – Telecommunications Infrastructure Standard for Data Centers
 - .13 ANSI/TIA-1152 – Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
 - .4 Building Industry Consulting Service International (BICSI):
 - .1 ANSI/NECA/BICSI 607 – Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
 - .2 BICSI – Telecommunications Distribution Methods Manual
 - .3 BICSI – Cabling Installation Manual.
 - .5 Electrical Industry Association (EIA):
 - .1 EIA-310 – Cabinets, Racks, Panels, and Associated Equipment
 - .6 International Standards Organization (ISO):
 - .1 IEC/ISO 11801 – Generic Cabling for Customer Premises
 - .7 Ontario Building Code
 - .8 Ontario Electrical Safety Code
 - .9 Cabling system manufacturers’ design and installation guidelines

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 All work shall be coordinated with other trades prior to commencing work.
 - .2 When installing material in a space where ceiling tiles and access floor tile have already been installed or are existing, this section to:
 - .1 remove and replace all associated tiles,
 - .2 perform tile cutouts for work directly related to contractor supplied material, and
 - .3 replace any tiles damaged at no additional cost to the owner. Tiles shall match existing.
 - .3 Coordinate with owner’s service provider technicians, network integrator, and owner’s forces for active equipment installation and associated cabling and services to that equipment.

.2 Scheduling:

- .1 Weekend and/or evening scheduling may be required for completion of the project within the specified schedule. Include such scheduling requirements, refer to Division 01 for further scheduling requirements, in all bid pricing.
- .2 Installation of system furniture workstation outlets will be done after hours immediately prior to owner's move-in. Coordinate installation with system furniture installer and ensure that all outlets are fully terminated and tested prior to owner's move-in. Ensure that sufficient labour is available and include all associated overtime costs in bid pricing.
- .3 Schedule work within telecommunications rooms to be completed early to allow owner to complete installation and testing of active equipment. Allow at least two weeks prior to owner occupancy for this work to be completed. Horizontal cable testing and labelling may be preformed after this deadline.

1.5 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Division 1 Submittals.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements
 - .1 Cable and Component Cutsheets
 - .2 Racks/Cabinets
 - .3 Power Bars
 - .4 Cords
 - .5 Grounding busbars
 - .6 Labeller and labels
 - .7 Testing equipment to be used
- .3 Certificates:
 - .1 Provide manufacturer's certificate indicating application assurance and application warranty for provided cabling and components for minimum of 15 years.
- .4 Test and Evaluation Reports:

- .1 Provide electronic copy of summary and full test results in sorted and searchable PDF format. Summary to be sorted by cable label and show a single line for each cable with the minimum information of: field label, channel loss, length, and pass/fail. Provide complete test results in a single combined non-secured, searchable PDF sorted by cable label. If graphical test results are available from tester, provide legible PDF of results and native formatting for information with free viewing software for current version of Microsoft Windows.

1.6 CLOSEOUT SUBMITTALS

- .1 Submittals under this Section shall be in conformance with Division 1.
- .2 Operation and Maintenance Manuals:
 - .1 Including the following:
 - .1 Product data sheets
 - .2 Structured Cabling Testing Report
 - .3 Firestopping Report
 - .3 Warranty Documents:
 - .1 Shall be in conformance with Division 1.
 - .2 Provide manufacturer's certificate indicating application assurance and application warranty for provided cabling and components for minimum of 15 years.
 - .4 Record Documents:
 - .1 As-built Drawings including but not limited to the following:
 - .1 Outlet final locations
 - .2 Cable labelling for horizontal and backbone
 - .3 Telecommunications rooms layouts
 - .4 Rack/Cabinet final elevations
 - .5 Software:
 - .1 All software required to view test results in native format in PC format.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturer's:

- .1 Manufacturer shall have a minimum of 5 years' experience having successfully supplied products required for the Work of this Section for other projects of similar size and complexity.
- .2 Installer's:
 - .1 Installer shall have a minimum of 5 years' continuous Canadian experience successfully completing projects similar in size and complexity as the Work of this Section. Submit proof of experience upon Consultant's request.
 - .2 Provide all system installations by a cabling system manufacturer certified installer with qualified and accredited technicians experienced with the specific work detailed in this Section. All subcontractors hired under this Section must also meet these criteria.

1.8 WARRANTY

- .1 Manufacturer Warranty:
 - .1 Provide a minimum 15-year manufacturers' product warranty against defects in materials and workmanship from the date of substantial completion.

1.9 CERTIFIED SYSTEM DESIGNER/FACILITATOR

- .1 Hire a structured cabling designer/facilitator with a RCDD on staff, who will be responsible for this project. Any change in the assignment of RCDD is to be authorized by the Owner. The proposed RCDD shall have a minimum of three (3) years experience. The RCDD will oversee the design, installation and certification of structured cabling systems.
- .2 The structured cabling designer/facilitator shall:
 - .1 Design the wiring system based on the contract documents.
 - .2 Supply all materials to the Owner standards.
 - .3 Perform and/or supervise the installation.
 - .4 After completion of the installation provide standard and enhanced testing and documentation of test results.
 - .5 Tabulate results into a report and provide certification that the installation meets the requirements for cabling certification.

2 PRODUCTS

2.1 OWNER FURNISHED PRODUCTS

- .1 Owner's Network Equipment:
 - .1 Core and network switches (fibre and copper) not connected directly to PoE Lighting.
 - .2 Routers, Firewalls, Storage Area Networks, and Servers
 - .3 Uninterruptible Power Supplies (UPS's)
 - .4 Wireless Access Points (WAP)
 - .5 Fibre optic patch cords to the above equipment
- .2 Service Provider Equipment:
 - .1 Gateways, Routers, Firewalls, Amplifiers, and Splitters
 - .2 Building entrance surge protection for above equipment
 - .3 Associated patch cord and cross-connects with above equipment.

2.2 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 Belden
 - .2 Commscope
 - .3 Hubbell
 - .4 Panduit
 - .2 Single source responsibility: Obtain each type of product in this Section from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

2.3 MATERIALS

- .1 Backbone Copper Cabling:
 - .1 Copper backbone cable is multi-pair 24 AWG solid copper conductor voice-grade unshielded twisted pair cable with color coded insulation and overall jacket. Fire rating is listed as FT4 (CMR).

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- .2 In telecom rooms, terminate backbone copper cabling onto 19-inch rack-mountable patch panels to match horizontal copper cabling installation.
 - .3 In main telecom room, terminate backbone copper cabling on Belden BIX-block cross-connect system.
 - .4 Between BIX voice terminations in main telecom room, provide 1-pair unshielded twisted-pair cross-connects.
 - .5 Between horizontal patch panels and backbone patch panels in telecom room, supply 4-conductor flat telephone line cords terminated on both ends with a 6-pin (RJ-11) modular plug. Determine lengths on site by field conditions to minimize slack cable. Provide quantity of patch cords equal to number of horizontal voice outlets.
- .2 Fibre Optic Cabling:
- .1 Intrabuilding backbone fibre optic cable to be OS2 optical fibre factory terminated onto MPO connectors at each end. Fire rating is listed as FT4 (OFNR) for cabling routed between telecom spaces.
 - .2 Intrabuilding backbone data cabling termination onto rack-mountable fibre optic patch panel with factory-terminated modular fibre optic cassettes. Modular fibre optic cassettes to have MPO connector at rear of cassette and have ceramic ferrule, duplex LC optical fibre connectors at front.
 - .3 Interbuilding backbone fibre optic cable to be OS2 optical fibre.
 - .4 Interbuilding backbone data cabling termination onto rack-mountable fibre optic patch panel with field-terminated splice trays. Splice tray then would factory-terminate to modular inserts with ceramic ferrule, duplex LC optical fibre connectors at front.
 - .5 Fibre optic patch cords
 - .1 Duplex LC male connectors at both ends unless noted otherwise. Quantity and length as determined on drawings.
- .3 Category Copper Cable:
- .1 All cabling and components to be ANSI/TIA-568.2 standard Category 6 or better.
 - .2 Four twisted-pair copper cables, connectors, and patching:
 - .1 Unshielded twisted pair
 - .2 Cable fire rating: CMR or CMP depending on application and fire code
 - .3 In damp or wet locations, use cable jacket and label rated for outdoor use. Cable connectors at each end of cable:

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- .1 Terminations: 8 position 8 contact (8P8C), modular, pinned for T568A and T568B configurations.
 - .2 Default connector to be female modular jack.
 - .3 Ceiling terminations use male MPTL (modular plug terminated link) connector for the following applications:
 - .1 Wireless Access Points (WAP)
 - .2 Video Surveillance Cameras
 - .4 Patch Cords:
 - .1 Patch Cords are used within a telecom space to connect from a patch panel to active equipment.
 - .2 4-pair unshielded twisted pair, 24 AWG, stranded copper modular with male 8-pin modular connector at each end.
 - .3 Determine lengths on site by field conditions to minimize slack cable using factory standard lengths.
 - .4 Quantity of cords to equal number of horizontal outlets.
 - .5 Cords to be factory terminated and tested.
 - .6 Cord to match manufacturer of horizontal cable and Category rating.
 - .5 Line Cords:
 - .1 Line cords are used within a floor area to connect between a horizontal outlet and equipment.
 - .2 4-pair unshielded twisted pair, 24 AWG, copper modular with male 8-pin modular connector at each end.
 - .3 Lengths of line cords to be as follows: 50% at 3 m (10 ft), 30% at 7m (23 ft), and 20% at 10 m (33 ft).
 - .4 Quantity of cords to equal number of horizontal outlets.
 - .5 Cords to be factory terminated and tested.
 - .6 Line cords passing free-air through ceiling space to be FT6 (CMP) fire rated.
 - .7 Cord to match manufacturer of horizontal cable and Category rating.
 - .6 Copper Patch Panels:

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- .1 At termination racks or cabinets, supply quantity of flat copper patch panels, with individual openings (ports) sized for modular jacks, to accommodate all modular jacks terminated at rack. Accommodate 48 ports for each patch panel. If less than 12 ports remain unfilled, supply one additional patch panel to accommodate future modular jacks. For each 48 ports provide one horizontal 2U high channel-style cable management panel.
 - .7 Termination Blocks:
 - .1 Terminate copper voice cabling on Belden BIX-block cross-connect system. Follow all recommended practices by manufacturer when installing mounts, distribution connectors, and wire management accessories. Wall mount BIX-blocks on painted 20 mm (3/4 in) fire-rated plywood backboard.
 - .4 Wireless Access Points (WAP):
 - .1 All cabling to be rated Category 6A. Otherwise match properties of Category copper cables detailed above.
 - .5 Long Reach Locations:
 - .1 For locations where cabling lies beyond 90 m (297 ft), supply a system that will allow data to reach the remote location.
 - .1 Powered fibre optic cabling and media conversion
 - .2 Passive or active PoE extenders
 - .3 For outdoor locations with multiple connections, hardened managed network switch
 - .2 Provide all associated power supplies to convert from local 120 V AC sources.
 - .3 Provide appropriate weather-resistant lockable enclosures for all exterior mounted equipment. Supply hardened equipment in outdoor locations that operate at -40 °C (-40 °F) to 50 °C (122 °F) without supplemental heating/cooling. For exterior WAP or radio locations, supply non-metallic enclosures.
 - .4 Provide surge protection for all copper cabling routing from exterior locations upon re-entry to building. Surge protection provided shall not degrade the cable performance.
 - .6 Equipment Mounting:
 - .1 Provide open frame steel 2-post equipment racks with flanged base, 19-inch mounting rails drilled front and back and tapped to EIA 310 spacing standards with a minimum of 44U in height (RF Mote #RFM-1944-RB). On each side of individual racks, include a full-height vertical cable management channel with a minimum width of 300 mm (12 in) between racks and 150 mm (6 in) on ends.
 - .2 Clearance: minimum 914 mm (36 in) in front of rack and minimum 1676 mm (66 in) in rear of rack

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- .3 Unless noted otherwise on drawing, on rear of rack supply two vertically mounted unswitched power strips with a minimum of eight CSA 5-20R receptacles each, with bottom fed 2.5 m (8 ft) cord with CSA L5-20P power connector. Racks containing only patch panels require a single power strip.
- .7 Grounding Busbar:
- .1 Supply tin-plated copper busbar on backboard within each telecommunications room. Busbar to be mounted with insulators and mounting bracket. Busbars to meet ANSI/NECA/BICSI 607 requirements.
 - .1 All telecommunications spaces supply 6 mm x 51 mm x 305 mm (0.25 in x 2 in x 12 in) with both 6 mm (1/4 in) stud holes with 16 mm (5/8 in) hole spacing and 10 mm (3/8 in) stud holes with 25 mm (1 in) hole spacing.
 - .2 Supply copper ground bar at bottom of all racks or cabinets and suitable for 6 AWG 2-hole lug connectors.
 - .3 Supply 2-hole lug connectors for all terminations to busbars.
- .8 Horizontal Outlets:
- .1 For standalone wall faceplates, supply up to 8-port per gang white faceplates to mount jacks.
 - .2 For combined power/telecom wall faceplates, supply white 3-port decorator style insert plates for mounting horizontal jacks within combined faceplate.
 - .3 For combined power/telecom multi-gang floor boxes, supply white 3-port decorator style insert plates for mounting horizontal jacks within floor box faceplate.
 - .4 For wall telephone locations, supply 1-port stainless steel telephone faceplates with dual mounting posts. Port to be suitable for 8-pin jack.
 - .5 For furniture mounted jacks, supply mounting faceplate suitable for furniture manufacturers openings. Only if there is no suitable faceplate, supply surface mount enclosure for housing jacks.
 - .6 Mount all ports with manufacturer's supplied jack. Supply blank port covers for all unused ports within faceplates.
- .9 Labelling:
- .1 Labelling to meet ANSI/TIA-606 standards and owner's nomenclature requirements. Include entire tag on labels. All final labels to be white, vinyl, machine printed using a legible sans serif font. All ink to be black, non-smudging, water resistant, and fade resistant.
 - .2 For cabinet/rack minimum 36-point
 - .3 For patch panel minimum 24-point

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- .4 For cables wrap around self-laminating cable labels with a minimum 10-point
 - .5 Each horizontal jack minimum 8-point
 - .10 Finishes:
 - .1 Colours used shall match that of the system being supplied. These colours apply to cable, jacks, and cords.
 - .1 Backbone Fibre Optic – as determined by cable type
 - .2 Backbone Copper – Grey
 - .3 Horizontal Data – Blue
 - .4 Horizontal Voice – White
 - .5 Audio Visual – Black
 - .6 Video Surveillance – Violet
 - .7 Wireless Access Points – Orange
 - .8 Bonding/Grounding – Green

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine all work of other Sections upon which the Work of this Section depends.
 - .2 Report in writing to the Consultant/Project Manager any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work of this Section.
 - .3 Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.
 - .4 Commencement of work implies acceptance of existing conditions and work by others.

3.2 PREPARATION

- .1 Protection of In-Place Conditions:

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- .1 Effectively protect the owner's facilities, equipment and materials from dust, dirt and damage during construction. Remove any protection at the completion of each shift unless the protection endangers work in progress or personal safety. Removal and replacement of ceiling or floor tiles to be the responsibility of this section. Replace all cable damaged from lack of effective protection during construction period with no additional cost to the owner. All areas should be cleaned of debris generated by this work at the completion of each shift.
 - .2 Preparation:
 - .1 Prior to pathway rough-in, coordinate the installation of all telecommunications infrastructure routing with Section 27 05 28 to resolve all interferences and cabling infrastructure requirements. Provided that final outlet locations are within the total shown and the average cable length to the telecommunications room does not change more than 3 m (10 ft) per cable, no additional costs to be paid for location changes.
 - .3 Demolition / Removal:
 - .1 Exercise extreme caution when working at or near any live connections to ensure that no interruption to active users occurs. Repair all interruptions immediately at full cost to this section.
 - .2 Completely remove and dispose of all existing cabling, terminations, faceplates, patch panels within the space to source unless indicated on the drawings or labeled for future use.

3.3 INSTALLATION

- .1 Install all cabling, components, and equipment detailed in this section unless noted otherwise.
- .2 Install cabling and components according to applicable standards and cabling system manufacturer's specifications, including cable stress, bending radius, maximum length, separation from other services, etc. All backbone and horizontal cabling to be continuous. No splicing is permitted except as noted.
- .3 Splices to be permitted for intrabuilding fibre optic cabling. Ensure all fibre optic cable splice loss is equal to or less than 0.2 dB.
- .4 For cabling run in free-air or plenum spaces, install J-Hooks as per Section 27 05 28. Support all hooks from ceiling structure and not from other equipment or supports for that equipment.
- .5 The use of J-Hooks and basket cable trays will not be allowed within inaccessible ceiling spaces. Installations within inaccessible ceiling spaces shall be done using adequately sized conduits.
- .6 Do not lay cabling or any other components on the ceiling tile or equipment withing ceiling.

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- .7 Terminate all copper category cabling in T568A configuration, unless existing installation is already terminated in T568B configuration.
 - .8 Within ceiling space above horizontal jack or connector location install a minimum of 1000 mm (39 in) of looped spare cable for future jack relocation. Support independently all looped spare cabling using J-Hooks as per Section 27 05 28. Do not lay looped spare cabling in cable tray or on any other components on the ceiling tile.
 - .9 For backbone copper installations, for each 25 pairs in a multi-pair cable, terminate onto 24 patch panel jacks, sequentially connecting each pair in cable to pair 1 of each patch panel jack. Neatly terminate and dress all cables in the rear of the panel.
 - .10 Neatly dress and comb all cabling to the backboard, tray, and racks.
 - .11 Enclose non-armoured fibre optic cable in conduit or corrugated tubing outside of each rack/cabinet within telecom rooms.
 - .12 Fill in all unused ports, inserts, and coverplates with manufacturer's blank.
 - .13 Labelling:
 - .1 Install labelling at following locations:
 - .1 Cabinet/Rack
 - .2 Patch Panel
 - .3 Cable at each terminus
 - .4 Each horizontal jack
 - .14 Bundling:
 - .1 When travelling along the same route in free-air or cable tray, neatly bundle more than two like cables together to maintain cable organization. Limit each bundle to 48 cables to limit cable overheating and performance issues. Do not mix cable types within same bundle.
 - .2 The use of plastic cable ties may be used for cable bundling outside of telecommunications spaces. Wide band Velcro-based ties to be used to allow cables to be easily added to or removed from bundles. Never cinch ties so tight that the cable jackets deform or bend beyond cable manufacturer's recommended limits.
 - .15 Telecommunications Grounding and Bonding:
 - .1 Follow regulations for grounding and bonding of communications equipment as per Electrical Code, ANSI/TIA-607, and ANSI/NECA/BICSI-607.
 - .2 Install backbone copper bonding conductor sized to ANSI/TIA-607 requirements:

- .1 Between main electrical room main ground bus and the main telecommunications room busbar.
 - .2 Between main telecommunication room busbar and each telecommunication room busbar.
 - .3 Install 6 AWG copper with green jacket from telecommunications busbar to all racks, cabinets, exposed steel structural columns, electrical panels ground bus to circuit supplying equipment in telecom room, cable trays, and access floor.
 - .4 All cable tray shall have copper 6 AWG bonding wire for the entire length with connection made at each section. If tray splits, each leg shall also be bonded in similar manner. Bond all communications cable tray to telecommunications room busbar.
 - .5 Use 2-hole crimp type connectors for all bonding and grounding connections to busbars.
- .16 Interface with Other Work:
- .1 Firestopping:
 - .1 Firestop all penetrations through the integrity of fire-rated architectural structures and assemblies, such as walls, ceilings and floors to maintain the structure's fire rating. Provide firestop within conduits or open spaces of cable trays. Conform all firestop penetrations to a specific ULC system number. All firestopping systems used for telecommunications cabling to use reusable materials (putty, pillows, etc.) unless directed by the engineer.
 - .2 Install firestopping material regardless if other non-firestopped penetrations through the fire separation are visible. If existing opening through fire separation is used, firestop entire opening and all other associated penetrations through that opening. If other trades use this opening as part of the scope of work of the project, then the cost of firestopping to shared among all trades using opening. If the opening is existing and used for structured cabling in this scope and is not firestopped, this Section to firestop the entire opening.
 - .3 Provide at each firestop penetration a fluorescent colored label indicating the following information: unique identification number, contractor name, date installed, ULC system number, cable type installed, and cable quantity. Provide a firestopping report with cable test results summarizing all firestop label information with photo of final installation.

3.4 SITE QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 Performance test using the most current available test methods and equipment installations. Provide all meters, tools and associated equipment and the services of technicians as required to carry out all testing.

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- .2 On completion of the installation of the system, provide tests to show that these specifications have been met both physically and functionally. All defects need to be rectified before final acceptance of the system. All test results to use field labelling and not default tester numbering.
 - .3 Provide electronic copy of summary and full test results in sorted and searchable PDF format. Summary to be sorted by cable label and show a single line for each cable with the minimum information of: field label, channel loss, length, and pass/fail. Provide complete test results in a single combined non-secured, searchable PDF sorted by cable label. If graphical test results are available from tester, provide legible PDF of results and native formatting for information with free viewing software for current version of Microsoft Windows.
 - .4 For testing that fails, complete re-termination or replacement of entire cable run. After re-installation, re-test all failed cabling. Submitted test report to show only passed tests.
 - .5 Test all installed fibre optic cabling to show that the installed cabling meets performance parameters of the manufacturer and ANSI/TIA-568.3.
 - .1 Pre-terminated cable requires only testing of insertion loss of an installed fiber optic cable plant performed with a light source and power meter (LSPM) or optical loss test set (OLTS) for each port to ensure no damage was caused to cable during installation.
 - .2 Intrabuilding fibre optic cable to have insertion loss and Optical Time-Domain Reflectometer (OTDR) testing for each terminated port.
 - .6 Test all installed copper cabling to show that the installed cabling meets performance parameters of the manufacturer, ANSI/TIA-568.2, and ANSI/TIA-1152 for the Category of cable installed.
 - .7 Test all installed coaxial cabling to show that the installed cabling meets performance parameters of the manufacturer and ANSI/TIA-568.4.
- .2 Non-Conforming Work:
- .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight or errors.
 - .2 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to the satisfaction of the Consultant at no additional cost to the Owner.
- .3 Manufacturer Services:
- .1 Have manufacturer's technical representative inspect the Work at suitable intervals during application, and at conclusion of the Work of this Section, to ensure the Work is correctly installed. Submit manufacturer's inspection reports and verifications that the Work of this Section is correctly installed.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 01 (and Division 20 or 26).

1.2 SUMMARY

- .1 Provide a complete and operating electrically supervised, zone annunciated intrusion alarm/access control system. This shall consist of central control equipment, multiplex/control panels, remote devices, power supplies with battery backup, etc., required for full and complete operation of the system.
- .2 The system is designed such that all data required to perform real time functions resides in the system memory or is distributed among the databases of the field devices.
- .3 The intrusion alarm door monitoring functions shall provide basic building perimeter protection through magnetic door contacts or electric door strikes. System control shall be provided from central control equipment and point multiplexers. The system shall contain all required components for alarm receiving circuits, control circuits and signal circuits.
- .4 The access control function shall provide controlled access to the building and internal spaces through the use of card readers, keypads, and contact devices interfacing with door control devices. System control shall be provided from central control equipment, access control units and reader multiplexers. The system shall contain all required components for interface, signal and control circuits.
- .5 On failure of the normal A.C. power source, the intrusion alarm/access control panels shall automatically switch to standby battery power. When the normal A.C. power is restored, the panels shall automatically switch back to A.C. operation and the battery pack shall be automatically recharged.
- .6 The system is designed for 120 volt, 60 cycle, two wire power supply to power supply units which will provide 12V DC system power supply.

1.3 REFERENCES

- .1 Underwriters Laboratories:
 - .1 UL 294, Standard for Safety for Access Control System Units.
 - .2 CAN/ULC-S302 - Standard for Installation and Classification of Burglar Alarm Systems for Financial and Commercial Premises, Safes and Vaults
 - .3 CAN/ULC-S303, Local Burglar Alarm Units and Systems.
 - .4 CAN/ULC-S304, Intrusion Detection.

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- .5 CAN/ULC-S306, Intrusion Detection Units.
 - .6 CAN/ULC-S304, Signal Receiving Centre and Premise Burglar Alarm Control Units.
 - .7 CAN/ULC-S3-1, Standard for Central and Monitoring Station Burglar Alarm systems.
 - .8 ORD-C634, Connectors and Switches for Use with Burglar Alarm Systems.
 - .9 UL 1076, Standard for Safety for Proprietary Burglar Alarm Units and Systems.
 - .10 ULC-S318, Power Supplies for Burglar Alarm Systems.
 - .11 CAN/ULC-S524 – Installation of Fire Alarm Systems
 - .12 CAN/ULC-S559 – Equipment for Fire Signal Receiving Centers and Systems
 - .13 CAN/ULC-S561 – Installation and Services for Fire Receiving Centers and Systems
 - .2 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-[98], Canadian Electrical Code, Part 1 (18th edition) Safety Standard for Electrical Installations.
 - .3 Applicable local Building Codes and Fire Codes
 - .4 Manufacturer's specifications, latest issue.

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Division 01 Submittals.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements
- .3 Complete sets of shop drawings shall be submitted indicating the following:
 - .1 System component numbers and dimensions.
 - .2 System operating characteristics and functions.
 - .3 Rough-in details.
 - .4 Wiring schematics.

1.5 QUALITY ASSURANCE

- .1 The intrusion alarm/access control system shall be installed in accordance with the requirements of the manufacturer and all applicable regulatory agencies and codes including:
 - .1 C.S.A. and U.L.C. Standards
 - .2 Ontario Building Code
 - .3 Electrical Safety Code
- .2 All system components shall conform to the following standards where appropriate:
 - .1 Manufacturing: ISO 9003
 - .2 Design: MIL 275E
 - .3 Communications: IEEE RS232C and RS 485
 - .4 EMI emissions: FCC part 15
 - .5 Electrostatic immunity: IEC 801.2 level 4
 - .6 AC transients: UL 864
- .3 The complete intrusion alarm/access control system shall be supplied, installed and tested by a qualified and approved security system installer.
- .4 Qualifications
 - .1 All system components shall be manufactured by reliable firms with at least 15 years experience in the development and manufacture of access control and point monitoring products.

1.6 SUPPORT SERVICES

- .1 The supplier shall be capable of providing on-going training and service for all system components.

1.7 SCOPE OF WORK

- .1 The security system supplier must design, furnish, install, connect and test a discrete monitoring system complete in all respects including miscellaneous associated equipment and sub-systems as hereinafter described or required for the proper operation of the system.
- .2 The system shall be a fully distributed architecture with intelligent Door Controllers capable of conducting a non-degraded access transaction in less than one second. Should any part of the system fail, the remainder shall be capable of granting access based on a valid card until full operation is restored.

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- .3 The system shall support Proximity card technologies. Each card shall have a unique card number.
 - .4 The time for which the door relay is energized shall be user definable. The system shall be capable of detecting both Door Held Open and Forced Entry conditions, and of reporting these events to the host system and dispatch console as alarms. The duration for activating a Door Held Open alarm condition shall be user definable.
 - .5 A Request To Exit (RTE) facility shall be available at each controlled door to allow personnel to exit through the door without generating a Forced Entry alarm.
 - .6 Manual commands shall be available for Door, Floors, Input Points and Output Relays, which allow the user to override automatic or Timed Commands. The manual override shall take precedence and devices shall only return to an automatic state when manually commanded to do so.
 - .7 All manual commands shall be available for a user-definable TIMED COMMAND to allow the user to set up regular, automatic schedules for these functions.
 - .8 The system shall provide a user-definable scrolling text window for facility management and emergency situations. This window shall provide the user with the ability to enter, and modify at any time site specific information to be used to assist in managing the facility. This information must be readily available via function key to the operator.

1.8 GENERAL ACCESS CONTROL REQUIREMENTS

- .1 In addition to the basic function of access control by cardholder I.D. and Time Zone, the system shall support the following modes of operation (if available at no additional cost to the system)
 - .1 Antipassback Mode
 - .1 The system shall allow the user to define readers for both IN/OUT and Timed Antipassback. Should the cardholder not use an OUT reader before an IN reader, or re-use the card within user-defined period, access will be denied.
 - .2 Dual Custody Mode
 - .1 The system shall have provision for defining doors which require TWO valid cards within 10 seconds before access is granted.
 - .3 Escort Mode
 - .1 The system shall support an enhanced Dual Custody mode where the first card shall be that of a supervisor.

1.9 WARRANTY

- .1 All system components shall be warranted to be free from defects in material and workmanship for the period of one (1) year from acceptance of the system. The warranty shall provide for free parts and labour for correction of problems as a result of defects in material or workmanship, including regular wear and tear, but does not cover customer operating negligence or abuse.
- .2 During the warranty period, bi-annual Site Inspections shall be performed, which include the following work:
 - .1 Systematically examine, clean, adjust and service as required under manufacturers specifications, all security equipment purchased under this contract.
 - .2 Inspect operability of computer hardware and software.

1.10 CERTIFIED SYSTEM DESIGNER / INTEGRATOR

- .1 Hire an Owner approved access control designer/integrator who will be responsible for this project.
- .2 The access control designer/integrator shall:
 - .1 Design the wiring system based on the contract documents.
 - .2 Supply all materials to the Owner standards.
 - .3 Perform and/or supervise the installation.
 - .4 After completion of the installation provide standard and enhanced testing and documentation of test results.
 - .5 Tabulate results into a report and provide certification that the installation meets the requirements for certification.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Single source responsibility: Obtain each type of product in this Section from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- .2 All specifications defined herein are to be standard features of the product and shall not require any custom software or special configuration.
- .3 The head-end equipment is existing and will not be modified in this project, including the host system, site commanders, printers, door controllers, etc.

2.2 DOOR CONTROLLERS

- .1 The system shall support a range of single and two-door controllers with card capacities of a minimum of 500 cards.
- .2 Door Controllers shall be intelligent devices, capable of functioning without degraded mode in the event of communication failure.
- .3 Each Door Controller shall support Wiegand, Magnetic Stripe and Proximity readers. Optional integrated keypads shall be supported in both the Wiegand and Magnetic Stripe readers. Styles available must include Insert and Swipe and be either surface, flush or mullion mount.
- .4 The Door Controller shall be capable of operating with cable distances of up to 600 feet to the reader.
- .5 The Door Controller shall keep a buffer of all transactions and send these as messages to the host Site Commander when polled. Should a communications failure with the host be in effect, buffered transactions shall be sent to the host as historic messages when communications are resumed.
- .6 Doors shall be provided with the following manual commands:
 - .1 UNLOCK MOMENTARY
 - .2 UNLOCK MAINTAINED
 - .3 LOCK
 - .4 CARD PLUS PIN MODE
 - .5 CARD ONLY
 - .6 INVOKE DUAL CUSTODY
 - .7 RESCIND DUAL CUSTODY
 - .8 INVOKE ESCORT MODE
 - .9 RESCIND ESCORT MODE
 - .10 LOCKOUT ALL CARDS
 - .11 RE-INSTATE ALL CARDS
 - .12 RETURN TO TIMED OPERATION

2.3 PROXIMITY READERS

- .1 The Proximity Reader contains a magnetic coil which energizes a Proximity Card, Key Tag or Badge Tag as it comes into range. The preprogrammed code generated by the custom CMOS microchip in the card or tag is instantly transmitted back to the reader. Numerous identical signals must be received from a card or tag, and verified by the reader, to assure valid data.
- .2 The proximity reader contains a microprocessor which decodes the signal and translates it to the proper data format (Wiegand, magnetic stripe or other popular card type). The proximity reader transmits one code pulse train to the host processor-even through the card or tag remains in range. To send out another data stream, the card or tag must be removed and presented again. This operation simulates exactly the operation of a typical mechanical card reader. Readers can also communicate with the host processor directly in RS-232 and RS-422.
- .3 The card is, by virtue of its design, thicker than average; it tends to be expensive; restrictive with respect to the amount of information which can be encoded, and can usually be read by RF test instruments. But is difficult to alter or counterfeit and a major advantage is that neither card nor reader need be exposed, as no contact is necessary.
- .4 Proximity Readers shall be recessed as per architectural detail in all locations, with the exception of areas indicated on the Drawings which shall be surface mounted.

2.4 PROXIMITY CARDS AND KEY FOBS

- .1 Provide credit card size access cards with custom graphics and card number graphics and colours to be determined at a later date. Provide a quantity of 10 cards as part of this contract.
- .2 Provide key fobs with custom graphics and card number graphics and colours to be determined at a later date. Provide a quantity of 10 key fobs as part of this contract.

2.5 EXIT PUSHBUTTONS

- .1 Provide exit pushbuttons on card access doors without panic hardware or double card access requirements.
- .2 Doors with panic hardware will have deactivating switch to allow door to open without causing alarm.
- .3 Mount exit pushbutton in single gang box.

2.6 DOOR DETECTOR DEVICES

- .1 Provide door monitoring magnet devices to monitor status of doors. Mount in head of door frame.
- .2 Provide suitable models for locations other than man doors e.g. at overhead doors.

2.7 POWER REQUIREMENTS

- .1 The power solution shall comprise of CSA listed power supplies and transformers to distribute low voltage power to system components.
- .2 The power solution shall include lockable, hinged covered, terminal cabinets for all power supplies, transformers, and power distribution terminal strips. The Contractor shall provide all conduit and wiring from the 120 VAC facilities to the terminal cabinets.
- .3 The power solution shall provide protection against surges, spikes, noise, harmonic distortion and other line problems for all system equipment and their components. In addition to generator support, all power sources shall be equipped with uninterrupted power supply capable of supporting all attached equipment for a period of 20 minutes.
- .4 All equipment and system components which are powered by more than 48 volts AC or DC shall be ULC listed for safety. This includes equipment or system components classified as non-power limited.
- .5 All system power supplies shall be monitored, by the Access Control System, for line failure on a dedicated monitoring input point. Therefore, when an AC line fails, a unique alarm condition will be caused.

2.8 FIELD DEVICES

- .1 Door Position Switches
 - .1 Door position switches shall be provided by this Contractor.
 - .2 Door position switches shall be concealed discrete devices unless otherwise noted and shall not be integral to other devices such as strikes, maglocks, etc. unless approved by the Owner. Where exposed mounting is necessary devices shall be mounted so as to limit easy access to unauthorized personnel.
 - .3 At high security locations, end-of-line resistors shall be installed at the door contact.
 - .4 Frame mounted magnetic door contacts, hinge mounted plunger type switches, will not be acceptable.
- .2 Automatic Door Operators
 - .1 Where automatic door operators are present, they shall be interfaced with the access control system as described in common portal functions. Dedicated low voltage power circuits will be provided from the door controller location to the automatic door operators interface board and electrified door devices to provide access control function when operator is de-energized.
 - .2 Where automatic revolving or sliding doors are to be installed, the door shall be capable of being locked securely when parked. Door contacts shall be provided on all door leafs to monitor door status.

.3 Tamper Alarms

- .1 All access control system equipment cabinets including system power supply cabinets, shall be equipped with sensors, which detect and remotely annunciate their opening.
- .2 All communication and alarm device cabling at the door and between the door controller panel and the door shall be supervised to detect and remotely annunciate "open", "high impedance", "low impedance", and "short" conditions. The end of line supervision device shall be installed as close as possible to the security device.

2.9 WIRING

- .1 Provide all wiring required for system interconnection in accordance with manufacturers requirements. All wiring shall be multi-conductor type, shielded as appropriate, complete with an overall jacket. Size and colour code wiring to suit system requirements. At connection points, terminate all wiring with crimp-on solder spade connectors to suit specific requirements.
- .2 Exposed wiring within ceilings shall be CMP communications cable, FT6 rated. Wiring in conduit shall be CMG communications cable.
- .3 Acceptable cabling products in order of preference as follows:
 - .1 Individual cables for each device sized as follows.
 - .1 Door contacts require 4C 22AWG
 - .2 Request to exit devices require 4C 22AWG
 - .3 Credential readers require 6C 22AWG
 - .4 Electrified Devices require 4C 18AWG
 - .2 Combo cable containing 1x4C 18AWG, 1x8C 22AWG and 1x6C 22AWG.

3 EXECUTION

3.1 INSTALLATION

- .1 Provide wiring of detection zones, initiating devices, control devices and signalling and annunciation equipment as indicated on drawings. Identify all wiring appropriately at points of connection and at control panel.
- .2 Mount all equipment and components as shown and arrange conveniently to suit dimensions of equipment and functional requirements. Refer to interconnection riser diagram for further details of requirements and to floor plans for component locations.
- .3 The security system supplier will provide a qualified installation crew to install all devices, make final connections to security console and make all tests and adjustments as necessary for a fully functional system.

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- .4 The supplier shall provide all system components covered by this specification. All wiring for communications, monitoring, alarm output will be provided by Division 26.
 - .5 The supplier shall provide three complete sets of documentation covering installation, operation and maintenance of all system components.
 - .6 On-site training for the number of operators determined by the Owner, for one day shall be provided as a precondition to acceptance.
 - .7 The purchaser shall provide 120 VAC power to the point of installation of each system component requiring AC power.

3.2 FIELD QUALITY CONTROL

- .1 At the completion of the installation of all system equipment and devices and after the connection of all controls, test and verify the entire system.
- .2 Only after the testing and verification task is completed, and all deficiencies rectified, demonstrate the proper functioning of the entire system.
- .3 The purpose of a verification procedure for the system is to make certain that all equipment operates as intended. Upon completion of the verification procedures, an approved certificate of verification shall be kept as part of the system documentation. An equipment schedule listing each device and showing confirmation that it was verified shall be provided.
- .4 The wiring to every device shall be inspected and tested to verify that removal of the device or breaking wire will cause the trouble signals to operate properly. Trouble signals shall be verified to operate on open circuit, short circuit, ground fault or the removal of any plug-in individual component. Verify that terminations have been provided for all conductors, and that where applicable correct polarities have been observed. All equipment installed as part of the system shall be inspected for visible damage or tampering which might interfere with its intended operation.
- .5 Any device which is field adjustable shall be tested to ensure that its setting is acceptable under ambient conditions at the location of installation.
- .6 Tests shall be made to verify that adequate power is available from both normal and standby sources under the maximum system load.
- .7 The normal system power supply shall be inspected to ensure that it is properly fused, locked away from unauthorized interruption, adequate to meet system requirements and separated from auxiliary device power sources such that a fault in such circuits cannot affect the system's unit control power.
- .8 All control equipment shall be tested for acceptable operation. An inspection and test shall be made of all cable terminals, plug connectors and plug-in circuits.
- .9 All field wiring shall be verified to be terminated on a single conductor per terminal basis.

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- .10 Simulation of open circuits, short circuits and ground faults shall be performed on selected components to confirm proper trouble circuit response.
 - .11 Ancillary equipment connections shall be tested for proper operation.
 - .12 Provide a comprehensive service, maintenance and warranty for the entire system for one year after substantial completion.

3.3 SYSTEM STARTUP

- .1 Prior to final set-up and programming of the system features and restrictions, the Security Contractor shall review with the Owners the specific operational options available. System set-up and programming shall be based on the results of this interview. All data for "First Day" system operation will be entered by the Contractor as instructed by the Owner.
- .2 The Successful Security Contractor shall be responsible for providing a group training session(s) to the Owners satisfaction by a qualified instructor regarding proper use and operation of the system. This training session(s) shall include a description of the features available with the new system and an explanation of the feature access procedure. Provide adequate facilities at the Owner premises for the training session/period.
- .3 Upon completion of the training session, the Security Contractor shall provide copies of printed literature describing the system features and their access procedure to be used for future reference. A brief review session shall be provided by the Security Contractor at the Owner's request at a future date.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes video surveillance system, including but not limited to the following:
 - .1 Provide and commission a video surveillance system to meet all requirements contained within the drawings and technical specifications.
 - .2 The Owner's current video surveillance system is as stated on the Drawings Provide a video surveillance system that integrates to the existing solution such that the facility can be monitored and managed using the existing video surveillance interface.
 - .3 Modify the existing control console to accommodate the revised monitor and controls layout.
 - .4 The video surveillance system shall be a complete solution that is scalable from the existing scope of this project to several hundred cameras which can be added on a unit-by-unit basis.
 - .5 Display both live and pre-recorded video images and diagnostic information as well as trigger other relevant system actions such as map display on alarm, camera recording on alarm.
 - .6 The video surveillance system shall have the capability of simultaneous live viewing and recording of individual cameras at different frame rates and resolutions.
 - .7 Monitor system locally at the security workstation, off-site at remote security workstation, or via mobile device.
 - .8 Program all interfaces from the new facility to the off-site monitoring centre.
 - .9 Notify the Owner 24 hours in advance of performing any work on the existing video surveillance system. Downtime of the existing system will not be permitted.
 - .10 System storage shall be based on a "Centralized" storage topology.
 - .11 Supply failover redundancy of the video surveillance system storage between two fire separated spaces along with redundant hardware for all components.
 - .1 Locate the primary storage array shall in the Primary Network Core Room.

- .2 Locate the secondary storage array shall in the Secondary Network Core Room.
- .3 Supply a minimum of 30 days video storage plus 25% for future.
- .4 Supply video surveillance storage capacity based on all cameras recording 24/7 in HD (1080p) quality at a rate of 30fps.
- .12 Terminate horizontal cables for video surveillance system cameras on rack mounted patch panels. Meet all requirements of 27 05 00 Structured Cabling.

1.3 REFERENCES

- .1 Abbreviations and Acronyms:
 - .1 CCTV: Close Circuit Television (legacy term for video surveillance systems)
 - .2 IP: Internet Protocol.
 - .3 ONVIF: Open Network Video Interface Forum (global open standard for the interface of physical IP-based security products)
 - .4 PoE: Power over Ethernet
 - .5 PTZ: Pan-Tilt-Zoom
- .2 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Canadian Standards Association (CSA):
 - .1 IEC/UL/CSA 62368-1 - Hazard-based electrical safety standard for IT equipment and Audio-Visual products
 - .2 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S316 - Standard for Performance of Video Surveillance Systems
 - .2 CAN/ULC-S4400 – Cannabis Facilities Security

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Division 1 Submittals.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements

.3 Shop Drawings:

- .1 Submit a complete set of shop drawings for the system indicating and following:
 - .1 device location plans with unique tags
 - .2 a full schematic wiring diagram with video interconnection detail drawings

1.5 CLOSEOUT SUBMITTALS

- .1 Provide submittals under this Section in conformance with Division 1.
- .2 Record Documents:
 - .1 Video camera surveillance table with unique tags, cable numbers, and IP addresses
- .3 Test and Evaluation Reports:
 - .1 Submit cybersecurity report or documentation as specified in Part 2 of this Section.
- .4 Software:
 - .1 Application software and a minimum two transferable licences to permit workstation users to retrieve and configure information based on the user's needs is to be supplied with the video surveillance system as specified in Part 2 of this Section.
 - .2 Submit copies of all software and licences required for operation and maintenance of equipment provided. Install, set up, and configure provided firmware or operating systems on designated equipment.
 - .3 Provide to Owner's representative all configuration requirements prior to installation including temporary credentials with level of administration access required, operating system, list of IP addresses required with mapping to tag or unique description, firewall configurations, and any other information to successfully install software or equipment.
 - .4 Pay for any software, firmware and operating system subscription fees for the warranty period and setup online accounts in conjunction with Owner's representative.
 - .5 Provide all software, firmware, and operating system user guides, installation manuals, cybersecurity certificates, and documentation in unsecured searchable PDF format.

- .6 Prior to warranty completion, update or upgrade all installed software to most current version compatible with equipment installed. During warranty period if any cybersecurity threats or known vulnerabilities to software are provided by the equipment manufacturer or relevant third-party software company, send immediate notification to Owner with instructions to patch or update software, firmware, or operating system.

1.6 CERTIFIED SYSTEM DESIGNER / INTEGRATOR

- .1 Hire an Owner approved video surveillance designer/integrator who will be responsible for this project.
- .2 The video surveillance designer/integrator shall:
 - .1 Design the wiring system based on the contract documents.
 - .2 Supply all materials to the Owner standards.
 - .3 Perform and/or supervise the installation.
 - .4 After completion of the installation provide standard and enhanced testing and documentation of test results.
 - .5 Tabulate results into a report and provide certification that the installation meets the requirements for certification.

2 PRODUCTS

2.1 OWNER FURNISHED PRODUCTS

- .1 Supplied by Owner:
 - .1 PoE Network Edge Switches
 - .2 Patch cords to edge switch
 - .3 Network Servers
- .2 Existing products:
 - .1 Video Management Software with required licences
 - .2 Video Storage System
 - .3 Video Monitors
 - .4 PC workstation for viewing recorded video

2.2 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules, and Specification:

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- .1 Acceptable Camera Manufacturers:
 - .1 Axis Communications
 - .2 Bosch
 - .3 Hanwha Techwin
 - .4 Motorola/Avigilon
 - .2 Single source responsibility: Obtain each type of product in this Section from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

2.3 PERFORMANCE/DESIGN CRITERIA

- .1 Cybersecurity
 - .1 Complete all communications in a secure manner to prevent unauthorized users from making control decision or manipulating data. Prevent unauthorized users from installing malicious software or malicious firmware onto the system via any communications gateway, HMI, or accessible ports.
 - .2 Provide report or documentation detailing cybersecurity assessment of the software, firmware, communications gateway, HMI, annunciators, remote devices, diagnostic tools, and any other associated accessories detailed in this Section.
 - .3 All authorized users require unique credentials and administration level to view, change, administer, maintain,
- .2 Video Cameras
 - .1 Supply video surveillance cameras to at a minimum meet the following classifications measured in pixels per meter (pix/m):
 - .1 Detection – 7 pix/m
 - .2 Recognition – 20 pix/m
 - .3 Identification – 50 pix/m
 - .2 Supply higher than the above noted pix/m if recommended by the camera manufacturer if higher pix/m is needed to achieve their definition of Detection, Recognition, and Identification.
 - .3 System not requiring proprietary recording hardware, hardware multiplexers or time-division technology for video recording and monitoring.
 - .4 Supply Detection level cameras covering all areas in the following locations:

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- .1 Both sides of all department entrances and exits except where noted as requiring higher than Detection level video surveillance.
 - .2 Inside all stairwells covering all stairs and landings
 - .3 Loading Dock
 - .4 Loading Dock Receiving and Post Receiving Breakout
 - .5 Lobby or public waiting areas
 - .6 Elevator Lobbies
 - .7 Feature stairs
 - .8 Doors accessing the roof
 - .9 All areas of the parking lot.
 - .10 Loading Area including parking
 - .11 All outdoor spaces such terraces and other spaces used by staff or visitors
 - .5 Supply Recognition level cameras covering all areas in the following locations:
 - .1 All entrances and exits to the facility, except where noted as requiring Identification level video surveillance.
 - .2 All stairwell entrances
 - .3 In front of reception desks
 - .4 Inside all elevator cabs
 - .5 Inside all telecom spaces
 - .6 Automated transaction machines such as vending, ATMs and parking
 - .7 Cashier positions and transaction counters
 - .8 On the site focused on the emergency duress stations
 - .6 Supply Identification level cameras covering all areas in the following locations:
 - .1 Main Walk-in Entrance Vestibule (both entering and exiting the building)
 - .2 Staff Entrance

2.4 MATERIALS

- .1 Video Cameras
 - .1 Provide all cameras as ONVIF compliant IP-based multi-streaming cameras. Using analog cameras and/or hardware video encoders is prohibited.

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- .2 Equip all video surveillance cameras with video motion detection analytics allowing for the alarming of cameras upon activation of motion within a predetermined field of view. Upon alarm, cameras record rate will increase, and the camera will call up on dedicated priority screen at the local security workstation, and any off-site monitoring centre.
 - .3 Use Power over Ethernet (PoE) for all cameras (IEEE 802.3af).
 - .4 All video streams from cameras digitally encoded using H.264 or H.265 compression formats for simultaneous monitoring and recording in real time.
 - .5 Commercial grade designed for 24/7/365 use
 - .6 Operate on an open-source platform using ONVIF
 - .7 Equipped with an IR-sensitive progressive scan megapixel sensor.
 - .8 Removable IR-cut filter, providing day/night functionality
 - .9 Lens: 5mm-50mm, Auto Iris, Varifocal
 - .10 The use of fisheye lens to increase field of view on fixed cameras is not permitted. Multiple cameras in the same housing with stitching technology is permitted for large field of view cameras.
 - .11 Manufactured with an IP52-rated, IK08 impact-resistant, polycarbonate casing
 - .12 Outdoor applications:
 - .1 Vandal Resistant housing compliant to IP66 Weather and Dust resistance.
 - .2 Image stabilization for wind and vibration.
 - .3 Person and vehicle detection to eliminate false positives.
 - .13 Manual 3-axis (pan/tilt/rotation) positioning
 - .14 Smoked lower dome
 - .15 Minimum illumination specifications:
 - .1 1080p 25/30 fps with Wide Dynamic Range (WDR)
 - .1 0.15 lux, F1.6 (colour)
 - .2 0.03 lux, F1.6 (monochrome)
 - .2 1080p 50/60 fps without WDR
 - .1 0.30 lux, F1.6 (colour)
 - .2 0.06 lux, F1.6 (monochrome)
 - .16 Pan-Tilt-Zoom (PTZ) cameras

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- .1 Lens: 20x optical + 10x digital
 - .2 Preset Tours: 100 each with 20 presets
 - .3 Pattern/Mimic Tours: 4 each up to 1 minute
 - .4 Pan/Tilt Speed: 0.001 /s to 360 /s
 - .5 Preset move Speeds: 200 /s
 - .6 Privacy Zones: 8 user defined
 - .7 Presets: 100
 - .8 Pan Range: 360° Continuous
 - .9 Tilt Range: 180°
 - .10 Image Stabilizer
 - .17 Minimum two video streams in 720p (1280x720) at up to 60 fps or 50 fps using H.264 or H.265.
 - .18 Ability to supply minimum of two (2) individually cropped out view areas
 - .19 Each camera bit rate, frame rate and resolution set independently from other cameras in the system. Altering these settings does not affect the recording and display settings of other cameras.
 - .20 Both landscape format (4:3 and 16:9 aspect ratio) as well as corridor format (3:4 and 9:16 aspect ratio).
 - .21 Operating Voltage: Power over Ethernet
 - .22 Video Compression: Full frame rate, full color: H.264 (AVC) or H.265 (HEVC)
 - .23 Video Bit Rate: User configurable bit rates from 32 Kbps to 4 Mbps
 - .24 Support password protection to prevent unauthorized administration access.
 - .25 Firewall on each device to allow access to specified IP addresses only. SSL and other non-IP address specific security measures are deemed insufficient.
 - .26 The use of fibre optic with media converts is permitted for outdoor site cameras exceeding 90 m (297 ft) in horizontal distance from the nearest Telecom Room. Supply UPS power with emergency back-up power to all media converters.
 - .27 Cameras to include the following technologies:
 - .1 zoned motion detection with event triggering
 - .2 wide dynamic range

.3 static privacy masking

.4 digital pan/tilt/zoom

.28 Supply appropriate mounting hardware and backboxes for the application to avoid obstructions and provide stable surface for camera mounting. Backboxes

3 EXECUTION

3.1 INSTALLATION

.1 Install complete video surveillance system with patch panels located in communications equipment racks. Camera locations as indicated on the drawings. Confirm exact locations prior to roughing-in.

.2 All network switches for the video surveillance system shall be installed by Owner.

.3 Cameras

.1 Position cameras not to be obstructed by any accessories, equipment, signage, or any other intrusions.

.2 Position cameras to not capture any private areas such as bedrooms and washrooms.

.4 Systems Integration:

.1 Integrate the video surveillance system with the access control system to provide automatic, real-time camera call up on alarm or alerts from each system.

.5 Infrastructure

.1 Install all cabling in conduit. Only within the telecom spaces can the cabling run in the open cabletray. Refer to electrical work Section 27 05 05, Pathways for Communications Systems.

.2 Ground and bond the system as per electrical work Section 27 05 10, Grounding and Bonding for Communications Systems.

3.2 SITE QUALITY CONTROL

.1 Site Tests and Inspections:

.1 The video surveillance system shall have a good quality continuous picture and distorted video or other problems and picture loss resulting from an improperly wired system. Be fully responsible for the elimination of such problems should it become evident and take whatever corrective measures that are needed to rectify the problem at no additional cost. Carefully check all cameras and their recordings to ensure they provide the required field of view, depth of field, maximum resolution, and highest frame rate. Employ measures such as shielding to avoid direct glare from sources other than sunlight.

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- .2 On completion of the installation of the system, tests shall be carried out in the presence of the Owner's Representatives and the Consultant to show that these specifications have been met both physically and functionally. All defects shall be rectified before final acceptance of the system. Thoroughly instruct the users in the proper operation of the system. Provide catalogues, operating instructions, service and repair manuals and schematics.

3.3 ADJUSTING

- .1 Adjust all camera angles to cover areas in accordance with the Owner's requirements. In camera enclosures with multiple cameras, adjust cameras to provide most diverse views and avoid aiming to spaces with no visual interest. Provide screenshots of all coverage area to Owner for review and re-adjust coverage based on markups.

3.4 CLOSEOUT ACTIVITIES

- .1 Demonstration and training:
- .2 Include for on-site operation demonstration and training session for 6 people.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 The existing system consists of a fire alarm control panel, manual pull stations, automatic thermal detectors, smoke detectors, trouble and alarm signals and remote annunciator panels as specified herein. The system contains all required components for alarm receiving circuits and signal circuits. The system is so arranged that the operation of any manual pull station or automatic thermal or smoke detector or sprinkler flow switch activates system signalling sequence. All system circuits, wiring and devices is fully supervised for faults. A circuit fault such as an open or ground or actuation of a valve tamper switch sounds the trouble signal but shall not cause a false alarm.
- .2 The system uses full digital communications to supervise all addressable loop devices for placement, correct location, and operation. It allows swapping of “same type” devices without the need of addressing and impose the “location” parameters on replacement device. It initiates and maintains a trouble if a device is added to a loop and clear the trouble when the new device is mapped and defined into the system.
- .3 On failure of the normal A.C. power source, the fire alarm control panel automatically switches to standby battery power. When the normal A.C. power is restored, the fire alarm control panel automatically switches back to A.C. operation and the battery pack automatically recharges. The system is designed for 120 volts, AC single phase power supply.
- .4 The existing fire alarm system control panel is Notifier (currently serviced and maintained by Vipond) and is suitable for the proposed system modifications.

1.3 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 26 05 00 Common Work Results for Electrical.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements
- .3 Complete sets of shop drawings shall be submitted indicating the following:
 - .1 System component number and dimensions.

- .2 System operating characteristics and functions.
- .3 Rough-in details.
- .4 Wiring schematics.

1.4 QUALITY ASSURANCE

- .1 The fire alarm system shall be installed in accordance with the requirements of all applicable regulatory agencies and codes including:
 - .1 CAN/ULC-S524 – Standard for Installation of Fire Alarm Systems
 - .2 CAN/ULC-S537 – Standard for Verification of Fire Alarm Systems
 - .3 Ontario Building Code
 - .4 Ontario Electrical Safety Code
- .2 Employ fully trained mechanics who are regularly employed in the field of graphics design and/or sign production to create the fire alarm zoning graphic.
- .3 Arrange for production of all graphic material.

1.5 SYSTEM OPERATION

- .1 All fire alarm stations, thermal detectors, products of combustion detectors, emergency evacuation speakers, emergency telephone, sprinkler system flow switches, and sprinkler/standpipe tamper switches shall be fully supervised.
- .2 The fire alarm system shall function such that the activation of any detection circuit will result in the following system operation:
 - .1 Cause audible signal devices to sound continuously throughout building.
 - .2 Activate all strobe appliances throughout the facility.
 - .3 Cause zone of alarm device to be indicated on control panel and remote annunciator panels.
 - .4 Cause fan systems to shut-down and electrically help open fire separation doors to close.
 - .5 Transmit a signal to the fire signal receiving centre or direct to municipal fire department.
 - .6 Transmit signal to elevator machine rooms for possible future special service operation.
 - .7 The system shall indicate trouble at the fire alarm control panel and remote annunciation devices when any fault occurs within the system.

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- .3 The auxiliary circuit connections shall provide automatic operation of auxiliary equipment with manual override on a circuit basis provided by panel control switches.

1.6 SYSTEM PROVISIONS

- .1 The system shall display both alarm and trouble indications from each fire alarm detection zone. The activities of the system shall be complete with custom labels, indicating the exact location of the activity, and shall be displayed on the fire alarm control panel and remote annunciator panels.
- .2 As a result of alarm conditions received the fire alarm control panel shall have the ability to automatically operate specified control points such as transmitting a signal to the fire signal receiving centre to summon the fire department, or stopping recirculating fan systems, closing fire separation doors, etc.
- .3 The system shall be equipped with a communication input/output port to allow use of remote printers and video display terminals for remote status indication.
- .4 The multiplex system shall be equipped with standby batteries and automatic charger to provide system operation and vital fire protection during commercial power outages. It shall also have provisions to operate remote LCD/LED annunciators. Annunciators shall be operable from the system communication circuits.

2 PRODUCTS

2.1 APPROVED MANUFACTURERS

- .1 Listed below are manufacturers that will provide complete fire alarm panel. Equivalent fire alarm systems by other suppliers and/or engine manufacturer may be accepted subject to review by the consultant. Fire Alarm Systems by the following manufacturer/model combinations will be considered for use on this project:
 - .1 Notifier

2.2 GENERAL

- .1 All equipment and components shall be the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling fire alarm and smoke control system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system. Provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these specifications.
- .2 The system shall utilize node-to-node, direct wired, multi-priority peer-to-peer network operations. The system shall utilize electronically addressed, smoke detectors, heat detectors and input/output modules as described in this specification.

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- .3 All integrated life safety system equipment shall be arranged and programmed to provide an integrated system for the early detection of fire, the notification of building occupants, the automatic summoning of the local fire department, the override of the HVAC system operation, and the activation of other auxiliary systems to inhibit the spread of smoke and fire, and to facilitate the safe evacuation of building occupants. In all operating modes, the processing of fire alarms shall have the highest priority.

2.3 SYSTEM CONFIGURATION

- .1 Each detection or signal loop shall be circuited so device loading is not to exceed 80% of loop capacity in order to allow for the addition of future devices.
- .2 Provide alarm receiving modules in the control panel for all alarm receiving circuits. Modules shall include an individual amber trouble lamp for each alarm receiving circuit to indicate the source of any faults.
- .3 The alarm receiving circuits shall have Class "A" operation. A single break or ground fault in the wiring to any initiating device shall cause a trouble signal, but shall not affect detection of an alarm from any initiating device while this fault exists.
- .4 Provide supervisory receiving modules in the control panel for all supervisory circuits. Modules shall include individual alarm and trouble lamps for each supervisory circuit to indicate circuit condition.
- .5 The supervisory circuits shall have Class "B" operation. A single break or ground fault in the wiring to any initiating device shall provide a trouble signal. A supervisory circuit alarm condition shall activate trouble sequence only.
- .6 Provide audible signal circuit modules in control panel for all signal circuits. Modules shall include individual alarm and trouble lamps for each signal circuit to indicate the circuit condition.
- .7 Provide auxiliary control relay modules in control panel for all auxiliary control circuits. Modules shall include individual trouble lamps for each circuit and supervised on-off-auto control switch for manual circuit operation override.
- .8 The signal and auxiliary control circuits shall have Class "A" operation. A single break or ground fault in the wiring to any audible signal or control device shall produce a trouble signal. but shall not affect signalling of an alarm condition while this fault exists.

2.4 SYSTEM DEVICES

- .1 All new and existing re-used system devices shall be fully compatible with control equipment and match in operation and performance characteristics. All signal bells and manual pull stations shall be identical in appearance. Replace existing components as appropriate to meet this requirement.
- .2 Manual Pull Stations types include:
 - .1 Manual Station, Single Stage, single-action pull lever, extruded aluminum with NO/NC contacts.

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- .2 Manual Station, Single Stage, single-action pull lever, extruded aluminum with two sets NO/NC contacts (for use with magnetic locks).
 - .3 Manual Pull stations will include these accessories where required:
 - .1 Where surface mounted, use a vendor approved surface wall box.
 - .2 Where indicated on drawings provide a vendor approved polycarbonate shield and frame that fits easily over manual pull station. The shield will have integrated battery-operated horn.
 - .3 Use manufacturer-approved manual pull station lowering kit to adjust height of existing manual pull stations.
 - .4 The automatic thermal detectors shall be the following:
 - .1 Fixed and Rate of Rise Heat Detector. 57 °C (135 °F), separate mounting base.
 - .2 Fixed and Rate of Rise Heat Detector. 90 °C (194 °F), with addressable module.
 - .3 Fixed Temperature Heat Detector. 57 °C (135 °F), separate mounting base.
 - .4 Fixed Temperature Heat Detector. 90 °C (194 °F), with addressable module.
 - .5 Fixed and Rate of Rise Heat Detector. 57 °C (135 °F), suitable for Class 1, Division 1, Group D (explosion proof) application with an address module.
 - .6 Fixed and Rate of Rise Heat Detector. 57 °C (135 °F), Suitable for moisture proof application with an address module.
 - .7 Fixed Temperature Heat Detector. 57 °C (135 °F), suitable for moisture proof application with an address module.
 - .5 Where indicated to provide a fire detector, provide suitable thermal detector listed above.
 - .6 The automatic smoke detectors shall be the following:
 - .1 Photoelectric Area Type with separate mounting base
 - .2 Photoelectric Type Duct Smoke Detector with housing, Form-C shut down relay and LED remote indicator and sampling tubes to suit duct dimensions and key-operated remote test station. Provide wall mount remote indicator minimum 300 mm (1 ft) below ceiling at detector location.
 - .3 Photoelectric Smoke and Fixed Temperature Type- intelligent multi-sensor detector. The smoke detector will be modular and allow for replacement of the photoelectric chamber
 - .4 Ionization, Photoelectric and Heat Type - multi-sensor detector with a separate mounting base.

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- .7 Provide relay type base for area smoke detectors as indicated to provide a remote alarm indication or perform auxiliary functions as applicable. Relay bases to be 4 wire version with end of line relay. Power source for relay activation to be run separately from detection circuit to allow multiple unit operation.
 - .8 The intelligent Analog detectors will be suitable for mounting on any detector-mounting base.
 - .1 Standard Detector Mounting Bases - The base will be capable of supporting one Remote Alarm LED Indicator. Provide remote LED alarm indicators where shown on the plans.
 - .2 Relay Detector Mounting Bases – The base will be provided for area smoke detectors as indicated on plans to provide a remote alarm indication or perform auxiliary functions as applicable. Relay bases to be 4 wire version with end of line relay. Power source for relay activation to be run separately from detection circuit to allow multiple unit operation. The relay will be a bi-stable type and selectable for normally open or normally closed operation. The position of the contact will be supervised
 - .3 Isolator Detector Mounting Bases – The base’s respective detector processor will control the operation of the isolator base. Following a short circuit condition, each isolator/detector will be capable of performing an internal self-test procedure to re-establish normal operation.
 - .9 Input modules will have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED will flash to confirm communication with the loop controller. A red LED will flash to display alarm status.
 - .1 Single Input Module - (Waterflow Detectors, Tamper Switches etc.) The Single Input Module will provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The single input module will support the following circuit types: Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.), Normally-Open Alarm Delayed Latching (Waterflow Switches), Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.), Normally-Open Active Latching (Supervisory, Tamper Switches).
 - .2 Dual Input Module - The Dual Input Module will provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation. The dual input module will support the following circuit types: Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.), Normally-Open Alarm Delayed Latching (Waterflow Switches), Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.), Normally-Open Active Latching (Supervisory, Tamper Switches).

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- .3 Single Input Signal Module - The Single Input (Single Riser Select) Signal Module will provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation. When selected as a telephone power selector, the module will be capable of generating its own "ring tone". The single input signal module will support the following operations:
Audible/Visible Signal Power Selector (Polarized 24 V DC @ 2 A).
 - .4 Control Relay Module - The Control Relay Module will provide one form "R" dry relay contact rated at 2 A @ 24 V DC to control external appliances or equipment shutdown. The control relay will be rated for pilot duty and releasing systems. The position of the relay contact will be confirmed by the system firmware.
 - .10 End-of-line resistors shall be mounted behind a white plastic single gang cover plate appropriately marked and must be U.L.C. approved.
 - .11 Notification appliances will be as follows:
 - .1 Speaker: Recess ceiling mount 200 mm (8 in) diameter voice quality speaker unit complete with 300 mm (12 in) round white baffle, backbox/enclosure and 70 V line matching transformer with 1/4 to 2 W taps. Where required, equivalent surface mount version with a square matte white baffle and finished surface backbox. Set tap initially to 1 W, then individually adjust to suit specific requirements.
 - .2 Combination Speaker-Strobe: Recess ceiling mount 200 mm (8 in) diameter voice quality speaker unit complete with 300 mm (12 in) round white baffle, backbox/enclosure and 70 V line matching transformer with 1/4 to 2 W taps. Where required, equivalent surface mount version with a square matte white baffle and finished surface backbox. Set tap initially to 1 W, then individually adjust to suit specific requirements. Strobe to be selected for 15 cd for corridors and 75 cd for rooms unless noted otherwise. Multi-candela strobe with intensity selectable as: 15, 30, 75 or 110 cd.
 - .3 Trim Plates: Provide trim plates for two-gang or 100 mm (4 in) square boxes.

3 EXECUTION

3.1 GENERAL

3.2 WIRING

- .1 Wiring shall be sized and colour coded in accordance with manufacturer's and Electrical Safety Code requirements, (minimum #14 - signal and control circuits, minimum #18 - annunciation, minimum #16 detection and supervisory circuits, minimum #12 power supply). All fire alarm system wiring shall be provided with a separate insulated ground conductor sized in accordance with Electrical Safety Code regulations.
- .2 All wiring for detection and signalling zones shall be installed as Class 'A' type obtained by wiring in a loop method around zone area such that wiring pairs (feed and return) are not installed in the same conduit and conduits are not run together.

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- .3 All other wiring shall be standard Class 'B' type.
 - .4 Install all wiring in a separate conduit system in accordance with this specification and Electrical Safety Code requirements complete with recessed device boxes for approved component mounting.
 - .5 Use fire rated pyrotenax mineral insulated cable as noted and/or required to meet Building Code regulations. For multiplex communication wiring to remote annunciator and transponders, use twisted shielded pair wiring in accordance with manufacturer's specifications.
 - .6 Connect auxiliary control circuits to the system to provide proper equipment operation. Provide in-line fuse protection at control panel for all auxiliary control circuits.
 - .7 Wiring connections shall be made as shown on drawings furnished by the manufacturer. Power shall not be applied to the system until the representative of the manufacturer has approved the connections to the control equipment.
 - .8 Wiring requirements for shielding certain conductors from others or routing in a separate raceway shall be as recommended by the manufacturer's documentation and included in the bid.
 - .9 Provide all new system wiring to comply with the new system circuit zoning, devices and wiring requirements. Re-connect existing control circuits for proper operation from new system equipment.

3.3 INSTALLATION

- .1 Mounting heights of equipment shall be as follows:
 - .1 Manual Stations – 1150 mm (46") to centre of back box. New stations installed at existing locations shall be re-positioned to new mounting height.
 - .2 Audible Signals - 2400 mm (8'-0") or 300 mm (12") below ceiling, to centre of device, whichever is lower.
 - .3 Visual Signals – 2400 mm (8'-0") to top of lens.
 - .4 End of line resistors - 1800 mm (6') to centre of device.
- .2 Locate detectors as shown considering spacing and mounting requirements contained in CAN/ULC-S524. Locate detectors away from radiating surfaces or positions affected by ventilation grilles.
- .3 End-of-line resistors will be furnished as required for mounting as directed by the manufacturer. These devices are not shown on plans but shall be located in public spaces.

- .4 Connect sprinkler system flow and alarm switches, by Division 21 Fire Suppression, to the fire alarm system to indicate an alarm condition on the appropriate zone. Connect standpipe/sprinkler system pressure and tamper switches, by Division 21 Fire Suppression, to the system to indicate a trouble condition on the appropriate zone. Connect fire pump power supply auxiliary monitor contacts to the system to indicate a trouble condition on the appropriate zone.
- .5 Connect supervisory device contacts to the system to indicate a trouble condition on the appropriate supervisory zone. Connect auxiliary control circuits to the system to provide proper equipment operation. Provide in-line fuse protection at control panel for all auxiliary control circuits.
- .6 Wiring connections shall be made as shown on Drawings furnished by the manufacturer. Power shall not be applied to the system until the representative of the manufacturer has approved the connections to the control equipment.
- .7 Connect auxiliary control circuits to the system to provide proper equipment operation. Provide in-line fuse protection at control panel for all auxiliary control circuits.

3.4 FIELD QUALITY CONTROL

- .1 The manufacturer shall make a complete inspection of all installed fire alarm equipment including each and every component such as manual pull stations, signal bells, automatic thermal and smoke detectors, annunciation and control equipment, etc. in accordance with CAN/ULC-S537 to ensure the following:
 - .1 That the system is complete and in accordance with the specifications.
 - .2 That the system is connected according to U.L.C. requirements.
 - .3 That the system is installed in accordance with the manufacturer's recommendations.
 - .4 That the regulations concerning the supervision of components have been adhered.
- .2 Any subsequent changes to conform to the above shall be done by the Contractor/Sub-Contractors with technical advice supplied by the manufacturer.
- .3 All fire alarm system testing and verification shall use only safe, non-damaging test methods in accordance with CAN/ULC-S536. Open flame or smoke shall not be used for any on-site testing of detection devices for proper operation.
- .4 During the period of inspection, this Contractor/Sub-Contractors shall supply to the manufacturer all personnel necessary to complete the inspection and also supply any required equipment such as ladders, scaffolding, etc.

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- .5 On completion of the inspection the manufacturer shall supply the Consultant with a certificate together with detailed inspection record sheets, confirming that the system is installed in accordance with the above outlined requirements. He shall also confirm in writing that all authorized building personnel have been instructed as to system operation and maintenance procedures etc.
 - .6 All costs involved in this inspection both from the manufacturer and this Section's work, will be included with the total tender price.
 - .7 Provide a one day familiarization, training and instruction session as required, for the Owner's maintenance staff to review the working and function of the system and equipment; and to instruct personnel about proper maintenance.
 - .8 It shall be the responsibility of the installing contractor to assure that construction debris does not adversely affect any sensing devices installed as part of this project. Should it be deemed necessary by the Consulting Engineer, End-User, or AHJ, the installing contractor shall be responsible for the cleaning of all smoke detectors prior to final acceptance.

3.1 THIRD-PARTY VERIFICATION

- .1 Verification shall be carried out in accordance to CAN/ULC-S537 Verification of Fire Alarm Systems. The Third-party verifier shall provide a Verification Certificate and Verification Report to show compliance with CAN/ULC-S537 Verification of Fire Alarm Systems.
- .2 Verification must be carried out by an agency (or individual) acceptable to the Authority Having Jurisdiction, who can demonstrate they have the sufficient training or experience, and who is not the installing contractor, fire alarm manufacturer, or involved in the design or installation of the fire alarm system.
- .3 All fire alarm system testing and verification will use only safe, non-damaging test methods in accordance with CAN/ULC-S536. Open flame or smoke will not be used for any on-site testing of detection devices for proper operation.

3.2 AUDIBILITY TESTING

- .1 All rooms within the scope of work shall be tested with a professional sound level meter that has an accuracy of ± 1.5 dB. Sound level meter used in testing shall be the same for all areas of the building for both with alarm and without. Tester will be calibrated immediately before and after the audibility measurements are taken based on ANSI S1.40, Specifications for Acoustical Calibrators.
- .2 Sound level measurements shall be taken in accordance to CAN/ULC-524 Appendix C - Sound Level Measurements with the following additional requirements.
 - .1 Tester will perform all tests with all doors and windows closed and when unusual noises are not present.

- .2 Tester will perform test to get ambient noise level without alarm to measure ambient sound level and perform the test again with the with alarm to measure alarm sound level.
- .3 All test results should be tabulated showing the following columns: room number/name, building code minimum sound level, ambient noise level, and alarm noise level

3.3 FIREWATCH

- .1 If during the course of construction, the fire alarm system or zones within the building are required to be fully or partially shut down for any period of time, provide a Firewatch for all the affected areas in accordance with the Fire Code during that time period. This Firewatch should be in place for the entire duration of the shutdown.

3.4 SEQUENCE OF OPERATION

- .1 The fire alarm system shall function such that the activation of any detection circuit (automatic detector, manual station, sprinkler flow switch) will result in the following system operation:
 - .1 Activate the control panel to cause general alarm signal to be produced by all signal devices throughout the building.
 - .1 All audible appliances shall be synchronized with each other when two or more signalling devices can be heard. Audible devices shall have the ability to be silenced.
 - .2 Strobes shall be synchronized with each other in any location with two or more strobes in a common field of view. Visual devices shall be non-silenced unless the system is successfully reset.
 - .2 Indicate alarm origin on control panel display and at the remote annunciators.
 - .3 Cause recirculating air fan systems to shut down. Cause other controlled equipment to shut down.
 - .4 Transmit signal to central monitoring station/municipal fire department (per ULC-S561).
 - .5 Transmit signal to return all elevators that serve the floor of alarm initiation to the ground floor. If the alarm originates from the ground floor, return all elevators to the floor above or to a level as directed by the local fire department
 - .6 Cause electrically connected or hold open doors to close and release lock on electrically latched exit doors throughout the building.
- .2 Alarm signals shall sound continuously (unless manually reset) for not less than 20 minutes at which time the audible signals shall automatically silence (TLC), but the visual alarm signal shall remain or until the alarm condition is reset to normal.
- .3 It shall not be possible to silence the alarm signals or reset the panel during the first minute of alarm. (Inhibit)

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- .4 The auxiliary circuit connections shall provide automatic operation of auxiliary equipment with manual override on a circuit basis provided by panel control switches. Control circuit operation shall be software programmable to perform functions in sequence or on the basis of specific input circuit status.
 - .5 The entire fire alarm system shall be electrically supervised such that the trouble signals shall operate until the trouble condition is corrected but shall not cause a false alarm. A trouble signal shall be transmitted upon loss of primary power, activation of a supervisory circuit (valve tamper switch), or any opens, grounds or disarrangement of system wiring and shorts across alarm signaling wiring detection of a circuit fault on any circuit. A trouble signal shall not interfere with the transmission of an alarm signal. A trouble condition on one zone shall not affect operation of the remaining zones.
 - .6 The system shall identify any off normal condition and log each condition into the system database as an event.
 - .1 The system shall automatically display on the control panel LCD the first event of the highest priority by type. The priorities and types shall be alarm, supervisory, trouble, and monitor.
 - .2 The system shall have a Queue operation, and shall not require event acknowledgment by the system operator. The system shall have a labeled color-coded indicator for each type of event; alarm - red, supervisory - yellow, trouble - yellow, monitor - yellow. When an unseen event exists for a given type, the indicator shall be lit.
 - .3 For each event, the display shall include the current time, the total number of events, the type of event, the time the event occurred and custom user description.
 - .4 The user shall be able to review each event by scrolling (up-down) for each event type.
 - .5 Upon acknowledging or silencing any event at the control panel, any new alarm, supervisory, or trouble events shall re-sound at the control panel.
 - .7 Smoke and heat detector devices in elevator lobby, shaft, and machine room will comply with sequences and operation of local, provincial, TSSA, and CSA B44.1 requirements for main/alternate floor recalls and shunt trip activations.

END OF SECTION