



Electrical Specifications

Issued for Tender Addendum No.5

Project Name

Toronto Western Hospital
Senior Emergency Medicine Centre (SEMC)
& External Corridor
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PART 1 – GENERAL**1.1 References**

- .1 The "General Conditions", Documents and all Sections of Division 01 apply to and are a part of this Section.

1.2 Application

- .1 This Section applies to and is an integral part of each Section of Electrical Divisions.

1.3 Definitions

- .1 Following are in addition to Division 01 definitions of words found in Sections of Electrical Divisions and on associated drawings:
 - .1 "concealed" - means hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions;
 - .2 "exposed" - means work normally visible, including work in equipment rooms, tunnels, and similar spaces;
 - .3 "finished" - means when in description of any area or part of an area or a product which receives a finish such as paint, or in case of a product may be factory finished;
 - .4 "provide" (and tenses of "provide") - means supply and install complete;
 - .5 "install" (and tenses of "install") - means secure in position, connect complete, test and verify;
 - .6 "supply" - means to procure, arrange for delivery to site, inspect, accept delivery and administer the supply of manufacturer's products and/or systems, and includes manufacturer's supply of any special cables, standard on site testing, initial start-up, programming, basic commissioning, warranties and assistance to Contractor;;
 - .7 "delete" (and tenses of "delete") – means to disconnect, make safe, remove including any back box and exposed conduits, patch and repair/finish surfaces to match adjoining similar construction, include for associated re-programming of systems and/or change of documentation identifications to suit deletions, and properly dispose of deleted products off site unless otherwise instructed by Consultant;
 - .8 "BAS" – means building automation system; references to "BAS", "BMS" – building management system and "FMS" –facilities management system, shall generally mean the same.
 - .9 "Electrical Divisions" – refers to Divisions 26, 27, 28 and other Divisions as specifically noted, and which the work shall be the responsibility of the Electrical Contractor, unless otherwise noted;
 - .10 "Mechanical Divisions" – refers to Divisions 20, 21, 22, 23, 25 and other Divisions as specifically noted, and which the work shall be the responsibility of the Mechanical Contractor, unless otherwise noted;

- .11 "governing authority" and/or "authority having jurisdiction" and/or "regulatory authority" and/or "Municipal authority" – means government departments, agencies, standards, rules and regulations that apply to and govern the work and to which the work must adhere.
- .2 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.

1.4 Documents

- .1 In the case of discrepancies or conflicts between the Drawings and Specifications, the Documents will govern in order specified in the "General Conditions", however, when the scale and date of the Drawings are the same, or when the discrepancy exists within the Documents, include the costliest arrangement.
- .2 The Specification is arranged in accordance with the CSI/CSC 50 Division Master Format.
- .3 Unless otherwise noted, sections of the Electrical Divisions 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.
- .4 The drawings are performance drawings, diagrammatic, and show approximate locations of equipment and materials. The drawings are intended to convey the scope of work and do not show architectural and structural details. The locations of materials and equipment shown may be altered, when reviewed by the Consultant, to meet requirements of the material and/or equipment, other equipment and systems being installed, and of the building. Provide fittings, offsets, transformations, and similar items required as a result of obstructions and other architectural or structural details but not shown on the electrical drawings.
- .5 The Specification does not generally indicate the specific number of items or amounts of material required. The Specification is intended to provide product data and installation requirements. It is necessary to refer to schedules, drawings (layouts, riser diagrams, schematics, details) and the Specification to provide correct quantities. Singular may be read as plural and vice versa in the Specification.
- .6 Starter schedule drawings are both mechanical and electrical, and apply to the work of Mechanical Divisions and Electrical Divisions. Be responsible for reviewing starter, motor control centre, and motor specification requirements of the Electrical and Mechanical Divisions specifications and drawings, prior to Bid submission and confirm exact scope and responsibility of work between Mechanical Divisions and Electrical Divisions.
- .7 The drawings and Specifications are prepared solely for use by the party with whom the Consultant has entered into a contract and there are no representations of any kind made by the Consultant to any party with whom the Consultant has not entered into a contract.

- .8 Bidders finding discrepancies in, or omissions from the Bid documents, or having doubt as to the meaning or intent thereof, shall at once notify the Consultant, in writing. Failure to do this means that the Contractor is fully aware of design intent and requirements, and will execute the full design within the submitted Bid Price. If a response is required at the discretion of the Consultant, a written instruction in the form of addendum shall be sent to all Bidders. All such addenda shall become part of the Contract Documents. Neither Owner nor Consultant will be responsible for verbal instructions.

1.5 Imperial and Metric Measurements

- .1 Generally, both metric and imperial units of measurement are given in Sections of Specification governed by this Section. Measurement conversions may be generally "soft" and rounded off. Exact measurements to be confirmed based on application. Where measurements are related to products, confirm with specified product manufacturers. Where measurements are related to installation and onsite applications, confirm issued document measurements with applicable local code requirements, and/or as applicable, make accurate measurements onsite. Where significant discrepancies are found immediately notify Consultant for direction.

1.6 Examination of Site

- .1 Carefully examine conditions at the site that will or may affect electrical work, and become familiar with site conditions and work associated with electrical work in order that your tender price includes for everything necessary for completion of the electrical work.
- .2 Ensure that materials and equipment are delivered to the site at the proper time and in such assemblies and sizes so as to enter into the building and to be moved into spaces where they are to be located without difficulty.

1.7 Work Hours and Phasing

- .1 Phasing and scheduling of the Work is required in order to maintain existing building operations. Include in Bid Price all costs (including costs for "off hours" work) for scheduling, coordination and construction phasing to suit this project as specified in Division 01, herein this Section and on the drawings.
- .2 Protect existing areas above, below and adjacent the areas of Work from any debris, noise, or interruptions to existing services to the satisfaction of the Owner and Consultant. Maintain in operation the existing services to these areas to allow Owner to continue use of these areas. If services that are required to be maintained run through areas of renovations, provide necessary protection to services or reroute, to approval of Owner and Consultant. Include for required premium time work to meet these requirements.
- .3 Work being performed within occupied spaces and work affecting surfaces adjacent to occupied spaces may need to be performed after regular business hours. For areas where spaces are used by the Owner on a 24 hours basis or over various hours, coordinate hours of work with the Owner on a regular basis to suit Owner's schedule. Execute work at times approved by Consultant and as agreed by the Owner, so as not to inconvenience the Owner's occupation or in any way hinder the Owner's use of building. Include for required premium timework to meet these requirements.

- .4 Project partial occupancy permits may be required throughout the project. Provide for each partial permit an ESA certificate, a fire alarm system verification certificate and any other testing/verification certificates such as nurse call and patient room wiring verification.

1.8 Planning and Layout of the Work

- .1 Base installation layout, design, terminations, and supply of accessories, on the Documents with specific coordination with reviewed shop drawings.
- .2 Co-ordinate work with the work of other trades to ensure a proper and complete installation. Notify trades concerned of the requirements for openings, sleeves, inserts and other hardware necessary in their work for the installation of your work.
- .3 Where work is to be integrated, or is to be installed in close proximity with the work of other trades, co-ordinate work prior to and during installation.
- .4 Plan, coordinate, and establish the exact locations and routing of services with affected trades prior to installation such that they will clear each other as well as any other obstruction. Generally, the order of right of way for services within the ceiling spaces to be as follows:
 - .1 piping requiring pitch, including drains, steam, condensate etc.;
 - .2 large piping 100 mm (4") and above;
 - .3 large ducts main runs;
 - .4 cable tray and bus duct;
 - .5 large conduit 100 mm (4") and above;
 - .6 small piping less than 100 mm (4");
 - .7 small ducts branch runs;
 - .8 small conduit less than 100 mm (4").
- .5 Unless otherwise directed by Consultant, the Mechanical Contractor is to determine final locations of major work within the ceiling spaces.
- .6 Do not use the Contract Drawing measurements for prefabrication and layout of raceways, conduits, ducts, bus ducts, luminaires, and other such work. Locations and routing are to be generally in accordance with the Contract Drawings, however, prepare layout drawings for such work. Use established bench marks for both horizontal and vertical measurements. Confirm inverts, coordinate with and make allowances for the work of other trades. Accurately layout the work, and be entirely responsible for work installed in accordance with layout drawings. Where any invert, grade, or size is at variance with the Contract Drawings, notify the Consultant prior to proceeding with the work.

- .7 Prepare plan and interference drawings (at a minimum drawing scale of 1:50 or ¼"=1' 0") of the work for submittal to the General Contractor, who will then arrange for preparation of detailed section drawings of ceiling spaces of corridors and any other congested areas. The sections are to be cross referenced with plan drawings so that trades may make use of the section drawings. The section drawings indicate lateral and elevation dimensions of major services within the ceiling space. Lateral dimensions are to be from grid lines and elevations from top of floor slab. Obtain from Consultant, disks of the engineering drawings for this use. Prints and/or disks of Contractors' interference drawings are to be distributed among other Trade Contractors and General Contractor. Submit drawings to Consultant for review. Failure of General Contractor to prepare and coordinate overall interface drawings of trades does not relieve Electrical Division Contractor of responsibility to ensure that work is properly planned and coordinated.
- .8 Carry out alterations in the arrangement of work that has been installed without proper co-ordination, study, and review, even if in accordance with the contract documents, in order to conceal the work behind finishes, or to allow the installation of other work, without additional cost. In addition, make any alterations necessary in other work required by such alterations, without additional cost.
- .9 Be responsible for making necessary changes, at no additional cost, to accommodate structural and building conditions that were missed due to lack of coordination by this Division.
- .10 Where drawings indicate that acoustic tile ceiling is being suspended below existing plaster ceiling, coordinate with General Trades Contractor the design of the framework used to support the suspended ceiling, lighting, diffusers, and other Electrical Divisions components that are mounted within or through ceiling. Do not mount devices to suspended ceiling. Secure and mount to ceiling slab above. Seal ceiling openings to maintain required fire rating.
- .11 Certain aspects of work require notification of and coordination with Owner. Generally, requirements are noted in Specifications. Confirm exact requirements with Consultant prior to start of Work.

1.9 Access for Service, Repair and Maintenance

- .1 Whether shown on drawings or not, leave adequate space and provision for servicing of equipment, removal and re-installation of replaceable items. Comply with local governing authority and code requirements with regards to access space provisions around equipment is provided for service, repair and maintenance.
- .2 Initiate coordination of location for service, repair and maintenance access with General Contractor.
- .3 Equipment is typically located so as to minimize number and carefully locate how access is obtained, or where access doors are installed. Do not relocate equipment without confirming that access can also be relocated. Confirm with drawings and Consultant for dimensioned locations for access doors.
- .4 Access is to be no less than that required by the manufacturer's installation instructions, and where not otherwise identified is to be:

- .1 Not less than 450 mm to 600 mm (18"-24") to at least one side of component requiring access;
- .2 Located such that a person 168 cm (5'-6") tall, standing on a standard 2.4 m, 3.6 m or 4.8 m (8', 12' or 16') ladder (or scissor lift where ceiling heights exceed 4.8 m [16']), with their head at the same elevation as equipment or device requiring access, can readily reach equipment or device without obstruction.
- .5 Do not install equipment tight to structural slab, where service access would require that component be located immediately above finished ceiling for access.

1.10 Component Final Locations

- .1 Owner and the Consultant reserve right to relocate electrical components such as receptacles, switches, communication system, outlets, hard wired outlet boxes and luminaries at a later date, but prior to installation, without additional cost to Owner, if relocation per components do not exceed 3 m (10') from original location. No credits will be anticipated where relocation per components of up to and including 3 m (10') reduces materials, products and labour. Should relocations exceed 3 m (10') from the original location, adjust contract price for that portion beyond 3 m (10') in accordance with provisions for changes in Contract Documents.

1.11 Systems Co-Ordination

- .1 Be responsible for and perform specific coordination of various low voltage systems supplied by Electrical Divisions and also with systems supplied by other Divisions of the Work. Include for but not be limited to provision of the following, as applicable:
 - .1 coordinate with General Contractor and other Subcontractors, the various systems of trades which in any way are interfaced with or monitored by or integrated to, or need to be coordinated with;
 - .2 prepare systems coordination drawings detailing related system coordination and integration points being monitored and/or controlled; submit coordination drawings as part of shop drawing submission;
 - .3 coordinate security system requirements with successful door hardware supplier and prepare detailed coordination drawings of component installations, wiring and conduit layouts, division of responsibility between various trades, etc.; review security system requirements with associated door hardware (electromagnetic locks, electric strikes, etc., to ensure proper sequence of operation and door functionality is provided to suit each door configuration); prepare detailed door functionality of each door configuration and submit for review by Consultant;
 - .4 review specifications of each trade/Division, i.e. BAS points, elevator requirements, electrical devices in millwork or prefabricated service consoles, etc., to ensure proper communications and power requirements;
 - .5 review systems requirements for component back boxes and conduits; ensure that system of conduits and boxes meet respective system wiring bending radii requirements;

- .6 review with manufacturers the coordination and integration requirements of their systems;
- .7 review each systems communication protocols to ensure they are compatible and can communicate with each other as required;
- .8 review system shop drawings prior to submission to Consultant, to verify that each system has been coordinated with other systems and that required options and features are selected to meet coordination requirements;
- .9 be present at testing and commissioning functions of each system and provide technical assistance with regards to system operations;
- .10 be the "on-site" coordinator of respective system trades with regards to respective system coordination of installation and testing;
- .11 liaise with Consultant with regards to ensuring that systems coordinate and integrate properly to satisfaction of Owner;
- .12 document coordination and integration requirements and maintain records for submission as part of shop drawings;
- .13 respond to coordination and integration requirements and be responsible for such work;
- .14 where a system integrator has been included for, coordinate integration requirements with system integrator.

1.12 Equipment Loads

- .1 Supply equipment loads (self-weight, operating weight, housekeeping pad, inertia pads, etc.) to the Consultant, via shop drawing submissions, prior to construction.
- .2 When the choice of specific equipment is made by Contractor, the actual weight, location and method of support of the equipment may differ from those initially given to the Consultants and thus from those assumed for design. Consequently, it is necessary to back-check all equipment loads, location and supports.
- .3 Where the supporting structure consists of structural steel framing, it is imperative that the equipment loads, location and method of support be confirmed prior to the fabrication of the structural steel. Be responsible for confirming the locations of all equipment with Consultant prior to construction.

1.13 Openings

- .1 Supply opening sizes and locations to Consultant to allow verification of their effect on the design, and for inclusion on the structural drawings where appropriate.
- .2 No openings will be permitted through the completed structure without written approval of Consultant. Any openings which are required through the completed structure must be clearly and accurately shown on a copy of the structural drawings. Exact locations, elevations and size of the proposed opening must be identified and submitted to Consultant for review, well in advance of doing the work.

1.14 Temporary Services

- .1 Coordinate with General Contractor, requirements for temporary services including but not limited to temporary exit pathways, as decided at discretion of General Contractor, to be illuminated complete with emergency lighting, exit signage and fire alarm devices in accordance with OBC and local governing inspection authorities.

1.15 Shop Drawings

- .1 Submit for review, properly identified and dimensioned shop drawings showing in detail the design, construction and performance of equipment and materials as requested in Sections of the Electrical Division of the Specification. Include equipment dimension drawings, system block diagrams and wiring schematic drawings. The shop drawings must be submitted to the Consultant for review prior to ordering and installation of equipment.
- .2 Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS", include your company name, the submittal date, and sign each copy. Shop drawings that are received and are not endorsed, dated and signed will be returned for re-submittal. Submit electronic copies of shop drawings unless otherwise directed by Consultant. Confirm exact requirements with Consultant.
- .3 Consultant will review shop drawings and will indicate his review status by stamping shop drawing copies as follows:
 - .1 "REVIEWED" or "REVIEWED AS NOTED" - If the Consultant's review of shop drawing is final, the Consultant will stamp the shop drawing "REVIEWED" or "REVIEWED AS NOTED" (appropriately marked).
 - .2 "RETURNED FOR CORRECTION" - If the Consultant's review of shop drawing is not final, the Consultant will stamp the shop drawing "RETURNED FOR CORRECTION", mark the submission with his comments, and return the submission. Revise the shop drawing in accordance with the Consultant's notations and resubmit.
 - .3 It is understood that the following shall be read in conjunction with the wording on the Consultant's shop drawing review stamp applied to each and every shop drawing submitted:

"THIS REVIEW BY THE CONSULTANT IS FOR THE SOLE PURPOSE OF ASCERTAINING CONFORMANCE WITH THE GENERAL DESIGN CONCEPT. THIS REVIEW DOES NOT MEAN THAT THE CONSULTANT APPROVES THE DETAIL DESIGN INHERENT IN THE SHOP DRAWINGS, RESPONSIBILITY FOR WHICH REMAINS WITH THE CONTRACTOR, AND SUCH REVIEW DOES NOT RELIEVE THE CONTRACTOR OF THE RESPONSIBILITY FOR ERRORS OR OMISSIONS IN THE SHOP DRAWINGS OR OF HIS RESPONSIBILITY FOR MEETING ALL REQUIREMENTS OF THE CONTRACT DOCUMENTS. BE RESPONSIBLE FOR DIMENSIONS TO BE CONFIRMED AND CORRELATED AT THE JOB SITE, FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION AND INSTALLATION, AND FOR COORDINATION OF THE WORK OF ALL SUBTRADES".

- .4 Each system (i.e.: fire alarm system, security system, etc.) and each major component (i.e.: switchboard, transformer etc.) shall each be separate shop drawing submissions. Shop drawings for common devices such as devices of each system or all luminaires, shall be submitted together.
- .5 Shop drawings for submission shall be obtained from product manufacturer's authorized representatives.
- .6 Where extended warranties are specified for equipment items, ensure that specified extended warranty is included in shop drawing submittal.

1.16 Work Standards

- .1 Where regulatory codes, standards and regulations are at variance with the Drawings and Specification, the more stringent requirement will apply.
- .2 Where any code, regulation, bylaw, standard, contract form, manual, printed instruction, and installation and application instruction is quoted it means, unless otherwise specifically noted, latest published edition at time of submission of Bids adopted by and enforced by local governing authorities having jurisdiction. Include for compliance with revisions, bulletins, supplementary standards or amendments issued by local governing authorities.
- .3 Supplementary mandatory Specifications and requirements to be used in conjunction with the project shall include the following:
 - .1 Ontario Electrical Safety Code (OESC);
 - .2 Electrical Safety Authority (ESA);
 - .3 Electrical and Electronic Manufacturers Association of Canada (EEMAC);
 - .4 Ontario Building Code (OBC);
 - .5 Canadian Standards Association (CSA);
 - .6 Underwriters' Laboratories of Canada (ULC);
 - .7 National Building Code of Canada (NBC);

- .8 Illuminating Engineering Society (IES);
 - .9 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., (ASHRAE);
 - .10 CSA Z32, "Electrical Safety and Essential Systems in Health Care Facilities";
 - .11 CSA C282, "Emergency Electrical Power Supply For Buildings";
 - .12 CSA Z432 Safeguarding of Machinery;
 - .13 CSA Z317.13, Infection Control During Construction or Renovation of Health Care Facilities;
 - .14 CSA Z317.5, Illumination Systems in Health Care Facilities;
 - .15 Occupational Health and Safety Act - Ontario Regulation 632, " Confined Spaces";
 - .16 National Fire Protection Association (NFPA);
 - .17 American Standards Association (ASA or ANSI);
 - .18 Institute of Electrical and Electronic Engineers (IEEE);
 - .19 Electronic Industries Association (EIA);
 - .20 Telecommunications Industry Association (TIA);
 - .21 Building Industry Consulting Services, International (BICSI);
 - .22 Material Safety Data Sheets by product manufacturers;
 - .23 Hydro inspection permits;
 - .24 Local Codes of governing authorities.
 - .25 UHN Design and Construction Guidelines
- .4 Comply with Owner's rules and regulations for Contractors working on site. Refer to Division 01.
 - .5 Work shall be carried out by licensed electricians with minimum five years' experience who hold Ontario Certificates of Qualifications, and current contractor's license.
 - .6 Ratio of Journeymen to Apprentices shall not exceed the ratio in the Trade Qualifications and Apprenticeship Act of Ontario.
 - .7 Coordinate work inspection reviews and approvals with governing inspection department to ensure that construction schedule is not delayed. Be responsible for prompt notification of deficiencies to Consultant and submission of reports and certificates to Consultant.

1.17 Infection Prevention and Decontamination Requirements

- .1 Review and comply with Owner policies and procedures with regards to working within areas of building. Include for requirements specified in Division 01 and in this article. Comply also with latest edition of CSA Z317.13.
- .2 Comply with Owner's latest policies and procedures regarding infection prevention measures during work of construction/renovation/installation/maintenance.

- .3 Comply with Owner's latest requirements regarding decontamination. Exact requirements and scope of this work are to be defined on drawings or in specifications where applicable and also may be defined in Division 01.
- .4 When requested by Owner, workers working on site to complete Hospital Infection Control training course.

1.18 Permits, Certificates and Fees

- .1 Contact and confirm with local authorities having jurisdiction including utility providers, the requirements for approvals from such authorities. Make necessary submissions and payments.
- .2 Obtain and pay for permits, certificates, and approvals required to complete the Work. Submit required applications, shop drawings, electrical distribution system protection device coordination studies, and short circuit calculations, any other information requested by local authority.
- .3 Be responsible for ensuring that authorities having jurisdiction which require on-site inspection of the work, have ample notification to perform inspection, with sufficient lead time to correct deficiencies in a manner that will not impede schedule of completion of the Work. Obtain and pay for required inspections and approvals.
- .4 Include in each copy of operating and maintenance instruction manuals, copies of approvals and inspection certificates issued by regulatory authorities to certify that the completed Work is in accordance with the regulations of the regulatory authorities and is acceptable to them.
- .5 Where electromagnetic locks are provided whether by this Division or by others, be responsible for obtaining and paying for required certificates of work with regards to such electromagnetic lock work.

1.19 Requirements for Contractor Retained Engineers

- .1 Professional engineers retained to perform consulting services with regard to work of this Division, i.e. seismic engineer, fire protection engineer, structural engineer, are to be members in good standing with local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of governing authorities in location of work.
- .2 Retained engineer's professional liability insurance is to protect Contractor's Consultants and Sub-Consultants, and their respective servants, agents, and employees against any loss or damage resulting from professional services rendered by Contractor's Consultants, Sub-Consultants, and their respective servants, agents, and employees in regards to work of this Contract.
- .3 Liability insurance requirements are as follows:
 - .1 coverage is to be minimum of \$1,000,000.00 inclusive of any one occurrence;
 - .2 insurance policy is not to be cancelled or changed in any way without insurer giving Owner a minimum of thirty days written notice;
 - .3 liability insurance is to be obtained from insurer registered and licensed to underwrite such insurance in location of work;

- .4 evidence of required liability insurance in such form as may be required is to be issued to Owner, Owner's Consultant, and Municipal Authorities as required prior to commencement of Contractor's Consultant's services.

1.20 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 products where required, and maintain one copy at the site in a visible and accessible location available to personnel.
- .2 Comply with requirements of Occupational Health and Safety Regulations and other regulations pertaining to health and safety, including worker's compensation/ insurance board and fall protection regulations. When working in confined spaces, comply with requirements of Occupational Health and Safety Act - Ontario Regulation 632/05, "Confined Spaces".
- .3 If at any time during course of existing building work, hazardous materials other than those identified in Project Documents and pertaining to Project Scope of Work, are encountered or suspected that were not identified as being present and which specific instructions in handling of such materials were not given, cease work in area in question and immediately notify Consultant. Comply with local governing regulations with regards to working in areas suspected of containing hazardous materials. Do not resume work in affected area without approval from the Consultant.

1.21 Scaffolding, Rigging, and Hoisting

- .1 Unless otherwise specified or directed, supply, erect and operate scaffolding, rigging, hoisting equipment and associated hardware required for work, and subject to approval of Consultant.
- .2 Immediately remove from the site scaffolding, rigging and hoisting equipment when no longer required.
- .3 Do not place major scaffolding/hoisting equipment loads on any portion of the structure without approval from the Consultant.

1.22 Progress Payment Breakdown

- .1 Prior to submittal of first progress payment draw, submit breakdown of cost of work to assist Consultant in reviewing and approving progress payment claims.
- .2 Payment breakdown is subject to Consultant's approval and progress payments will not be processed until an approved breakdown is in place. Breakdown is to include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning including testing, adjusting and balancing, and project closeout submittals.
- .3 Equipment, material and labour costs are to be indicated for site services (if applicable), and various products, in same manner as they will be indicated on progress draw.

1.23 Notice for Required Field Reviews

- .1 Whenever there is a requirement for the Consultant to perform a field review prior to concealment of any work, unless otherwise noted, give minimum five (5) working days notice in writing to the Consultant.
- .2 If the Consultant is unable to attend a field review when requested, arrange an alternative date and time.
- .3 Do not conceal work until the Consultant advises that it may be concealed.

1.24 Changes or Revisions to the Work

- .1 Wherever the Consultant proposes in writing to make a change or revision to the design, arrangement, quantity or type of any work from that called for on or in the contract documents, submit to the Consultant for approval, a detailed, itemized, estimate breakdown of the cost of all equipment, materials and labour entering into each change or revision.
- .2 Do not execute any changes or revisions until written authorization for such changes or revisions has been issued by the Consultant.
- .3 For any revision which includes deleted work as well as additional work, the total cost of the deleted work must be subtracted from the cost of the additional work before adding percentages for overhead and profit.

1.25 Cleaning Up

- .1 During construction, keep the site reasonably clear of rubbish and waste material resulting from electrical work on a daily basis to the satisfaction of the Consultant. Before applying for a Certificate of Substantial Performance of the Work, remove all of your rubbish and debris, and arrange for and pay for the repair of any damage caused as a result of electrical work.
- .2 Coordinate with General Contractor to ensure that disposal services are compliant with Federal/Provincial and Municipal Solid Hazardous Waste Guidelines.
- .3 At time of final cleaning, clean luminaire reflectors, lenses, and other luminaire surfaces that have been exposed to construction dust and dirt, including the top surface, whether exposed or in the ceiling space.
- .4 Clean switch, receptacle, and communications outlets, coverplates, and exposed surfaces.
- .5 Clean all other electrical equipment and devices installed as part of this project.
- .6 For electrical equipment rooms, electrical closets and communication closets, perform the following:
 - .1 using HEPA type vacuum cleaner, thoroughly vacuum and clean interiors and bus work of all switchboards, panels, cabinets and other electrical equipment of all construction debris and dust prior to energization.

- .2 HEPA vacuum the top of all switchboards, panels, cabinets, bus ducts, cable trays and conduits, and all mechanical duct work in room, followed by a thorough HEPA vacuuming of the floors. Thoroughly wash floors with wet mop and clean water. Control access to the room after cleaning. Provide temporary filter media on air supply ducts to these rooms to prevent re-contamination from other areas of construction.
- .3 thoroughly re-clean as necessary prior to final turn over to Owner.
- .4 do not lay permanent switchboard matting in electrical rooms until rooms are thoroughly re-cleaned, and floors wet mopped and dried, immediately prior to final turn over to Owner.

1.26 Quality of Work

- .1 Where evidence exists that defective work has occurred or that work has been carried out incorporating defective materials, the Consultant may have tests, inspections or surveys performed, analytical calculations of equipment performance and the like to help determine whether the work must be corrected or replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor's expense, regardless of their results, which may be such that in the Consultant's opinion, the work may be acceptable.
- .2 All testing shall be conducted in accordance with the requirements of the OBC, ESA and OESC, except where this would, in the Consultant's opinion, cause undue delay or give results not representative of the rejected material in place. In this case, the tests shall be conducted in accordance with the standards given by the Consultant.
- .3 Materials or work, which fails to meet specified requirements, may be rejected by the Consultant whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected, defective materials or work shall be promptly removed and replaced, or repaired to the satisfaction of the Consultant at no expense to the Owner.

1.27 Final Inspection

- .1 Submit to Consultant, written request for final inspection of systems accompanied by written certification that following has been successfully completed:
 - .1 deficiencies noted during job inspections;
 - .2 field quality control procedures;
 - .3 systems start-up procedures;
 - .4 systems have been tested and verified, and are ready for operation;
 - .5 completed maintenance and operating data have been submitted and approved;
 - .6 tags are in place and equipment identification;
 - .7 cleaning up;
 - .8 spare parts and replacement parts specified have been provided and receipt acknowledged by Consultant;
 - .9 as-built and Record drawings have been completed and approved;

- .10 Owner's staff have been instructed in operation and maintenance of systems;
- .11 fire alarm verification has been 100% completed and Verification Certificate has been submitted and accepted;
- .12 commissioning procedures.

1.28 Record As-Built Drawings

- .1 The drawings for this project have been prepared on a CAD system using AutoCAD software of version confirmed with Consultant. For the purpose of producing record "as built" drawings, copies of contract drawings shall be purchased from Consultant, at the Contractor's expense of \$25.00 CDN plus HST, per drawing, up to first ten (10) drawings, and \$5.00 CDN plus HST, per any additional drawings thereafter.
- .2 When work begins at the site, clearly and accurately mark on a bound set of white prints of the Contract Drawings, on a daily basis, all changes and deviations from the routing of main service and system feeders and locations of equipment and devices shown on the Contract Drawings. Locate fire alarm devices and identify addresses. Identify fire alarm zones. Changes and deviations include those made by addenda, change orders, and site instructions, and changes and deviations indicated on supplemental drawings issued with addenda, change orders, and site instructions. Maintain the "As built" white prints at the site for periodic inspection by the Consultant throughout the duration of the work.
- .3 Pay particular attention to accurately dimensioning the location of all concealed services terminated for future extension, and work concealed within the building in inaccessible locations.
- .4 Before applying for a Certificate of Substantial Performance of the Work, update a clean copy of the Contract Document drawing set in accordance with the marked up set of "as built" white prints including all deviations from original Contract Document drawings, thus forming an "as built" drawing set. Submit the "as built" site drawing prints to the Consultant for review. Make necessary revisions to drawings as per Consultant's comments, to satisfaction of Consultant.
- .5 Use the final reviewed "as built" drawing set to provide CAD files of the drawings, thus forming true "as built" set of contract drawings. Load drawing files in searchable pdf format, onto USB type flash drive. Provide complete set of "as-built" drawings and submit the "as built" sets of white prints, and USB drive to Consultant.
- .6 Prepare and submit for review with record drawings, a neat, clear, properly identified, "as-built" electrical riser diagram record drawing (in AutoCAD format release version confirmed with Consultant) of entire electrical distribution system up to and including line side connections to panelboards. Building and room outlines are to reflect "as-built" outlines. Include diagrams for feeder types and sizes, conduit sizes, breaker, switchboard and distribution panel sizes, etc., and get approval by Consultant. Size diagrams same size as issued full size project drawings. Mount riser diagrams on 10 mm (3/8") thick foam core complete with mylar finish cover, and hardware suitable for wall mounting in main electrical room.

- .7 Include on single lines, panelboard locations identified by room numbers below panel. When a specific identified location is not available, nearest available room number to be used followed by a (Δ) triangle to flag an approximate location. Encircle various loads by Building Wings for ease of identification. Group lighting loads on panelboards on top of panel. Identify motor control centres and splitters similar to panelboards. Identify fuse sizing including existing equipment where there is no difficulty in obtaining information. Use these requirements for pricing, and confirm exact requirements with Consultant prior to commencing work.
- .8 All submitted drawings shall be of the same quality as original contract document drawings. The CAD drawing files shall be of form compatible with AutoCAD software of version confirmed with Consultant.
- .9 Failure to maintain accurate record drawings will incur additional 5% holdback on progress claims.
- .10 For projects with phased turnover of the project (refer to Division 01), the Consultant will review with the Contractor the completeness of as-built drawings prior to turn over of an area. Copies of the hand drawn as-built drawings shall be made available to the Owner's maintenance personnel.
- .11 Deleted

1.29 Operating and Maintenance Instruction Manuals

- .1 Submit draft copy to Hospital Plant Services and one (1) copy to Consultant of operating and maintenance manuals for review. Make necessary revisions.
- .2 For each item of equipment for which a shop drawing is required (except for simple equipment), supply project specific, indexed copies of equipment manufacturer's operating and maintenance instruction data manuals. Consolidate each copy of the data in an identified hard cover three-ring binder. Each binder shall include:
 - .1 clearly identified project name label on front of binder;
 - .2 list of contents;
 - .3 for major pieces of equipment and systems, manufacturer's authorized contact person name and telephone number;
 - .4 a copy of each "reviewed" shop drawing;
 - .5 complete explanation of operation principles and sequences;
 - .6 complete part lists with numbers;
 - .7 recommended maintenance practices and precautions;
 - .8 copies of all inspection certificates issued by regulatory authorities;
 - .9 complete wiring and connection diagrams;
 - .10 photocopies of additional and revised panel board directories;
 - .11 copies of all test reports and commissioning reports;
 - .12 copies of warranties;
 - .13 items requested specifically in Section Articles.

- .3 Binders are not to exceed 3" thick and not to be more than 2/3 full.
- .4 The operating and maintenance instructions must relate to the job specific equipment supplied under this project and relate specifically to the Owner's building. The language used in the manuals shall be simple practical operating terms and language easy for the in-house maintenance staff to understand how each system should operate and should be maintained.
- .5 After review by Consultant and approval from Consultant, submit minimum one complete hard copy set of operating and maintenance instruction manuals to the Consultant before applying for a Certificate of Substantial Performance of the Work. Refer to Division 01 for additional number of hard copies to be submitted.
- .6 When shop drawings are returned to you marked "REVIEWED AS NOTED" with revisions marked on the shop drawing copies, such shop drawings are to be revised by the equipment supplier to incorporate the comments marked on the "reviewed" shop drawings and a clean updated copy is to be included in the operating and maintenance manual.
- .7 Prepare an overall CD containing full as built documentation and operating and maintenance manual documents, in searchable pdf format. Submit to Consultant.
- .8 Provide digital copies of contents of operating and maintenance manuals and load onto USB type flash drive (can be same one for as-built drawings) and submit to Consultant.

1.30 Warranty

- .1 Warranties for work to be in strict accordance with contract documents and free from defects for a period of three (3) years from date of issue of a Certificate of Substantial Performance of the Work for final phase of project.
- .2 Warrant work to be in accordance with Contract Documents and free from defects for defined warranty period. This is to be inclusive of systems and equipment handed over to Owner in earlier phases of Project. Be responsible for providing whatever "bridging" or additional extended warranty period is required from time that material is purchased and/or completion of phases, until this time.
- .3 Warranty to include parts, labour, travel costs and living expenses incurred by manufacturer's authorized technician to provide factory authorized on-site service.
- .4 Repair and/or replace any defects that appear in Work within warranty period without additional expense to Owner. Be responsible for costs incurred in making defective work good, including repair or replacement of building finishes, other materials, damage to other equipment. Ordinary wear and tear and damage caused wilfully or due to carelessness of Owner's staff or agents is exempted.
- .5 Do not include Owner deductible amounts in warranties.
- .6 Refer to Divisions 00 and 01 for additional warranty requirements.

1.31 Products

- .1 Wherever possible, coordinate product (equipment and materials) deliveries with manufacturers and/or suppliers so that products are delivered to the site when it is required, or so that it can be stored within the building and protected from the elements.

- .2 Properly protect products on site from damage due to the elements, the electrical work and the work of other trades, to the satisfaction of the Consultant. All equipment and materials must be in new condition when the work is substantially performed.
- .3 Provide products that are RoHS compliant where possible, to reduce or eliminate the use of chemical compounds, including lead, onsite.
- .4 Provide Canadian manufactured products wherever possible and where required quality and performance is obtainable at competitive prices. Products shall be supplied from manufacturer's authorized Canadian representative, unless otherwise noted. Unless otherwise specified, all materials and apparatus shall be new and shall comply with applicable respective CSA Standards and/or ULC listings. Equipment shall meet or exceed ASHRAE/IES 90.1 Standards, as applicable.
- .5 The systems and equipment of this Project shall be "State of the Art" technology and be the most recent and up to date product that is available to be supplied at time of shop drawing submission. Products that have been stored or "on the shelf" for an extended period of time will not be accepted. Software shall be latest version available and be provided with updates available at time of system installation. All systems shall be designed such that its software shall be backward compatible, as applicable, i.e. future upgrades will not need any hardware revisions to utilize the latest software.
- .6 Materials and equipment scheduled and/or specified have been selected to establish a performance and quality standard, and, in some instances, a dimensional standard. In most cases, base specified manufacturers are stated for any material or equipment specified by manufacturer's name and model number. Generally, where acceptable manufacturers are listed, the first name listed is the base specified company. The Bid Price may be based on materials and equipment supplied by any of the manufacturers' base specified or named as acceptable for the particular material or equipment. If acceptable manufacturers are not stated for a particular material or piece of equipment, base the Bid Price on material supplied by the base specified manufacturers.
- .7 The listing of a product as "acceptable" does not imply automatic approval by the Consultant and/or Owner. It is the sole responsibility of the Contractor to ensure that any price quotations received and submittals made are for products/systems that meet or exceed the specifications included herein.
- .8 If materials or equipment supplied by a manufacturer named as acceptable are used in lieu of the base specified manufacturer, be responsible for ensuring that the material or equipment is equivalent in performance and operating characteristics (including energy consumption if applicable) to the base specified materials or equipment, and, it is to be understood that any additional costs, and changes to associated or adjacent work resulting from provision of material supplied by a manufacturer other than the base specified manufacturer is included in the Bid Price. In addition, in equipment spaces where equipment named as acceptable is used in lieu of base specified equipment and the dimensions of such equipment differs from the base specified equipment, prepare and submit for review, accurately dimensioned layouts of rooms affected.

- .9 In addition to the manufacturers' base specified or named as acceptable, other manufacturers of materials or equipment may be proposed as substitutions to the Consultant for acceptance, listing in each case a corresponding credit for each substitution proposed, however, the Bid Price must be based on equipment or materials base specified or named as acceptable. Certify in writing to the Consultant that the proposed substitution meets all space, power, design, energy consumption, and all other requirements of the base specified or acceptable material or equipment. In addition, it is to be understood that there will be no increase in the Contract Price by reason of any changes to associated equipment, mechanically, electrically or architecturally, required by acceptance of proposed substitution. The Consultant has sole discretion in accepting any such proposed substitution of material or equipment. Indicate any proposed substitutions in areas provided on Bid Form.
- .10 Submit the names of the manufacturers for materials and equipment that you will supply, and which were specified or scheduled with a manufacturer's name. Note: The names of manufacturers on the list must be one (1) of the names as base specified or named acceptable for the particular products, unless prior written permission has been given for use of products by other manufacturers. If names are not submitted, or if name identified is not listed in issued documents, or if more than one (1) name is identified for a product, it shall be assumed and expected that the base specified products will be provided.
- .11 Where products are listed as "or approved equal", certify in writing that the product to be used in lieu of base specified product, at least meets space, power, design, energy consumption, and other requirements of the base specified product and thus shall be equivalent or better than the base specified product. When requested by the Consultant, provide full design detail drawings and specifications of proposed products. Acceptance of these "or approved equal" products shall be at the sole discretion of the Consultant. There shall be no increase in Contract price due to Consultant's rejection of proposed equivalent product.
- .12 Any proposed substitutions initiated by the Contractor after award of Contract may be considered by Consultant at Consultant's discretion, with costs for such review by the Consultant to be borne by the Contractor.

1.32 Instructions to Owner

- .1 Instruct the Owner's designated representatives in all aspects of the operation and maintenance of systems and equipment listed in the trade Sections governed by this Section. Obtain in writing from the Consultant a list of the Owner's representatives to receive instructions.
- .2 Arrange for and pay for the services of qualified service technicians and other manufacturer's representatives required for instruction of specialized portions of the installation.
- .3 Submit to the Consultant prior to application for a Certificate of Substantial Performance of the Work, a complete list of systems for which instructions were given, stating for each system:
 - .1 date instructions were given to the Owner's staff;
 - .2 duration of instruction;

- .3 names of persons instructed;
- .4 Other parties present (manufacturer's representative, consultants, etc.).
- .4 Obtain the signatures of the Owner's staff to verify that they properly understood the system installation, operation and maintenance requirements, and have received operating and maintenance instruction manuals and "As-built" record drawings.
- .5 Provide digital video disc (DVD) recording of operating and instructions training for following systems:
 - .1 emergency power gensets and control system;
 - .2 fire alarm system;
 - .3 security systems;
 - .4 nurse call system.
- .6 Provide a custom video in DVD format that details on site systems and equipment operations and includes following:
 - .1 professional videographer on site to capture training session; use wireless lavalier microphone to capture crystal clear audio of trainer in association with video footage; edit video to remove unnecessary footage;
 - .2 DVD to include custom site specific system/equipment screens that outline key information about system/equipment and devices used on site only;
 - .3 DVD to also include custom site specific video that details programming procedures in conjunction with a voiceover from on-site technician;
 - .4 DVD created with a main menu screen and authored with chapters to allow operator to access specific areas of training instantly.
- .7 Supply minimum quantity of 3 copies of DVDs for each system/equipment.

1.33 Commissioning

- .1 Commissioning Agent is to be appointed by the Owner to oversee the commissioning activities of the contract. Interface, cooperate and coordinate with the Commissioning Agent and attend commissioning meetings. Perform commissioning activities for aspects of work provided in Electrical Divisions and perform corrective work identified by the Commissioning Agent.
- .2 Submit a copy of test reports of systems and equipment to the Commissioning Agent, prior to start of commissioning activity or as directed by Commissioning Agent.
- .3 Commissioning Agent may also be present for any testing/commissioning activities and are to be notified by the Contractor in advance of these activities.
- .4 Refer to following Sections for additional commissioning requirements:
 - .1 01 91 13 Facility Commissioning – General;
 - .2 01 91 15 Facility Commissioning – Electrical.

PART 2 PRODUCTS

NIL

PART 3 EXECUTION

NIL

END OF SECTION

1 GENERAL

1.1 REFERENCES

- .1 Division 01 apply to and are a part of this Section.

1.2 APPLICATION

- .1 This Section specifies requirements that are common to Electrical Divisions work Sections and it is a supplement to each Section and is to be read accordingly. Where requirements of this Section contradict requirements of Divisions 01, conditions of Division 01 to take precedence.
- .2 This Section specifies products, criteria and characteristics, and methods and execution that are common to one or more Electrical Sections. It is intended as a supplement to each Electrical Section and is to be read accordingly.
- .3 Be responsible for advising product vendors of requirements of this Section.

1.3 SUBMITTALS

- .1 Submit shop drawings for products of this Section.

1.4 PRODUCT REQUIREMENTS IN SPECIAL AREAS

- .1 Products in non-climate controlled areas are to include weatherproof provisions such as gasketed covers, corrosion resistant hardware, weatherproof finishes, etc. Devices to be manufactured to operate in extreme temperatures.
- .2 Products in public areas such as exterior areas and in parking areas are to also be vandal-proof and impact resistant.

1.5 DEFINITIONS

- .1 "concealed" – means hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions.
- .2 "exposed" – means work normally visible, including work in equipment rooms, service tunnels, and similar spaces.
- .3 "finished" - means when in description of any area or part of an area or a product which receives a finish such as paint, or in case of a product may be factory finished.
- .4 "provision" or "provide" (and tenses of "provide") – means supply and install complete.
- .5 "install" (and tenses of "install") – means secure in position, connect complete, test, adjust, verify and certify.
- .6 "supply" – means to procure, arrange for delivery to site, inspect, accept delivery and administer supply of products; distribute to areas; and include manufacturer's supply of any special cables, standard on site testing, initial start-up, programming, basic commissioning, warranties and manufacturers' assistance to Contractor.
- .7 "delete" or "remove" (and tenses of "delete" or "remove") – means to disconnect, make safe, and remove obsolete materials including back boxes and exposed piping and raceways; and patch and repair/finish surfaces to match adjoining similar construction; include for associated re-programming of systems and/or change of documentation identifications to suit deletions, and properly dispose of deleted products off site unless otherwise instructed by consultant.

- .8 "BAS" – means building automation system; "BMS" – means building management system, "FMS" – means facility management system; and "DDC" means direct digital controls; references to "BAS", "BMS", "FMS" and "DDC" generally mean same.
- .9 "governing authority" and/or "authority having jurisdiction" and/or "regulatory authority" and/or "Municipal authority" – means government departments, agencies, standards, rules and regulations that apply to and govern work and to which work must adhere.
- .10 "Mechanical Divisions" - refers to Divisions 20, 21, 22, 23, 25 and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Mechanical Contractor, unless otherwise noted.
- .11 "Electrical Divisions" – refers to Divisions 26, 27, 28 and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Electrical Contractor, unless otherwise noted.
- .12 "Consultant" – means person, firm or corporation identified as such in Agreement or Documents, and is licensed to practice in Place of the Work, and has been appointed by Owner to act for Owner in a professional capacity in relation to the Work.
- .13 Wherever words "indicated", "shown", "noted", "listed", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean product referred to is "indicated", "shown", "listed", or "noted" on Contract Documents.
- .14 Wherever words "reviewed", "satisfactory", "as directed", "submit", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean that work or product referred to is "reviewed by", "to the satisfaction of", "submitted to", etc., Consultant.

1.6

DOCUMENTS

- .1 Drawings and Specifications are portions of Contract Documents and identify labour, products and services necessary for performance of work and form a basis for determining pricing. They are intended to be cooperative. Perform work that is shown, specified, or reasonably implied on the drawings but not mentioned in Specification, or vice-versa, as though fully covered by both.
- .2 Review Drawings and Specification in conjunction with documents of other Divisions and, where applicable, Code Consultant's report.
- .3 Unless otherwise specifically noted in Specifications and/or on Drawings, Sections of Electrical Divisions 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 Sections are to be read as a whole.
- .4 Drawings are performance drawings, diagrammatic, and show approximate locations of equipment and materials. Any information regarding accurate measurement of building is to be taken on site. Do not scale Drawings, and do not use Drawings for prefabrication work.
- .5 Drawings are intended to convey scope of work and do not show architectural and structural details. Provide fittings, offsets, transformations and similar items required as a result of obstructions and other architectural and/or structural details but not shown on Drawings.
- .6 Locations of equipment and materials shown may be altered, when reviewed by Consultant, to meet requirements of equipment and/or materials, other equipment or systems being installed, and of building.

- .7 Specification does not generally indicate specific number of items or amounts of material required. Specification is intended to provide product data and installation requirements. Refer to schedules, Drawings (layouts, riser diagrams, schematics, details) and Specification to provide correct quantities. Singular may be read as plural and vice versa.
- .8 Starter/ variable frequency drive (VFD) schedule drawings are both mechanical and electrical, and apply to work of Mechanical Divisions and Electrical Divisions. Be responsible for reviewing starter, VFD, and motor specification requirements of Mechanical Divisions specifications and drawings. Confirm and coordinate exact scope of work and responsibility of work between Mechanical Divisions and Electrical Divisions.
- .9 Drawings and Specifications are prepared solely for use by party with whom Consultant has entered into a contract and there are no representations of any kind made by Consultant to any other party.
- .10 In case of discrepancies or conflicts between Drawings and Specifications, Documents will govern in order specified in "General Conditions", however, when scale and date of Drawings are same, or when discrepancy exists within Documents, include most costly arrangement.

1.7 **WORK STANDARDS**

- .1 Where any code, regulation, bylaw, standard, contract form, manual, printed instruction, and installation and application instruction is quoted it means, unless otherwise specifically noted, latest published edition at time of obtaining building permit and enforced by local governing authorities having jurisdiction. Include for compliance with revisions, bulletins, supplementary standards or amendments issued by local governing authorities.
- .2 Where regulatory codes, standards and regulations are at variance with Drawings and Specification, more stringent requirement will apply unless otherwise directed by Consultant.
- .3 Supplementary mandatory Specifications and requirements to be used in conjunction with project include but are not limited to following:
 - .1 Canadian Standards Association (CSA);
 - .2 Long-Term Care Home Design Manual 2015 by MOHLTC;
 - .3 Ontario Fire Code Ontario Long Term Care Homes Act (LTCHA);
 - .4 UL 2560 Standard for Emergency Call Systems for Assisted Living and Independent Living Facilities;
 - .5 Electrical and Electronic Manufacturers Association of Canada (EEMAC);
 - .6 Electrical Safety Authority (ESA);
 - .7 Electronic Industries Association (EIA);
 - .8 Illuminating Engineering Society (IES);
 - .9 Institute of Electrical and Electronic Engineers (IEEE);
 - .10 National Electrical Manufacturers Association (NEMA);
 - .11 National Fire Protection Association (NFPA);
 - .12 Occupational Health and Safety Act - Ontario Regulation 632, "Confined Spaces";
 - .13 Occupational Health and Safety Act (OHSA);
 - .14 Ontario Building Code (OBC);

- .15 Ontario Electrical Safety Code (OESC);
- .16 Technical Standards and Safety Authority (TSSA);
- .17 Telecommunications Industry Association (TIA);
- .18 Underwriters' Laboratories of Canada (ULC);
- .19 Ministry of Health and Long-Term Care Regulations;
- .20 Material Safety Data Sheets by product manufacturers;
- .21 local utility inspection permits;
- .22 codes, standards, and regulations of local governing authorities having jurisdiction;
- .23 additional codes and standards listed in Trade Sections;
- .4 Provide applicable requirements for barrier free access in accordance with latest edition of local governing building code.
- .5 Where any governing Code, Regulation, or Standard requires preparation and submission of special details or drawings for review they are to be prepared and submitted to appropriate authorities. Be responsible for costs associated with these submittals.
- .6 Unless otherwise specified install, equipment in accordance with 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.
- .7 Work is to be performed by journeyperson tradesmen who perform only work that their certificates permit, or by apprentice tradesmen under direct on site supervision of experienced journeyperson tradesman. Journeyperson to apprentice ratio is not to exceed ratio determined by the Board as stated in Ontario College of Trades and Apprenticeship Act or local equivalent governing body in Place of the Work.
- .8 Journeyperson tradesmen are to have a copy of valid trade certificates available at site for review by Consultant at any time.
- .9 Experienced and qualified superintendent is to be on-site at times when work is being performed.
- .10 Coordinate work inspection reviews and approvals with governing inspection department to ensure that construction schedule is not delayed. Be responsible for prompt notification of deficiencies to Consultant and submission of reports and certificates to Consultant.
- .11 Properly protect equipment and materials on site from damage due to elements and work of trades, to satisfaction of Consultant. Equipment and materials are to be in new condition upon Substantial Performance of the Work.

1.8 **PERMITS, CERTIFICATES, APPROVALS AND FEES**

- .1 Contact and confirm with local authorities having jurisdiction including utility providers, requirements for approvals from such authorities.
- .2 Submit required applications, shop drawings, electrical distribution system protection device coordination studies, and short circuit calculations, and any other information requested by local authority.

- .3 Be responsible for ensuring that authorities having jurisdiction which require on-site inspection of work, have ample notification to perform inspection, with sufficient lead time to correct deficiencies in a manner that will not impede schedule of completion of Work.
- .4 Submit to Consultant, approval/inspection certificates issued by governing authorities to confirm that Work as installed is in accordance with rules and regulations of local governing authorities and are acceptable.
- .5 Include in each copy of operating and maintenance instruction manuals, copies of approvals and inspection certificates issued by regulatory authorities.
- .6 Where electromagnetic locks are provided whether by this Division or by others, be responsible for obtaining and paying for required certificates of work with regards to such electromagnetic lock work.

1.9 **REQUIREMENTS FOR TRADE CONTRACTOR RETAINED ENGINEERS**

- .1 Professional engineers retained to perform consulting services with regard to Project work, i.e. structural engineer, are to be members in good standing with local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of governing authorities in Place of the Work.
- .2 Retained engineer's professional liability insurance is to protect Contractor's consultants and their respective servants, agents, and employees against any loss or damage resulting from professional services rendered by aforementioned consultants and their respective servants, agents, and employees in regards to the Work of this Contract.
- .3 Liability insurance requirements are as follows:
 - .1 coverage is to be a minimum of \$1,000,000.00 CDN inclusive of any one occurrence;
 - .2 insurance policy is not to be cancelled or changed in any way without insurer giving Owner minimum thirty days written notice;
 - .3 liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the Place of the Work;
 - .4 Retained consultants are to ascertain that sub-consultants employed by them carry insurance in the form and limits specified above;
 - .5 evidence of the required liability insurance in such form as may be required is to be issued to Owner, Owner's Consultant, and Municipal Authorities as required prior to commencement of aforementioned consultant's services.

1.10 **WORKPLACE SAFETY**

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for products where required, and maintain one copy at site in a visible and accessible location available to personnel.
- .2 Comply with requirements of Occupational Health and Safety Act and other regulations pertaining to health and safety, including worker's compensation/ insurance board and fall protection regulations. When working in confined spaces, comply with requirements of Occupational Health and Safety Act - Ontario Regulation 632, "Confined Spaces" and any other applicable Ministry of Labour requirements.

1.11

PLANNING AND LAYOUT OF WORK

- .1 Base installation layout, design, terminations, and supply of accessories, on Contract Documents with specific coordination with reviewed shop drawings.
- .2 Plan, coordinate, and establish exact locations and routing of services with affected trades prior to installation such that services clear each other as well as other obstructions. Generally, order of right of way for services to be as follows:
 - .1 piping requiring uniform pitch;
 - .2 piping 100 mm (4") dia. and larger;
 - .3 large ducts (main runs);
 - .4 cable tray and bus duct;
 - .5 conduit 100 mm (4") dia. and larger;
 - .6 piping less than 100 mm (4") dia.;
 - .7 smaller branch ductwork;
 - .8 conduit less than 100 mm (4") dia..
- .3 As confirmed with Consultant, Mechanical Contractor is to determine final locations of major work within ceiling spaces.
- .4 Unless otherwise shown or specified, conceal work in finished areas, and conceal work in partially finished and/or unfinished areas to extent made possible by the area construction. Install services as high as possible to conserve headroom and/or ceiling space. Notify Consultant where headroom or ceiling space appears to be inadequate prior to installation of work.
- .5 Do not use Contract Drawing measurements for prefabrication and layout of raceways, conduits, ducts, bus ducts, luminaires, and other such work. Locations and routing are to be generally in accordance with Contract Drawings, however, prepare layout drawings for such work. Use established bench marks for both horizontal and vertical measurements. Confirm inverts, coordinate with and make allowances for work of other trades. Accurately layout work, and be entirely responsible for work installed in accordance with layout drawings. Where any invert, grade, or size is at variance with Contract Drawings, notify Consultant prior to proceeding with work.
- .6 Prepare plan and interference drawings (at a minimum drawing scale of $\frac{1}{4}"=1' 0"$) of work for coordination with each trade Contractor. Arrange for preparation of detailed section drawings of ceiling spaces of corridors and any other congested areas. Sections are to be cross referenced with plan drawings so that trades may make use of section drawings. Section drawings to indicate lateral and elevation dimensions of major services within ceiling space. Lateral dimensions are to be from grid lines and elevations from top of floor slab. Obtain from Consultant, engineering drawings for this use. Contractors' interference drawings are to be distributed among other Trade Contractors. Submit drawings to Consultant for review. Failure of General Contractor to prepare and coordinate overall interface drawings of trades does not relieve respective Division Contractor of responsibility to ensure that work is properly planned and coordinated.
- .7 Carry out alterations in arrangement of work that has been installed without proper coordination, study, and review, even if in accordance with Contract Documents, in order to conceal work behind finishes, or to allow installation of other work, without additional cost. In addition, make necessary alterations in other work required by such alterations, without additional cost.

- .8 Control products, products requiring maintenance, junction boxes, 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.
- .9 Be responsible for making necessary changes, at no additional cost, to accommodate structural and building conditions that were missed due to lack of coordination.
- .10 Where drawings indicate that acoustic tile ceiling is being suspended below plaster ceiling, coordinate design of framework used to support suspended ceiling, lighting, diffusers, and other Divisions components that are mounted within or through ceiling. Do not mount devices to suspended ceiling. Secure and mount to ceiling slab above. Seal ceiling openings to maintain required fire rating.

1.12 **COORDINATION OF WORK**

- .1 Review Contract Documents and coordinate work with work of each trade. Coordination requirements are to include, but not be limited to following:
 - .1 requirements for openings, sleeves, inserts and other hardware necessary for installation of work;
 - .2 concrete work such as housekeeping pads, sumps, bases, etc., required for work, and including required dimensions, operating weight of equipment, location, etc.;
 - .3 depth and routing of excavation required for work, and requirements for bedding and backfill;
 - .4 wiring work required for equipment and systems but not specified to be done as part of mechanical work, including termination points, wiring type and size, and any other requirements.
- .2 Ensure materials and equipment are delivered to site at proper time and in such assemblies and sizes so as to enter into building and be moved into spaces where they are to be located without difficulty.
- .3 Wherever possible, coordinate equipment deliveries with manufacturers and/or suppliers so equipment is delivered to site when it is required, or so it can be stored within building subject to available space as confirmed and protected from elements.
- .4 Ensure proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Comply with code requirements with regards to access space provision around equipment. Remove and replace any equipment which does not meet this requirement.
- .5 Where work is to be integrated, or is to be installed in close proximity with work of other trades, coordinate work prior to and during installation.

1.13 **COMPONENT FINAL LOCATIONS**

- .1 Owner and Consultant reserve right to relocate electrical components such as receptacles, switches, communication system, outlets, hard wired outlet boxes and luminaries at a later date, but prior to installation, without additional cost to Owner, if relocation per components do not exceed 3 m (10') from original location. No credits will be anticipated where relocation per components of up to and including 3 m (10') reduces materials, products and labour. Should relocations exceed 3 m (10') from original location, adjust contract price for that portion beyond 3 m (10') in accordance with provisions for changes in Contract Documents.

1.14 **SYSTEMS COORDINATION**

- .1 Be responsible for and perform specific coordination of various low voltage systems supplied by Electrical Divisions and also with systems supplied by other Divisions of Work. Include for but not be limited to provision of following, as applicable:
- .1 coordinate with General Contractor and other Subcontractors, various systems of trades which in any way are interfaced with or monitored by or integrated to, or need to be coordinated with;
 - .2 prepare systems coordination drawings detailing related system coordination and integration points being monitored and/or controlled; submit coordination drawings as part of shop drawing submission;
 - .3 coordinate security system requirements with successful door hardware supplier and prepare detailed coordination drawings of component installations, wiring and conduit layouts, division of responsibility between various trades, etc.; review security system requirements with associated door hardware (electromagnetic locks, electric strikes, etc.), to ensure proper sequence of operation and door functionality is provided to suit each door configuration; prepare detailed door functionality of each door configuration and submit for review by Consultant;
 - .4 review systems requirements for component back boxes and conduits; ensure that system of conduits and boxes meet respective system wiring bending radii requirements;
 - .5 review specifications of each trade/Division with each trade/Division (i.e. for BAS points, elevator requirements, electrical devices in millwork, outlet box and back box requirements), to ensure proper power supplies, interconnecting wiring requirements and back box/ outlet box requirements;
 - .6 review with manufacturers coordination and integration requirements of their systems;
 - .7 review each systems communication protocols to ensure they are compatible and can communicate with each other as required;
 - .8 review system shop drawings prior to submission to Consultant, to verify that each system has been coordinated with other systems and that required options and features are selected to meet coordination requirements;
 - .9 be present at testing and commissioning functions of each system and provide technical assistance with regards to system operations;
 - .10 be "on-site" coordinator of respective system trades with regards to respective system coordination of installation and testing;
 - .11 coordinate with Consultant with regards to ensuring that systems coordinate and integrate properly to satisfaction of Owner;
 - .12 document coordination and integration requirements and maintain records for submission as part of shop drawings;
 - .13 respond to coordination and integration requirements and be responsible for such work;
 - .14 where a system integrator has been included for, coordinate integration requirements with system integrator.

1.15 **PRODUCTS**

- .1 Be responsible for ordering of products (equipment and materials) in a timely manner in order to meet project-scheduling timelines. Failure to order products to allow manufacturers sufficient production/delivery time to meet project-scheduling timelines is an unacceptable reason to request for other suppliers or substitutions.
- .2 Provide Canadian manufactured products wherever possible or required and when quality and performance is obtainable at a competitive price. Products are to be supplied from manufacturer's authorized Canadian representative, unless otherwise noted. Unless otherwise specified, products are to be new and are to comply with applicable respective Canadian standards. References to UL listings of products to include requirements that products are to be also Underwriters Laboratories of Canada (ULC) listed for use in Canada. Products are to meet or exceed latest ANSI/ASHRAE/IES 90.1 standards, as applicable. Do not supply any products containing asbestos materials or PCB materials.
- .3 Systems and equipment of this Project are to be "State of the Art" and be most recent and up to date series/version of product that is available at time of shop drawing review process. Products that have been stored or "on shelf" for an extended period of time will not be accepted. Software is to be of latest version available and be provided with updates available at time of shop drawing review process. Systems are to be designed such that its software is backwards compatible. Future upgrades are not to require any hardware replacements or additions to utilize latest software.
- .4 Products scheduled and/or specified have been selected to establish a performance and quality standard, and, in some instances, a dimensional standard.
- .5 Documents have been prepared based on product available at time of Bidding. If, after award of Contract, and if successful manufacturer can no longer supply a product that meets specifications, notify Consultant immediately. Be responsible for obtaining other manufacturers product that complies with specified performance and criteria and meets project timelines. Proposed products are subject to review and consideration by Consultant and are considered as substitutions. In addition, if such products require modifications to room spaces, mechanical systems, electrical systems, etc., submit such changes in detail to Consultant for review and consideration for acceptance.
- .6 Listing of a product as "acceptable" does not imply automatic acceptance by Consultant and/or Owner.
- .7 In addition to manufacturer's products specified as acceptable, other manufacturers of products may be proposed as substitutions to Consultant for review and consideration for acceptance, listing in each case a corresponding credit for each substitution proposed. Certify in writing to Consultant that proposed substitution meets space, power, design, energy consumption, and other requirements of specified or acceptable product. Consultant has sole discretion in accepting any such proposed substitution of product. Do not order such products until they are accepted in writing by Consultant.
- .8 Where products are listed as "or approved equal", certify in writing that product to be used in lieu of specified acceptable product, at least meets space, power, design, energy consumption, and other requirements of specified product and is equivalent or better than specified product. When requested by Consultant, provide full design detail drawings and specifications of proposed products. Acceptance of these "or approved equal" products is at sole discretion of Consultant.

- .9 Whenever use of product other than specified acceptable product is being supplied, ensure corresponding certifications and product information (detailed catalogue and engineering data, fabrication information and performance characteristics) are submitted to Consultant for review. Failure of submission of these documents to Consultant in a timely manner to allow for review will result in specified acceptable product to be supplied at Consultant's discretion.
- .10 Any proposed changes initiated by Contractor may be considered by Consultant at Consultant's discretion.
- .11 Whenever use of product other than based specified products or named as acceptable is being supplied, allow sufficient time for processing of product submissions and time for Consultant's review, such that there will not be significant impact on contract time or work schedule.

1.16

CONTINUITY OF SUPPLY FOR STANDARDIZATION

- .1 Utilize materials of one manufacturer for aspects of work, where practical. Utilize one common manufacturer for wiring devices, such as switches and receptacles, whether installed loose or in a pre-manufactured component. Coordinate with each supplier and ensure conformance with this requirement. Identify deviations to Consultant and obtain approval of change prior to proceeding with work.

1.17

SHOP DRAWINGS

- .1 At start-up meeting confirm with Consultant, products to be included in shop drawing submission. Prepare and submit list of products to Consultant for review.
- .2 Submit electronic copies of shop drawings unless otherwise directed by Consultant. Confirm exact requirements with Consultant.
- .3 Submit for review, drawings showing in detail design, construction, and performance of equipment and materials as requested in Specification. Include minimally for preparation and submission of following, as applicable:
 - .1 product literature cuts;
 - .2 equipment data sheets;
 - .3 equipment dimension drawings;
 - .4 system block diagrams;
 - .5 sequence of operation;
 - .6 connection wiring schematic diagrams;
 - .7 functionality with integrated systems.
- .4 Each shop drawing or product data sheet is to be properly identified with project name and product drawing or specification reference. Shop drawing or product data sheet dimensions are to match dimension type on drawings.
- .5 Where any item of equipment is required by Code or Standard or By-Law to meet a specific energy efficiency level, or any other specific requirement, ensure this requirement is clearly indicated on submission.
- .6 Ensure proposed products meet each requirement of Project. Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS". Include company name, submittal date, and sign each copy. Shop drawings that are received and are not endorsed, dated and signed will be returned to be resubmitted.

- .7 Consultant to review shop drawings and indicate review status by stamping shop drawing copies as follows:
 - .1 "REVIEWED" or "REVIEWED AS NOTED" (appropriately marked) – If Consultant's review of shop drawing is final, Consultant to stamp shop drawing;
 - .2 "RETURNED FOR CORRECTION" – If Consultant's review of shop drawing is not final, Consultant to stamp shop drawing as stated above, mark submission with comments, and return submission. Revise shop drawing in accordance with Consultant's notations and resubmit.
- .8 Following is to be read in conjunction with wording on Consultant's shop drawing review stamp applied to each and every shop drawing submitted:

"THIS REVIEW BY CONSULTANT IS FOR SOLE PURPOSE OF ASCERTAINING CONFORMANCE WITH GENERAL DESIGN CONCEPT. THIS REVIEW DOES NOT MEAN THAT CONSULTANT APPROVES DETAILED DESIGN INHERENT IN SHOP DRAWINGS, RESPONSIBILITY FOR WHICH REMAINS WITH CONTRACTOR. CONSULTANT'S REVIEW DOES NOT RELIEVE CONTRACTOR OF RESPONSIBILITY FOR ERRORS OR OMISSIONS IN SHOP DRAWINGS OR OF CONTRACTOR'S RESPONSIBILITY FOR MEETING REQUIREMENTS OF CONTRACT DOCUMENTS. BE RESPONSIBLE FOR DIMENSIONS TO BE CONFIRMED AND CORRELATED AT JOB SITE, FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION AND INSTALLATION, AND FOR CO-ORDINATION OF WORK OF SUB-TRADES."
- .9 Submit each system and each major component as separate shop drawing submissions. Submit together, shop drawings for common devices such as devices of each system.
- .10 Obtain shop drawings for submission from product manufacturer's authorized representatives and supplemented with additional items specified herein.
- .11 Do not order product until respective shop drawing review process has been properly completed by Consultant.
- .12 Where extended warranties are specified for equipment items, submit specified extended warranty with shop drawing submittal.
- .13 Refer to specific requirements in other Sections.

1.18 **EQUIPMENT LOADS**

- .1 Supply equipment loads (self-weight, operating weight, housekeeping pad, inertia pads, etc.) to Consultant, via shop drawing submissions, prior to construction.
- .2 Where given choice of specific equipment, actual weight, location and method of support of equipment may differ from those assumed by Consultant for base design. Back-check equipment loads, location, and supports, and include necessary accommodations.
- .3 Where supporting structure consists of structural steel framing, it is imperative that equipment loads, location, and method of support be confirmed prior to fabrication of structural steel. Be responsible for confirming locations of equipment with Consultant prior to construction.

1.19 **OPENINGS**

- .1 Supply opening sizes and locations to Consultant to allow verification of their effect on design, and for inclusion on structural drawings where appropriate.

- .2 No openings are permitted through completed structure without written approval of Consultant. Show required openings on a copy of structural drawings. Identify exact locations, elevations, and size of proposed openings and submit to Consultant for review, well in advance of doing work.
- .3 Prior to leaving site at end of each day, walk through areas of work and check for any openings, penetrations, holes, and/or voids created under scope of work of project, and ensure that any openings created under scope of work have been closed off, fire-stopped and smoke-sealed. Unless directed by Owner and coordinated with Consultant, do not leave any openings unprotected and unfinished overnight.

1.20 **SCAFFOLDING, HOISTING, AND RIGGING,**

- .1 Unless otherwise specified or directed, supply, erect and operate scaffolding, rigging, hoisting equipment and associated hardware required for work, and subject to approval of Consultant.
- .2 Immediately remove from site scaffolding, rigging and hoisting equipment when no longer required.
- .3 Do not place major scaffolding/hoisting equipment loads on any portion of structure without approval from Consultant.

1.21 **NOTICE FOR REQUIRED FIELD REVIEWS**

- .1 Whenever there is a requirement for Consultant to perform a field review prior to concealment of any work, to inspect/re-inspect work for deficiencies prior to Substantial Performance of the Work, for commissioning demonstrations, and any other such field review, give minimum 5 working days' notice in writing to Consultant.
- .2 If Consultant is unable to attend a field review when requested, arrange an alternative date and time.
- .3 Do not conceal work until Consultant advises that it may be concealed.
- .4 When Consultant is requested to perform a field review and work is not ready to be reviewed, reimburse Consultant for time and travel expenses.

1.22 **PRELIMINARY TESTING**

- .1 When directed by Consultant, promptly arrange, pay for, and perform site tests on any piece of equipment or any system for such reasonable lengths of time and at such times as may be required to prove compliance with Specification and governing Codes and Regulations, prior to Substantial Performance of the Work.
- .2 When, in Consultant's opinion, tests are required to be performed by a certified testing laboratory, arrange and pay for such tests.
- .3 These tests are not to be construed as evidence of acceptance of work, and it is agreed and understood that no claim for delays or damage will be made for injury or breakage to any part or parts of equipment or system due to test where such injuries or breakage were caused by faulty parts and/or workmanship of any kind.
- .4 When, in Consultant's opinion, tests indicate that equipment, products, etc., are defective or deficient, immediately remove such equipment and/or products from site and replace them with acceptable equipment and/or products, at no additional cost.

1.23 **PROVISIONS FOR SYSTEMS/EQUIPMENT USED DURING CONSTRUCTION**

- .1 Any system or piece of equipment that is specified to be provided under requirements of Documents and is required to be used during construction stages of work prior to issuing of Certificate of Substantial Performance of the Work, are to be provided with special interim maintenance and service to cover systems/equipment during time of use during construction period of project until project has been certified as substantially performed and such systems/equipment are turned over to Owner.
- .2 During this period of construction, such systems/equipment to not become property of Owner or be Owner's responsibility for maintenance or service. Systems/equipment are to remain property of respective manufacturers/suppliers or Contractor, who are responsible for full maintenance and servicing of systems/equipment in order to maintain validity of warranties after turn over to Owner.
- .3 Prior to application for a Certificate of Substantial Performance of the Work and turn over to Owner, such systems/equipment to be cleaned, restored to "new" condition, genset "serviced", paint finishes "touched-up", filters cleaned or replaced, etc.

1.24 **TEMPORARY SERVICES**

- .1 Coordinate with General Contractor, requirements for temporary services including but not limited to temporary electrical power, lighting and exit pathways. Locations of exit pathways to be as decided at discretion of General Contractor, and to be illuminated complete with emergency lighting, and provided with exit signage and fire alarm devices in accordance with requirements of local governing building code and local governing inspection authorities.

1.25 **CLEANING**

- .1 During construction, keep site reasonably clear of rubbish and waste material resulting from work on a daily basis to the satisfaction of Consultant. Before applying for a Certificate of Substantial Performance of the Work, remove rubbish and debris, and be responsible for repair of any damage caused as a result of work.
- .2 At time of final cleaning, clean luminaire reflectors, lenses, and other luminary surfaces that have been exposed to construction dust and dirt, including top surface, whether it is exposed or in ceiling space.
- .3 Clean switches, receptacles, communications outlets, coverplates, and exposed surfaces.
- .4 Clean other electrical equipment and devices installed as part of this project.
- .5 For work performed in electrical equipment rooms, electrical closets and communication closets, perform following:
 - .1 HEPA vacuum and clean interiors and buswork of switchboards, panels, cabinets and other electrical equipment of construction debris and dust prior to energization;
 - .2 HEPA vacuum top of switchboards, panels, cabinets, bus ducts, cable trays and conduits in room, followed by a thorough HEPA vacuuming of floors;
 - .3 do not lay permanent switchboard matting in electrical rooms until rooms are re-cleaned, and floors wet mopped and dried just prior to final turn over to Owner.

1.26 **RECORD AS-BUILT DRAWINGS**

- .1 As work progresses at site, clearly mark in red in a neat and legible manner on a set of bound white prints of Contract Drawings, changes and deviations from routing of services and locations of equipment shown on Contract Drawings, on a daily basis. Changes and deviations include those made by addenda, change orders, and site instructions. Use notes marked in red as required. Maintain white print red line as-built set at site for exclusive use of recording as-built conditions, keep set up-to-date, and ensure set is available for periodic review. As-built set is also to include following:
 - .1 dimensioned location of inaccessible concealed work;
 - .2 locations of control devices with identification for each;
 - .3 location and identification of devices in concealed locations such as accessible ceiling spaces and raised floors;
 - .4 for underground piping and ducts, record dimensions, invert elevations, offsets, fittings, cathodic protection and accessories if applicable, and locate dimensions from benchmarks to be preserved after construction is complete;
 - .5 location of concealed services terminated for future extension and work concealed within building in inaccessible locations.
 - .6 location of fire alarm devices and include addresses of devices; identify fire alarm zones;
 - .7 identify routing and location of concealed conduits/ducts of diameter 50 mm (2") and greater;
- .2 Before applying for a Certificate of Substantial Performance of the Work, update a clean copy of Contract Drawing set in accordance with marked up set of "as-built" white prints including deviations from original Contract Drawings, thus forming an "as-built" drawing set. Submit "as-built" site drawing prints to Consultant for review. Make necessary revisions to drawings as per Consultant's comments, to satisfaction of Consultant.
- .3 Use final reviewed "as-built" drawing set to provide Revit models thus forming true "as-built" set of Contract Drawings. Identify set as "Project Record Copy". Load digital copies of final reviewed by Consultant as-built drawings onto USB type flash drive. Provide 2 complete sets of "as-built" drawings on separate USBs. Submit "as-built" sets of white prints and USBs to Consultant.
- .4 Submitted drawings are to be of same quality as original Contract Drawings. Revit models are to be compatible with Revit software release version confirmed with Consultant.
- .5 Prepare and submit for review with record drawings, a neat, clear, properly identified, "as-built" electrical distribution riser diagram record drawing (in same format and release version as the design document - confirmed with Consultant) of entire electrical distribution system up to and including line side connections to panelboards. Building and room outlines are to reflect "as-built" outlines. Include in diagrams for feeder types and sizes, conduit sizes, breaker, switchboard and distribution panel sizes, etc. Submit sample version to Consultant for review and comments prior to final manufacturer. Size diagrams same size as issued full Size Drawings. Mount riser diagrams on 10 mm (3/8") thick foam core complete with mylar finish cover, and hardware suitable for wall mounting in main electrical room.

- .6 Include on single lines, panelboard locations identified by room numbers below panel. When specific identified location is not available, nearest available room number to be used followed by a (Δ) triangle to flag approximate location. Encircle various loads by Building Wings (where applicable) for ease of identification. Group lighting loads on panelboards on top of panel. Identify motor control centres and splitters similar to panelboards. Identify fuse sizing including existing equipment where there is no difficulty in obtaining information. Use these requirements for pricing, and confirm exact requirements with Consultant prior to commencing work.

1.27

OPERATING AND MAINTENANCE MANUALS

- .1 Submit draft copy to Consultant for review. Incorporate any Consultant's comments in preparation final manuals.
- .2 For each item of equipment for which a shop drawing is required (except for simple equipment), supply minimum 3, project specific, indexed copies of equipment manufacturers' operating and maintenance (O&M) instruction data manuals. Confirm exact quantity of manuals with Consultant. Consolidate each copy of data in an identified hard cover three "D" ring binder. Each binder to include:
 - .1 front cover: project name label; wording – "Electrical Systems Operating and Maintenance Manual"; and date;
 - .2 introduction sheet listing Consultant, Contractor, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses;
 - .3 equipment manufacturer's authorized contact person name, telephone number and company website;
 - .4 Table of Contents sheet, and corresponding index tab sheets;
 - .5 copy of each "REVIEWED" or clean, updated "REVIEWED AS NOTED" shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, company website address, and email address for local source of parts and service; when shop drawings are returned marked "REVIEWED AS NOTED" with revisions marked on shop drawing copies, they are to be revised by equipment supplier to incorporate comments marked on "reviewed" shop drawings and a clean updated copy is to be included in operating and maintenance manuals;
 - .6 Maintenance data is to include:
 - .1 operation and trouble-shooting instructions for each item of equipment and each system;
 - .2 schedules of tasks, frequency, tools required, and estimated task time;
 - .3 recommended maintenance practices and precautions;
 - .4 complete parts lists with numbers.
 - .7 Performance data is to include:
 - .1 equipment and system start-up data sheets;
 - .2 equipment test reports;
 - .3 final verification and commissioning reports.
 - .8 explanation of operating principles and sequences;
 - .9 inspection certificates issued by regulatory authorities;

- .10 wiring and connection diagrams;
- .11 copies of additional and revised panelboard directories;
- .12 warranties;
- .13 items requested specifically in Section Articles.
- .3 Generally, binders are not to exceed 75 mm (3") thick and not to be more than 2/3 full.
- .4 Operating and maintenance instructions are to relate to job specific equipment supplied under this project and related to Owner's building. Language used in manuals is to contain simple practical operating terms and language easy for in-house maintenance staff to understand how to operate and maintain each system.
- .5 Before applying for a Certificate of Substantial Performance of the Work, assemble one copy of O & M Manual and submit to Consultant for review prior to assembling remaining copies. Incorporate Consultant's comments into final submission.
- .6 Provide 2 digital copies of contents of operating and maintenance manuals and load onto separate USB type flash drives and submit to Consultant. Prepare digital copies using version of Adobe Acrobat Portable Document Format or equal as confirmed with Consultant and enhanced with bookmarks and internal document links.

1.28 **PROJECT CLOSE OUT SUBMITTALS**

- .1 Prior to application for Substantial Performance of the Work, submit required items and documentation specified, including following:
 - .1 Operating and Maintenance Manuals;
 - .2 as-built record drawings and associated data;
 - .3 extended warranties for equipment as specified;
 - .4 operating test certificates;
 - .5 final commissioning report;
 - .6 identified keys for equipment and/or panels for which keys are required, and other items required to be submitted;
 - .7 other data or products specified.

1.29 **INSTRUCTIONS TO OWNER**

- .1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.
- .2 Train Owner's designated personnel in aspects of operation and maintenance of equipment and systems as specified. Demonstrations and training are to be performed by qualified technicians employed by equipment/system manufacturer/supplier. Supply hard copies of training materials to each attendee.
- .3 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Use Operating and Maintenance Manuals during training sessions. Training modules include but are not limited to:

- .1 Operational Requirements and Criteria: equipment function, stopping and starting, safeties, operating standards, operating characteristics, performance curves, and limitations;
- .2 Troubleshooting: diagnostic instructions, test and inspection procedures;
- .3 Documentation: equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like;
- .4 Maintenance: 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: diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.
- .4 Before instructing Owner's designated personnel, submit to Consultant for review preliminary copy of training manual and proposed schedule of demonstration and training dates and times. Incorporate Consultant's comments in final copy.
- .5 Obtain in writing from Consultant, list of Owner's representatives to receive instructions. Submit to Consultant prior to application for Certificate of Substantial Performance of the Work, complete list of systems for which instructions were given, stating for each system:
 - .1 date instructions were given to Owner's staff;
 - .2 duration of instruction;
 - .3 names of persons instructed;
 - .4 other parties present (manufacturer's representative, consultants, etc.).
- .6 Obtain signatures of Owner's staff to verify they properly understood system installation, operation and maintenance requirements, and have received operating and maintenance instruction manuals and "as-built" record drawings.
- .7 Submit to Consultant copy of electronic version of training materials loaded on USB flash drive. Include in operating and maintenance manuals submission.
- .8 Provide USB recording of operating and instructions training for following systems:
 - .1 emergency power gensets and control system;
 - .2 fire alarm system;
 - .3 security systems;
 - .4 resident-staff communication response system;
 - .5 dimming system;
 - .6 BAS.
- .9 Provide custom video in USB format that details on site systems and equipment operations and includes following:
 - .1 professional videographer on site to capture training session; use wireless lavalier microphone to capture crystal clear audio of trainer in association with video footage; edit video to remove unnecessary footage;
 - .2 USB to include custom site specific system/equipment screens that outline key information about system/equipment and devices used on site only;

- .3 USB to also include custom site specific video that details programming procedures in conjunction with a voiceover from on-site technician;
 - .4 USB created with a main menu screen and authored with chapters to allow operator to access specific areas of training instantly.
- .10 Supply minimum quantity of 3 copies of DVDs for each system/equipment. Owner to have option of such information loaded and submitted on USB flash drives.

1.30**FINAL INSPECTION**

- .1 Submit to Consultant, written request for final inspection of systems. Include written certification that:
- .1 deficiencies noted during job inspections have been completed;
 - .2 field quality control procedures have been completed;
 - .3 maintenance and operating data have been completed and submitted to, reviewed and accepted by Consultant;
 - .4 tags and nameplates are in place and equipment identifications have been completed;
 - .5 clean-up is complete;
 - .6 spare parts and replacement parts specified have been provided and acknowledged by Consultant;
 - .7 as-built and record drawings have been completed and submitted to, reviewed and accepted by Consultant;
 - .8 Owner's staff has been instructed in operation and maintenance of systems;
 - .9 commissioning procedures have been completed.

2**PRODUCTS****2.1****CONDUITS**

- .1 EMT (Thinwall), galvanized electrical metallic tubing to CSA C22.2 No. 83, complete with factory made bends where site bending is not possible and joints and terminations made with steel couplers and steel set screw type connectors with insulated throats, and concrete tight where required.
- .2 Rigid galvanized steel to CSA C22.2 No. 45, with exterior zinc and interior enamel coatings, galvanized threads where factory cut and red lead coated threads where site cut. Factory made bends where site bending is not possible, factory made and threaded fittings, and connectors, and terminations with rigid couplings, and concrete tight where required.
- .3 Galvanized steel flexible liquid tight metallic conduit to CSA C22.2 No. 56, complete with liquid-tight flexible conduit connectors at terminations.
- .4 Galvanized steel flexible metallic conduit to CSA C22.2 No. 56, complete with proper and suitable squeeze type connectors at terminations.
- .5 CSA approved and labelled, FT-4 rated, rigid plastic (PVC) conduit complete with site made heat gun bends on conduit to 50 mm (2") diameter, factory made elbows in conduit larger than 50 mm (2") diameter, solvent weld joints, factory made expansion joints where required, and terminations made with proper and suitable connectors and adaptors.

- .6 Medium density CSA certified polyethylene flexible plastic conduit in a continuous coil of proper length.
- .7 Factory threaded rigid bronze conduit with water-tight screwed joints, fittings, and connectors.

2.2 **OUTLET BOXES**

- .1 CSA approved stamped galvanized steel outlet boxes.
- .2 CSA certified, cast Feraloy and aluminium outlet boxes.
- .3 CSA certified rigid plastic (PVC) outlet boxes.
- .4 Standard general purpose service floor boxes: CSA approved, UL scrub water compliant, fully adjustable angular and vertically, formed steel/cast iron, round single gang / rectangular or square multi-gang as required, flush in concrete floor installation, boxes complete with conduit knockout openings, adjustable collars, hinged flip open brass covers with provisions for mounting of duplex power receptacles, telephone jacks and data jacks. Provide barriered boxes when boxes contain both power and communication outlets and different voltage levels. Size boxes to suit thickness of floor slab as confirmed with Consultant and also to suit required bending radii of conductors. Refer to drawings for number of gang requirements. Acceptable manufacturers are Hubbell, Legrand and Thomas & Betts, or approved equivalent. Special floor boxes are specified elsewhere in another Section.
- .5 Each outlet box and back box to be suitable in respects for application and complete with suitable securing lugs, connectors suitable for connected conduit, knockouts and, where necessary, suitable plaster rings, concrete rings, covers, carpet flanges and any other required accessory.
- .6 Electrical boxes exposed exterior of building or in non-climate controlled locations to be weatherproof boxes complete with gasketed covers/faceplates.

2.3 **PULLBOXES AND JUNCTION BOXES**

- .1 Galvanized or prime coat plated steel, suitable in respects for application and complete with screw-on or hinged covers as required, and connectors suitable for connected conduit.
- .2 CSA certified, threaded cast Feraloy outlet boxes of an exact type to suit application, each complete with screw-on gasketed cover.
- .3 Rigid plastic (PVC), CSA certified, junction boxes and access fittings with solvent weld type joints and screw-on PVC covers.
- .4 Physical size of pullboxes to be as required by local governing electrical code to suit number and size of conduits and conductors.
- .5 Each box to be suitable in respects for application and complete with suitable securing lugs, connectors suitable for connected conduit, knockouts and, where necessary, suitable plaster rings, concrete rings, covers and any other required accessory.
- .6 Boxes exposed exterior of building or in non-climate controlled locations to be weatherproof boxes complete with gasketed covers.

2.4 **SLEEVES**

- .1 Galvanized steel sleeves as follows:

.1 No. 24 gauge with an integral flange at one (1) end to secure sleeve to formwork construction;

.2 Schedule 40 pipe;

.2 Schedule 40 PVC sleeves.

2.5 **SWITCHES**

.1 Switches to be CSA approved, ULC listed and labelled devices.

.2 CSA approved, heavy duty, back, and side wired, AC quiet action toggle type, 20 ampere, 120-277 V switches. Provide single way, 2-way, 3-way, and key type to suit specific application requirements.

.3 CSA approved, heavy duty, back and side wired, AC quiet action toggle type, 20 ampere, 347 V switches.

.4 CSA approved, heavy duty, AC quiet action, illuminated polycarbonate handle toggle type, 20 ampere, 120-277 V switches.

.5 Pressure sensitive door switches complete with metal box, plates, and wire leads, and suitable for flush installation. Light is "ON" when door is open.

.6 Special switches not specified above are to be specified on drawings. Low voltage lighting controls are specified in Section entitled Lighting Control.

.7 Acceptable manufacturers are:

.1 Hubbell Canada Inc.;

.2 Legrand - Pass & Seymour;

.3 Leviton;

.4 Or approved equivalent.

2.6 **RECEPTACLES**

.1 Receptacles to be CSA approved, ULC listed, certified and labelled devices.

.2 Back and side wired, specification grade, flush, nylon face/body construction, duplex U-ground, 15/20 ampere, 125 V, 2-pole, 3-wire grounding receptacles.

.3 Back and side wired, specification grade, flush, nylon face, single, 20 ampere, 125 V, 3-wire grounding receptacles.

.4 Back and side wired, specification grade, flush, nylon face, single, 20 ampere, 250 V, 2-pole 3-wire grounding receptacle.

.5 Back and side wired, specification grade, 15 ampere, 125 V, 2-pole, 3-wire grounding, tamper-resistant (safety shutter) duplex receptacles.

.6 15/20 ampere, 125 V, duplex, ULC Class "A", Group One, tamper resistant, weather resistant ground fault circuit interrupting receptacles complete with red ground fault LED and 10ka short circuit current rating.

.7 Tamper resistant, back and side wired, 15 ampere, 125 V complete with dual USB charging outlets (USB-A and USB-C or to the latest USB charging receptacle standard).

- .8 EEMAC type 14-30R, 30 ampere, 125/250 V, 3-pole, 4-wire single electric clothes dryer receptacles with steel faceplates.
- .9 EEMAC type 14-50R, 50 ampere, 125/250 V, 3-pole, 4-wire single electric range receptacles with steel faceplates.
- .10 Specification grade, 15 ampere, 125 V, 2-pole, 3-wire, tamper resistant, safety shutter receptacles.
- .11 Specification grade, 15 ampere, 125 V, single, 2-pole, 3-wire grounding twist lock receptacle.
- .12 Extra heavy duty hospital grade with green dot symbol, back and side wired, flush, thermoplastic polyester face/body construction, duplex U-ground, 15 ampere, 125 V, 2-pole, 3-wire grounding receptacles complete with one piece nickel-plated brass mounting strip with integral grounding clips, ground retention clips, nickel-plated brass wiring clamps with nickel-plated brass screws, front circuit identification area and reinforced thermoplastic base.
- .13 Where noted that 20 A receptacles are required, include for "T" slot type of respective series of receptacles.
- .14 Colour of special switches and receptacles (unless specified above), to be as specified in PART 3 of this Section of Specification.
- .15 Special receptacles not specified above are to be specified on drawings. Low voltage lighting controls are specified in Section entitled Lighting Control.
- .16 Acceptable manufacturers are:
 - .1 Hubbell Canada Inc.;
 - .2 Legrand - Pass & Seymour;
 - .3 Leviton;
 - .4 Or approved equivalent.

2.7 **FACEPLATES**

- .1 Phenolic (urea thermosetting plastic) faceplates complete with matching screws.
- .2 Stainless steel wallplates.
- .3 NEMA 3R rated, CSA approved, ULC listed and labelled, single gang, vertical/horizontal mounting, weather-proof in-use, gasketed, cast aluminium faceplates for standard duplex receptacles in wet locations.
- .4 NEMA 3R rated, CSA approved, ULC listed and labelled, single gang, vertical/horizontal mounting, weather-proof in-use, gasketed, cast aluminium faceplates for GFI receptacles in wet locations.
- .5 ULC listed and labelled, single gang, vertical mounting, weather proof in-use, gasketed, clear bubble plate, silicone rubber faceplates for standard AC toggle switches in wet locations.
- .6 Galvanized steel stamped faceplates.
- .7 Colours and finishes of faceplates are specified in Part 3 of this Section.
- .8 Acceptable manufacturers are as per switches and receptacles.

2.8 **BASKET CABLE TRAY**

- .1 CSA approved and labelled, basket type cable tray system complete with factory made couplers, fittings, tee sections, elbows, universal dropouts, etc., and required supporting and installation accessories. Features include but are not limited to following:
 - .1 minimum 300 mm x 100 mm (12" x 4") unless otherwise noted on drawings;
 - .2 welded wire construction of minimum 5 mm (0.197") diameter carbon steel wires and hardware, conforming to requirements of ASTM A510 Grade 1008 with black powder coated finish paint to ASTM D 3451;
 - .3 continuous, rigid, welded steel wire mesh cable tray system;
 - .4 top wire safety edge;
 - .5 wire mesh welded at intersections;
 - .6 mesh sections having minimum one (1) bottom longitudinal wire along entire length;
 - .7 warning signs;
 - .8 accessories included as required.
- .2 Prior to start of work, prepare and submit detailed installation drawings, including plans, elevations and sections of proposed tray and routing. Coordinate such drawings with coordination drawings of trades. Include for design calculations to determine load limitations.
- .3 Tray to not have sharp edges that may damage cables during running of cables. Final finish to be smooth with no burrs that may damage cables.
- .4 Use manufacturer's trained and certified installers to perform work. Use tools as recommended by and supplied by tray manufacturer. Utilize manufacturer's supplied cutter for cutting tray. Submit with shop drawings, copies of installing technicians' certificates of training on respective tray systems.
- .5 Provide support of a trapeze configuration containing horizontal hanger brackets and vertical threaded rods on each side. Secure rods to brackets as per system manufacturer's instructions. Space supports at maximum 1.5 m (5'), to provide support of loads up to 53 kg/m (36 lbs per foot).
- .6 Provide support of a center hanging configuration containing horizontal hanger brackets and vertical threaded PVC insulated rods in middle. Secure rods to brackets as per system manufacturer's instructions. Space supports at maximum 1.5 m (5'), to provide support of loads up to 53 kg/m (36 lbs per foot).
- .7 Where cable tray penetrates fire rated construction, provide ULC listed and labelled, fire stopping and smoke seal materials or fittings to protect integrity of fire rated construction. Install work in compliance with ULC standards and where required by local governing codes, provide suitable for plenum environments.
- .8 Provide tray complete with grounding/bonding provisions, fittings, tee sections, elbows, universal dropouts, expansion fittings, etc., and required supporting and installation accessories. Provide dividers to separate various system cabling to a degree confirmed by Consultant, but typically two (2) dividers in a 300 mm (12") wide tray. Provide conduit fittings where conduits enter tray and provide dropouts at ends where cables exit/enter. Supply cable installation rollers for pulling cables safely into tray. System accessories to be supplied by system manufacturer and be as recommended by system manufacturer for specific applications.
- .9 Acceptable manufacturers are:

- .1 Legrand-Cablofil;
- .2 Leviton;
- .3 Canadian Electrical Raceways;
- .4 Hubbell;
- .5 Or approved equivalent.

2.9 **CABLE DUCT**

- .1 CSA approved and labelled, 250 mm (10") wide, 100 mm (4") deep, unless otherwise noted on drawings, constructed from No. 16 gauge galvanized steel, barriered 3-compartment solid bottom custom cable duct wireway supplied in 3 m (10') lengths with hinged covers supplied in 1.5 m (5') long sections and complete with required dividers, conduit knockouts, elbows, fittings, end closures, grommet ends, couplings, etc., and required mounting and connection hardware.
- .2 Prior to start of work, prepare and submit detailed installation drawings, including plans, elevations and sections of proposed routing. Coordinate such drawings with coordination drawings of trades.
- .3 Lengths of ducts, number of barriers and cover types may vary depending on site installation requirements. For flush or surface mounted applications, provide removable screw-on or hinged covers of lengths to avoid supports and to accommodate restricted spaces are required to suit and are to be reviewed and coordinated with Consultant. Ducts within walls do not require removable covers.
- .4 For surface wall mounting applications, cable duct to be complete with drilled holes for mounting and wall brackets.
- .5 For ceiling suspended applications, provide support of a trapeze configuration containing horizontal hanger brackets and vertical threaded rods on each side of duct. Secure rods to brackets and ceiling slab as per system manufacturer's instructions.
- .6 Entire duct system to be provided with powder coat finish of colour confirmed with Consultant.
- .7 Submit with shop drawings, copy of CSA certificate of approval for specified ducts.
- .8 Acceptable manufacturers are:
 - .1 Legrand -Wiremold;
 - .2 Thomas & Betts;
 - .3 Canadian Electrical Raceways;
 - .4 Or approved equivalent.

2.10 **SURFACE SERVICE RACEWAYS**

- .1 CSA certified, ULC listed and labelled, multi-outlet, multi-channel painted steel finished service raceways to be provided for specific applications where power and communication systems are required to be distributed in surface mounted channels. Include for:
 - .1 duplex grounding receptacles and mounting knockout plates;
 - .2 data outlet mounting bracket;
 - .3 telephone outlet mounting bracket;

- .4 dual covers (one for power and one for communications);
- .5 clips, couplings, brackets, fittings, elbows, boxes, tees mounting hardware, etc., for a complete raceway system;
- .6 wiring for power.
- .2 Generally, type of raceways is noted on drawings, but in absence of direction, in areas where multiple services are required, provide multi-compartment raceways to suit application. Where only single service is required, provide single type raceways.
- .3 Coordinate and measure exact dimensions for lengths, to meet site installation. Where horizontal sections meet vertical sections, provide manufacturer's proper connecting fitting such that there are no openings or exposed conductors. Ensure that bending radii requirements of various cabling standards are met.
- .4 Coordinate requirements for data/voice jacks and wiring with telecommunications network cabling specialist trade. Size raceways for computer network structured cabling in compliance with EIA/TIA Standards for required Category of cabling as per section entitled Structured Cabling System. Increase raceway sizing to suit.
- .5 Acceptable manufacturers are:
 - .1 Legrand-Wiremold;
 - .2 Thomas & Betts;
 - .3 Panduit;
 - .4 Or approved equivalent.

2.11

SERVICE POLES

- .1 CSA approved, ULC listed and labelled, service poles for provision of power, telephone and data communications to open floor office spaces and similar locations.
- .2 Service poles consist of following features:
 - .1 2-compartment, (power and communications), extruded aluminum column, barriered internally to separate power wiring from communications wiring;
 - .2 15A-125 volt, duplex receptacles, hard wired back to panel circuit;
 - .3 provision of openings and mounting brackets for telephone jacks;
 - .4 provision of openings and mounting brackets for data communication jacks;
 - .5 snap open cover on communication side of pole;
 - .6 base plate for securing pole assembly to floor and provisions at top for clamping to T-bar ceiling system and trim plate to cover ceiling opening;
 - .7 a painted or anodised aluminum finish.
- .3 Generally, configuration of poles and device requirements are noted on drawings, but in absence of direction, in areas where multiple services are required, provide multi-compartment raceway poles to suit application. Where only single service is required, provide single type raceway poles.
- .4 Coordinate and measure exact dimensions to meet site installation.

- .5 Coordinate requirements for data/voice jacks and wiring with telecommunications network cabling specialist trade. Size pole raceways for computer network cabling in compliance with EIA/TIA Standards for required Category of cabling as per Section entitled Structured Cabling System. Increase raceway sizing to suit.
- .6 Acceptable manufacturers are:
 - .1 Legrand-Wiremold;
 - .2 Thomas & Betts;
 - .3 Wellmark;
 - .4 Or approved equivalent.

2.12 FIRESTOPPING AND SMOKE SEAL MATERIALS

- .1 Asbestos-free, elastomeric materials and intumescent materials, tested, listed and labelled by ULC in accordance with CAN 4-S115-M85, and CAN/ULC-S101-M 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) no less than fire rating for surrounding construction.
- .2 Fire stopping and smoke seal material system to be specifically ULC certified with designated reference number for its specific installation. As part of shop drawing submission, submit copies of firestopping drawings with ULC certificate and number for each specific installation. Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.
- .3 Systems to consist of both elastomeric and intumescent materials that are compatible with abutting dissimilar materials and finishes. Coordinate material requirements with trades supplying abutting areas of materials.
- .4 Typically, for openings of up to 250 mm (10") in diameter, provide putty pad type firestop materials, non-hardening, water resistant putties containing no solvents, inorganic fibres or silicone compounds.
- .5 Typically, for openings of greater than 250 mm (10") in diameter, and for rectangular openings, provide pillow type firestop materials, non-curing, mineral fibre core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag.
- .6 Supply products of a single manufacturer for use on work of this Division.
- .7 Installer to be manufacturer trained and certified on specific product. Submit copy of certificate with shop drawings.
- .8 Include for manufacturer's authorized representative to inspect and verify each installation and application. Submit test report signed and verified by system installer's authorized representative and manufacturer's representative.
- .9 Acceptable certification to also include certification by Underwriters Laboratories of Northbrook IL, using tests conforming to ULC-S115 and given cUL listing published by UL in their "Products Certified for Canada (cUL) Directory".
- .10 Acceptable manufacturers are:
 - .1 3M Canada Inc.;
 - .2 Nelson;

- .3 Hilti Canada;
- .4 Or approved equivalent.

2.13 **FASTENING AND SECURING HARDWARE**

- .1 Concrete inserts - for concrete work for single or double conduit, cable tray, runs of three (3) or more conduits etc., and equipment, or where a grid support system is required.
- .2 Concrete fasteners – anchors, lead cinch anchors and/or self-drilling anchors.
- .3 Masonry inserts – expansion shields and machine bolts or, for light loads, fibre or lead plugs and screws.
- .4 Drywall or plaster wall and/or ceiling fasteners – 2-wing spring toggles.
- .5 Structural steel - beam clamps.
- .6 Metal framing channels – 40 mm (1-5/8") width, galvanized steel channels complete with required fittings and ancillary hardware; acceptable manufacturers are:
 - .1 Unistrut;
 - .2 Thomas & Betts;
 - .3 Eaton B-Line.
- .7 Metal "J" hooks or cable support systems for communications system cabling in accessible ceiling spaces where conduit or cable tray is not being provided. Obtain written approval of Consultant for use of J-hooks.
- .8 Tie wraps for bundling and securing cables.

2.14 **ACCESS DOORS**

- .1 Coordinate consistency of look and finish of access doors on project with each Division of Work. Coordinate exact requirements with General Trades Contractor.
- .2 Access doors to be rust resistant steel door panels, with concealed hinges and positive locking and self-opening screwdriver operated lock. Wall type frame to be suitable for wall installation and have integral keys for plaster walls. Doors in tile wall to be stainless steel and in ceilings to be suitable for plaster covering with only frame joint showing. All other doors to be prime painted steel.
- .3 Size access door to suit the concealed work for which they are supplied, and wherever possible they are to be of standard size for all applications, but in any case they are to be minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.
- .4 Lay-in type tiles, properly marked, may serve as access panels. Coordinate marking of ceiling tiles with Consultant. Panels in glazed tile walls to be 12 gauge, 304 alloy stainless steel, No. 4 finish, with recessed frame secured with stainless steel counter-sunk flush head screws.
- .5 Panels in plaster surfaces to have dish-shaped door and welded metal lath, ready to take plaster. Provide a plastic grommet for door key access.
- .6 Other access doors to be welded 12 gauge steel, flush type with concealed hinges, lock and anchor straps, complete with factory prime coat. Submit to Consultant for review, details of non-standard door construction details.

- .7 Access doors in fire rated ceilings, walls, partitions, structures, etc., to be ULC listed and labelled and of a rating to maintain fire separation integrity.
- .8 Where access doors are located in surfaces where special finishes are required, they are to be of a recessed door type capable of accepting finish in which they are to be installed so as to maintain final building surface appearance throughout.
- .9 Acceptable manufacturers include Le Hage, SMS, Pedlar and Acudor, or approved equivalent.

2.15 FLOOR BOXES

- .1 Legrand CAT# RFB6OG, CSA approved, UL scrub water compliant, ULC listed and labelled, fully assembled and pre-wired, flush floor box, rectangular fitting assembly as follows:
 - .1 4-independent wiring compartments that allow capacity up to 4 duplex power receptacles and/or communication brackets for telecommunications services;
 - .2 steel construction, suitable for on-grade applications;
 - .3 fully adjustable before and after concrete pour;
 - .4 knockouts sized from 21 mm to 53 mm (3/4" to 2");
 - .5 tunnelling from compartments as required;
 - .6 mounting brackets for power receptacles and communication modular devices; note that depth to suit floor slab restrictions as directed by Consultant;
 - .7 activation cover consisting of hinged, rectangular or round, flush access cover opening a full 180 degrees to lie flat on the floor; cover includes two smaller slide open cable egress doors; complete with full sized self-closing recessed handle, trim rings and flooring insert areas; die cast aluminium construction; exact finish and flooring type to be confirmed with Consultant prior to ordering;
 - .8 unit designed to prevent water and debris from entering box as per requirements of UL 514A and UL 514 C.
- .2 Coordinate dimensions of assembly with thickness of floor/ceiling slab. Exact requirements of devices to be provided as required for specific applications. Flush heads must be provided unless otherwise approved by Consultant. Confirm type of floor with Consultant prior to ordering and provide coverplate to suit floor type.
- .3 Refer to drawing details and notes for additional device requirements. Provide duplex receptacles to standards as specified in wiring devices article. Refer to drawing details and notes for device requirements. Coordinate AV requirements and telecommunication jack types and installation

requirements with respective system subcontractor responsible for work of AV and structured cabling system.

.4 Acceptable manufacturers are:

- .1 Legrand Wiremold;
- .2 Hubbell Canada Inc;
- .3 Thomas & Betts.

2.16 **IDENTIFICATION NAMEPLATES**

- .1 Laminated plastic black-white-black with bevelled edges, stainless steel screws, and proper identification engraving. Each nameplate to be sized to suit equipment for which it is provided, and required wording. Confirm nomenclature with Consultant. Various colour configurations to be used to differentiate systems. Confirm exact colour scheme with Consultant.
- .2 Portable electronic labelling system complete with self-adhesive, permanent printed labels with required nomenclature.

2.17 **WARNING SIGNS**

- .1 Semi-rigid vinyl panels with drilled holes in each corner, stainless steel screws, pressure sensitive mounting pads on back, and required printed wording. Generally, wording to be red on a white background with black trim confirmed with Consultant.

2.18 **SYSTEM BACKBOARDS**

- .1 Construction grade fir plywood, containing no added urea formaldehyde, flame retardant prime coat painted on exposed surfaces, minimum 20 mm (3/4") thick, as sized on drawings and with flame spread rating in accordance with local governing building code requirements.

2.19 **SPRINKLER PROTECTION**

- .1 Provide drip shields for protection of surface mounted equipment enclosures from water spray and dripping of liquids. Features of shields include:
 - .1 factory constructed by respective equipment manufacturers;
 - .2 constructed from non-combustible materials (sheet steel);
 - .3 enamel painted to match equipment;
 - .4 surfaces and edges filled/sanded smooth prior to painting;
 - .5 supported from equipment with structural steel rods/metal framing or other method approved by Consultant;
 - .6 structural support finish painted to match shield.
- .2 Include with equipment shop drawings, detailed dimensions of drip shields and methods of supporting.
- .3 Equipment with top cable/conduit entries to include additional sealing of entries with gasketting and/or waterproof sealant to prevent water from entering enclosure.

- .4 Design ventilation louvers such that live components are not exposed to water spray and dripping liquids.
- .5 Above requirements are additional minimum "sprinkler protection" standards for equipment specified as EEMAC/NEMA 1, 2 or 12.
- .6 Obtain CSA approval where required by local governing authorities.

2.20**ROOFTOP CONDUIT SUPPORT SYSTEM**

- .1 Rooftop support systems with features as follows:
 - .1 CSA approved and/or ULC listed and labelled;
 - .2 non-penetrating of roof;
 - .3 vibration dampening;
 - .4 does not float;
 - .5 suitable for outdoor wet and freezing environments without damage caused by weather or freeze and thawing when exposed to de-icing chemicals;
 - .6 environmental friendly;
 - .7 constructed of recycled rubber.
- .2 Materials:
 - .1 Base made of 100% recycled rubber and polyurethane pre-polymer with a uniform load capacity to suit specific load application of support (minimum 744 kg/m [500 pounds/linear foot]); each base to have a reflective red stripe.
 - .2 Base dimensions: 150 mm (6") wide by 125 mm (5") tall by required overall length (minimum 225 mm [9"]); this is to be minimum dimensions, but base requirements must be increased to suit specific applications as recommended by system manufacturer; includes low base steel frame C channel 1.9 mm (14 gauge) – 25 mm (1") high strut galvanized per ASTM A653; and pipe roller assembly.
 - .3 Base with two 13 mm (1/2") dia electro zinc all threaded rod risers and 14 ga. 25 mm (1") high galvanized steel slotted channel; adjustable height up to 400 mm (16"); refer to drawings or confirm with Consultant for exact height requirements.
 - .4 Attaching hardware: Zinc-plated threaded rod, nuts and attaching hardware per ASTM B633.
 - .5 Conduit clamps: single pipe supports constructed of galvanized steel and sized to accommodate sizing of installed conduits.
- .3 Confirm with system manufacturer that selected products provide proper support for application.
- .4 Acceptable manufacturers are as follows:
 - .1 Cooper B-Line;
 - .2 Clearline Technologies (C-Port);
 - .3 Erico (Caddy Pyramid);
 - .4 Or approved equivalent.

3**EXECUTION**

3.1 **GENERAL CONDUIT INSTALLATION REQUIREMENTS**

- .1 Install conduit concealed in finished areas, and concealed to degree made possible by finishes in partially finished and unfinished areas. Conduit may be exposed in unfinished areas such as Electrical and Mechanical Rooms, unless otherwise noted on drawings or specified herein. Refer to and examine architectural drawings and room finish schedules to determine finished, partially finished or unfinished areas of building. Documents do not identify exact routing. Where shown, routing is diagrammatic, identifying general requirements of routing and locations. Include for necessary offsets, fittings, transformations and similar items required as a result of obstructions and other architectural or structural details not shown.
- .2 Where conduits are exposed, arrange them to avoid interference with other work, parallel to building lines and install as high as possible. Do not install conduits within 150 mm (6") of "hot" pipes or equipment unless conduits are associated with equipment. Independently run conduit to be supported from wall/ceiling structure, not from ceiling hangers, ductwork, piping, cable trays, formed steel decking, etc. Do not run conduits within 900 mm (3') of equipment access opening covers.
- .3 So as not to impair required strength of structure, following criteria to be generally followed but which is to be reviewed and coordinated with with Consultant prior to start of Work:
 - .1 where conduits pass by a column, stay at least two times thickness of slab and drop away from column;
 - .2 where conduits terminate adjacent to a column or wall, bring conduit in toward column/wall as close to 90° to face of column as possible within two times thickness of slab and drop away from column;
 - .3 maximum size of conduit in structural slabs is 1/5 of solid portion of slab thickness;
 - .4 where more than two conduits are adjacent to each other, they are to be spaced greater of 3 diameters or 100 mm (4") apart;
 - .5 total of depth of conduits crossing over each other is to be less than one-third thickness of slab;
 - .6 place conduit in middle third of thickness of slab; do not lay conduit directly on reinforcing steel;
 - .7 do not run conduit adjacent to parallel reinforcing bars;
 - .8 do not run conduit longitudinally in beam without review with Consultant; pass through beams at right angles to span of beam;
 - .9 where conduits pass through beams, maintain at least twice depth of beam separation away from supports;
 - .10 do not run conduits in slab beside a drop or beam within twice depth of slab from edge of drop or beam;
 - .11 do not run conduits through shear walls or columns without review with Consultant;
 - .12 do not place conduit in structural elements in parking garage structures, water retaining structures or structures subjected to de-icing chemicals, without review with Consultant.
- .4 For proposed use of conduit runs underground below slab include following provisions:
 - .1 concrete encased ductbank with conduits of non-ferrous materials and sloped to drain properly into pit;

- .2 proper drain pit;
- .3 system to be a pull-in system;
- .4 20% spare conduits (with minimum of at least 1);
- .5 system proposal to consider and address any effects of magnetic fields.
- .5 Conduits are sized on drawings, but in absence of type and sizing, type and size to suit intended application in accordance with applicable local governing electrical code requirements. Sizes identified on drawings are minimum sizes and are not to be decreased unless reviewed with Consultant.

3.2 **INSTALLATION OF CONDUIT**

- .1 Provide conduit for conductors except armoured cable and copper sheathed mineral insulated conductors, and except where duct or similar raceway materials are provided.
- .2 Provide conduit as follows:
 - .1 for interior building surface mounted services greater than 600 V – rigid galvanized steel;
 - .2 for feeders exceeding 600 V for main distribution wiring in Electrical rooms, and for concealed conduit in exterior walls - rigid galvanized steel;
 - .3 for exposed conduit outside building, for semi-exterior areas such as loading areas, backyards, and within parking garage floor areas – rigid galvanized steel (rigid PVC where permitted by local codes and reviewed with Consultant);
 - .4 for exposed conduit in non-climate controlled areas, in areas of corrosive elements – epoxy coated ridged galvanized steel;
 - .5 for branch circuit conductors underground inside building, and underground outside building beneath concrete, asphalt, and similar paving material-rigid PVC;
 - .6 for branch circuit conductors underground outside building clear of concrete, asphalt and similar paving material-flexible polyethylene plastic conduit;
 - .7 for conductors in surface mounted conduit of parking garage – rigid galvanized steel; conduit not to be embedded in concrete within parking garage areas, unless approved in writing by Consultant; if approval obtained from Consultant, rigid PVC may be used embedded in concrete slabs;
 - .8 for conductors associated with pool area outlets and equipment – surface mounted epoxy coated rigid galvanized steel or rigid PVC in concrete slab;
 - .9 for exposed conduit mounted at a height of less than 1200 mm (4') in electrical, mechanical or other service areas – rigid galvanized steel;
 - .10 for short branch circuit connectors to motorized equipment and distribution transformers (minimum length 450 mm (18"), maximum length 600 mm (24") with 180° loop where possible) – galvanized steel flexible liquid-tight conduit;
 - .11 for branch circuit conductors associated with isolated power systems and located in a concealed space in a wall or in a concrete floor slab-rigid PVC with separate insulated ground conductor;
 - .12 at points, where conductors cross building expansion joints – galvanized steel flexible conduit with no less than 600 mm (24") of extra curve;

- .13 for branch circuit conductors in poured concrete slab – rigid PVC;
- .14 for interior conduit above 50 mm (2") diameter containing distribution conductors or communication systems conductors (fire alarm, telephone etc.) (except as noted above) – EMT with separate insulated ground conductor;
- .15 for corrosive environments – epoxy coated rigid steel;
- .16 for conductors except as noted above or elsewhere in this Specification – EMT.
- .3 Run rigid conductors in rigid type conduits suitable for application. Do not use flexible conduit.
- .4 Secure conduit located in poured concrete work in place in a manner such that conduit will not float or move when concrete is poured. Adequately protect such conduit from damage prior to and during concrete pour, and from concrete and water penetration.
- .5 Review with Consultant prior to Start of Work, maximum allowable size of conduit for installation in poured concrete. Placement of reinforcing steel in structural concrete work will take precedence over placement of conduit. Spaced adequately multiple runs of conduit in poured concrete work, as reviewed with Consultant.
- .6 Install flexible polyethylene conduit in continuous lengths wherever possible and "snake" conduit in trench. Where joints are necessary, make same with nylon inserts and stainless steel gear type clamps. Terminate with rigid conduit threadless connectors. Grade bed to provide proper drainage of conduits.
- .7 Support underground conduit on a well-tamped flat bed of earth, free from rocks or protrusions of any kind. Grade and slope bed to provide conduits and ducts with proper drainage. Coordinate with General Trades Contractor for provision of means to carry away drainage water. Obtain required approvals of work from local governing electrical utility and review with Consultant prior to back filling and covering. Provide pull cord in each duct run.
- .8 Provide manufactured expansion joints in rigid PVC plastic conduit at spacing as recommended by conduit manufacturer.
- .9 Provide a separate ground conductor in plastic conduits.
- .10 Support and secure surface mounted and suspended single or double runs of metal conduit at support spacing in accordance with local governing electrical code requirements by means of galvanized pipe straps, conduit clips, ringbolt type hangers, or by other proper manufactured devices.
- .11 Support multiple mixed size metal conduit runs with Unistrut Ltd., Electrovert Ltd. "CANTRUSS" or Burndy Ltd. "FLEXIBLE" conduit racks spaced to suit spacing requirements of smallest conduit in group.
- .12 Unless otherwise noted, provide conduit fittings constructed of same materials as conduit and which are suitable in respects for application.
- .13 Provide proper adaptors for joining conduits of different materials.
- .14 Cut square and properly ream site cut conduit ends.

- .15 Provide conduit as sized on drawings. Size conduit not sized on drawings in accordance with latest edition of local governing electrical code with consideration that sizes of branch circuit conductors indicated are minimum sizes and must be increased as required to suit length of run and voltage drop in accordance with voltage drop schedule found on drawings or at end of this section. Where conductor sizes are increased to suit voltage drop requirements, increase scheduled or specified conduit size to suit. Unless otherwise noted on drawings or required by local governing electrical code or specified elsewhere, conduit to be of minimum size 13 mm (1/2") diameter. Structured network cabling system conduit to be of minimum 19 mm (3/4") diameter, unless otherwise noted.
- .16 Site made bends for conduit to maintain full conduit diameter with no kinking, and conduit finishes are not flake or crack when conduit is bent.
- .17 Plug ends of roughed-in conduits which are exposed during construction with approved plugs.
- .18 Ensure that conduit systems which are left empty for future wiring are clean, clear, capped and properly identified at each termination point. Provide end bushing and suitable fish wires in such conduits.
- .19 Provide empty conduits to ceiling spaces from flush mounted panelboards located below and/or near hung ceiling. Refer to drawing detail.

3.3 **EXPANSION FACILITIES FOR CONDUIT CROSSING BUILDING EXPANSION JOINTS**

- .1 Wherever concealed or surface mounted conduits cross building expansion joints, provide expansion facilities to permit free movement without imposing additional stress or loading upon support system, and to prevent excessive movement at joints and connections, in accordance with drawing details.

3.4 **INSTALLATION OF OUTLET BOXES AND BACK BOXES**

- .1 Provide an outlet box or back box for each luminaire, wiring device, telephone outlet, fire alarm system component, communications systems components, and each other such outlet.
- .2 Size boxes to accommodate exact supplied components and for bending radii of installed cables. Confirm requirements with respective system vendors.
- .3 Outlet boxes flush mounted in interior construction, surface mounted in concealed interior locations, and surface mounted in exposed interior locations where connecting conduit is EMT, to be stamped and galvanized steel outlet boxes unless otherwise noted.
- .4 Outlet boxes for surface mounted exterior lighting, receptacles, and other device outlets, boxes flush mounted in exterior building surfaces, and boxes mounted in interior device locations where connecting conduit is rigid and boxes in perimeter wall where insulation and vapour barrier is present, and boxes in non-climate controlled areas to be "FS" or "FD" Series cast boxes unless otherwise noted.
- .5 Provide sealing around boxes in walls where insulation and vapour barrier is present or for walls of rooms that are sealed. Maintain sealing system of wall.
- .6 Outlet boxes in underground plastic conduit systems to be rigid PVC plastic outlet boxes, unless otherwise noted.

- .7 Outlet boxes for flush floor mounted devices to be concrete tight formed galvanized steel fully adjustable flush floor boxes. Locate in to position and install in accordance with manufacturer's instructions. Coordinate installation with trades pouring concrete floor slab or trade responsible for floor construction. For flush floor boxes in modular constructed area shall comply with the modular construction requirements.
- .8 Provide a barriered outlet box for switches connected to normal and emergency power and share a common faceplate.
- .9 Provide outlet boxes for special wiring devices, for special equipment and special applications. Refer to requirements specified in other Sections and/or on drawings.
- .10 Size and arrangement of outlet boxes to suit device which they serve.
- .11 Mounting heights and locations for outlet boxes are typically indicated on drawings, however confirm exact location and arrangement of outlets prior to roughing-in. Architectural drawings and Consultant's instructions have precedence over electrical drawing diagrammatic layouts and specified mounting heights and locations.
- .12 Do not install outlet or back boxes "back-to-back" in walls and partitions. Stagger such outlets and seal against noise transmission in accordance with drawing details. "Thru-wall" type boxes will not be permitted for any application.
- .13 Provide blank coverplates over boxes left empty for future installation of devices. Clearly identify each box as to its intended use, to consultant's approval and reviewed with Consultant. Generally, provide stainless steel type blank coverplates.

3.5

INSTALLATION OF PULLBOXES AND JUNCTION BOXES

- .1 Provide pullboxes in conduit systems wherever shown on drawings, and/or wherever necessary to facilitate conductor installations. Generally, conduit runs exceeding 30 m (100") in length, or with more than two - 90° bends, are to be equipped with a pullbox installed at a convenient and suitable intermediate accessible location.
- .2 Size boxes to accommodate exact supplied system and for bending radii of installed cables. Confirm requirements with respective system vendors.
- .3 Provide junction boxes wherever required and/or indicated on drawings and as required by local governing electrical code.
- .4 Provide sealing around boxes in walls where insulation and vapour barrier is present or for walls of rooms that are sealed. Maintain sealing system of wall.
- .5 Boxes in rigid conduit and EMT inside building to be stamped galvanized or prime coated steel.
- .6 Boxes in exterior rigid conduit and boxes in perimeter wall where insulation and vapour barrier is present, to be "Condulet" cast gasketed boxes, unless otherwise noted.
- .7 Boxes in plastic conduit to be rigid PVC plastic boxes complete with required couplings.
- .8 Pullboxes and junction boxes to be accessible after work is completed.
- .9 Accurately locate and identify concealed pullboxes and junction boxes on "As-built" record drawings.
- .10 Clearly identify main pull or junction boxes in publicly accessible areas (excluding obvious outlet boxes) by painting outside of covers. Spray painting is not permitted unless reviewed with Consultant. Paint colours to be in accordance with following schedule:

- .1 lighting-yellow;
- .2 normal power-blue;
- .3 essential power-orange;
- .4 fire alarm-red;
- .5 telephone-green;
- .6 miscellaneous signals-brown.
- .11 In addition to painting miscellaneous signal boxes, clearly identify specific system in which box is installed.
- .12 Cover boxes in fire walls with aluminium tape and seal with caulking.

3.6 **INSTALLATION OF SLEEVES**

- .1 Where conduits, round ducts and conductors pass through structural poured concrete, provide sleeves of type suitable for application, and approved by local governing codes.
- .2 Sleeves in concrete slabs, except as noted below, are to be No. 24 gauge or equivalent, with an integral flange to secure sleeves for formwork construction.
- .3 Sleeves in waterproof concrete slabs and in other slabs where waterproof sleeves are required are to be lengths of Schedule 40 pipe sized to extend 100 mm (4") above floor.
- .4 Sleeves in poured concrete walls and foundation are to be Schedule 40 pipe.
- .5 Size sleeves, unless otherwise noted, to leave 13 mm (1/2") clearance around conduit, duct, conductor, etc. Void between sleeves and conduit, duct, conductors, etc., to be packed and sealed for length of sleeves as in accordance with article entitled "Firestopping and Smoke Seal Materials" specified here in this Section. Ensure that sleeves set in exterior walls are packed and sealed with governing authority approved materials suitable for application and that both ends of sleeves are packed watertight with approved permanently flexible and water tight materials. Exact responsibility of work to be coordinated with General Trades Contractor.
- .6 Submit to concrete reinforcement detailer at proper time, drawings indicating required sleeves, recesses and formed openings in poured concrete work. Completely and accurately dimension such drawings and relate sleeves, recesses and formed openings to suitable grid lines and elevation datum.
- .7 Supply sleeves of a water protecting type in accordance with detail found on drawings for installation in following locations:
 - .1 in Mechanical and Fan Room floor slabs, except where on grade;
 - .2 in slabs over Mechanical, Fan, Electrical and Telephone Equipment Rooms or closets;
 - .3 in floors equipped with waterproof membranes.
- .8 "Gang" type sleeving to be permitted only with approval of consultant and reviewed with Consultant.
- .9 Terminate sleeves for work which is exposed, so that sleeve is flush at both ends with wall, partition, or slab surface such that sleeve may be covered completely by escutcheon plates.

3.7 **INSTALLATION OF SWITCHES**

- .1 Provide switches and install in electrical outlet boxes. Refer to drawings to determine flush or surface mounting requirements. Generally, flush mount devices in finished areas. Size electrical boxes to suit device requirements as per device manufacturer's recommendations. Properly ground device to box and ground system as per code requirements and manufacturer's instructions.
- .2 For pricing only, switches to be ivory for devices connected to normal power circuits, red for devices connected to emergency power circuits.
- .3 Every switch connected to emergency power circuits, to be illuminated toggle type.
- .4 Illuminated operation of lighted switches to suit specific applications as confirmed with Consultant.
- .5 Ensure that switches located adjacent to doors are located at strike side of door. Confirm door swing requirements on architectural drawings, not on electrical drawings.
- .6 Coordinate installation of door switches with trades responsible for provision of doors and frames. Confirm exact locations of switches with Consultant to ensure optimum operation of switch to door position.

3.8 **INSTALLATION OF RECEPTACLES**

- .1 Provide receptacles and install in electrical outlet boxes. Refer to drawings to determine flush or surface mounting requirements. Generally, flush mount devices in finished areas. Size electrical boxes to suit device requirements as per device manufacturer's recommendations. Properly ground device to box and ground system as per code requirements and manufacturer's instructions.
- .2 For pricing only, receptacles to be ivory for devices connected to normal power circuits, red for devices connected to emergency power circuits.
- .3 Safety shutter type receptacles to be located where shown and required by code.
- .4 Install USB charger receptacles in extra deep boxes in accordance with manufacturer's recommendations.
- .5 Install exterior receptacles located in landscaped grounds in accordance with drawing detail.
- .6 Where receptacles are indicated in counters and benches, box cut-out to be provided in counter and bench. Provide a box, receptacle, plate and branch circuit wiring. Branch circuit wiring within counters and benches to be flexible armoured cable, under requirements of local governing electrical code and standards. Install and connect complete.

3.9 **INSTALLATION OF FACEPLATES**

- .1 Provide each switch and receptacle with a faceplate with an opening or openings suitable for device it conceals and covers openings around boxes. Secure faceplates to device frames with screws to match faceplates. Provide larger than standard type faceplates for devices that require engraved nomenclature to define special purpose for that device.
- .2 Provide faceplates with suitable identification label. Colour finish to be red for devices on emergency power, but to be confirmed with Consultant.
- .3 Provide galvanized stamped steel faceplates in service areas and equipment rooms where devices are surface mounted.

- .4 Provide faceplates for housekeeping receptacles with label printed with "Housekeeping Only" lettering.
- .5 Provide weatherproof insulated faceplates with hinged and gasketed receptacle access flaps for weatherproof receptacles denoted "WP" on drawings.
- .6 Generally, oversized faceplates to be provided where engraved lettering is required.
- .7 Faceplates for flush floor mounted receptacles to be forged brass rectangular faceplates.
- .8 Provide phenolic (urea thermosetting plastic) faceplates for all front of house areas (areas accessible to residents). Phenolic faceplates shall be white in colour.
- .9 Provide stainless steel faceplates for all areas that may be exposed to corrosive substances.

3.10 **INSTALLATION OF CABLE TRAY**

- .1 Provide sample of tray and detailed drawing layout of work prior to start of work, accurately dimensioned and showing required routing, penetrations, connections, bends, supports, etc.
- .2 Obtain required training from manufacturer's representative on any special installation procedures. Install tray in accordance with manufacturer's instructions to suit specific installation requirements. Use manufacturer's recommended tools for cutting and installing tray.
- .3 Drawings are diagrammatic and do not identify required changes in elevations and architectural features. Site measure exact routing and lengths. Provide detailed drawing layout of work prior to start of work, accurately dimensioned and showing required penetrations, connections, bends, etc.
- .4 Install and hang cable tray at maximum 1.5 m (5') centres and in accordance with manufacturer's published literature employing horizontal bracket supported to ceiling slab by vertical threaded rod hangers. Do not secure assembly from ductwork, suspended ceiling structures, lighting, etc. Secure rod hangers directly to ceiling slab. Locate supports as not to interfere with removal or opening of covers. Typically locate spans at intervals $\frac{1}{4}$ span from supports, as recommended by tray manufacturer. Refer to drawing details and/or manufacturer's instructions. Include for provision of required seismic restraints as to comply with local governing building code requirements.
- .5 Provide proper fittings in cable tray at points of conduit entry. Terminate conduits at or in tray with proper grommetted and bushed terminations.
- .6 Equip tray with necessary wall flanges, dropouts, enclosures, reducers, fittings, and similar accessories required, maintaining effective free cross-sectional area of tray clear of obstructions that might damage conductor insulation during installation.
- .7 Properly secure, adequately support and neatly harness conductors in tray. Seal cable tray penetrations of building fire barriers by means of ULC listed and labelled fire stopping and smoke sealing material.
- .8 Provide continuous paths along entire lengths of cable tray to maintain proper ground continuity. Utilize system manufacturer's proper grounding and bonding fittings and hardware. Ground and bond system as per local governing electrical code requirements.
- .9 File smooth cuts to tray and re-touch with galvanizing compound.
- .10 Install expansion connectors where cable tray crosses building expansion joints.
- .11 After installation is complete, install warning signs on tray in visible locations.

- .12 Inspect tray for rough finishing burrs, sharp edges, and mechanical deficiencies prior to installing of cabling. Eliminate these deficiencies to satisfaction of Consultant, prior to installing cables.

3.11 **INSTALLATION OF CABLE DUCT**

- .1 Provide sample of duct and detailed drawing layout of work prior to start of work, accurately dimensioned and showing required routing, penetrations, connections, bends, supports, etc.
- .2 Obtain required training from manufacturer's representative on any special installation procedures. Install tray in accordance with manufacturer's instructions to suit specific installation requirements. Use manufacturer's recommended tools for cutting and installing duct.
- .3 Drawings are diagrammatic and do not identify required changes in elevations and architectural features. Site measure exact routing and lengths. Provide detailed drawing layout of work prior to start of work, accurately dimensioned and showing required penetrations, connections, bends, etc.
- .4 Provide cable duct with required covers. Provide required components and required mounting and connection accessories.
- .5 Secure surface wall mounted duct in place with mounting hardware recommended by duct manufacturer to suit specific installation.
- .6 Install and hang cable duct at maximum 1.5 m (5') centres and in accordance with manufacturer's published literature. Do not secure assembly from ductwork, suspended ceiling structures, lighting, etc. Secure rod hangers directly to ceiling slab. Locate supports as not to interfere with removal or opening of covers.
- .7 Provide proper fittings in cable duct at point of conduit entry. Terminate conduits at or in duct with proper grommetted and bushed terminations.
- .8 Equip duct with necessary wall flanges, dropouts, enclosures, reducers, fittings, and similar accessories required, maintaining effective free cross-sectional area of duct clear of obstructions that might damage conductor insulation during installation.
- .9 Properly secure, adequately support and neatly harness conductors in duct. Seal cable duct penetrations of building fire barriers by means of ULC listed and labelled fire stopping and smoke sealing material.
- .10 Provide continuous paths along entire lengths of cable duct to maintain proper ground continuity. Utilize system manufacturer's proper grounding fittings and hardware.
- .11 Install expansion connectors where cable duct crosses building expansion joints.
- .12 After installation is complete, install warning signs on duct in visible locations.
- .13 Inspect duct for rough finishing burrs, sharp edges, and mechanical deficiencies prior to installing of cabling. Eliminate these deficiencies to satisfaction of Consultant, prior to installing cables.

3.12 **INSTALLATION OF SURFACE SERVICE RACEWAYS**

- .1 Provide surface mounted, service raceway assemblies complete with specified and required accessories necessary for a complete electrical raceway system. Site measure for proper lengths. Provide required type and quantity of receptacles. Confirm exact types for each application with Consultant prior to ordering. Confirm finishes with Consultant prior to ordering.

- .2 Obtain required training from manufacturer's representative on any special installation procedures. Install raceways in accordance with manufacturer's instructions to suit specific installation requirements. Use manufacturer's recommended tools for cutting and installing raceways.
- .3 Assemble and secure raceways, boxes and other components to surfaces in accordance with manufacturer's instructions and requirements. Connect complete. Where possible butt raceway ends to adjacent walls, cabinets, counters, etc. Where raceway is to be attached to equipment or sections of millwork, install raceway for full length of equipment/millwork, unless otherwise noted. Mount-faceplates flush to raceway with no gaps. Keep number of elbows, offsets and connectors to a minimum.
- .4 Do not exceed wire fill requirements given in manufacturer's instructions.
- .5 Provide barriers for systems with different voltages in raceway.
- .6 Test prewired raceways after installation work is complete.
- .7 Provide wiring devices of types and standards as specified in wiring devices section.
- .8 Coordinate requirements with structured cabling system vendor to ensure that raceways are suitable for and comply with standard for telecommunication jacks and cabling. Ensure that device mounting brackets are co-ordinated to suit final modular jack being installed.

3.13**INSTALLATION OF SERVICE POLES**

- .1 Provide specified service poles complete with receptacles, communications facilities and required ancillary devices. Install in locations and connect complete. Site measure for proper lengths. Quantities and types of outlets required to be as shown on drawings. Confirm finishes with Consultant prior to roughing in.
- .2 Obtain required training from manufacturer's representative on any special installation procedures. Install poles in accordance with manufacturer's instructions to suit specific installation requirements.
- .3 Secure poles to floor and to T-bar ceiling grid system in accordance with manufacturer's instructions.
- .4 Extend circuits from designated power panel to feed poles receptacles. Provide junction box in ceiling space. Co-ordinate installation of boxes to suit location of poles.
- .5 Do not exceed wire fill requirements given in manufacturer's instructions.
- .6 Provide barriers for systems with different voltages in raceway.
- .7 Ground and bond devices as per local electrical code requirements.
- .8 Refer to and provide additional applicable testing requirements of distribution system testing and coordination study article.
- .9 Test prewired raceway poles after installation work is complete.
- .10 Provide wiring devices of types and standards as specified.
- .11 Coordinate requirements of modular telecommunication jacks with structured cabling system vendor to ensure that raceways are suitable for and comply with standard for telecom jacks and cabling. Ensure that device mounting brackets are co-ordinated to suit final modular jack being installed.

3.14 INSTALLATION OF FIRESTOPPING AND SMOKE SEAL MATERIALS

- .1 Where electrical work penetrates or punctures fire rated construction, provide ULC certified, listed and labelled firestopping and smoke sealing packing material systems to seal openings and voids around and within raceway and to ensure that continuity and integrity of fire separation is maintained. Submit to Consultant, copies of certificates of compliance from an independent testing agency, attesting that fire stopping and smoke seal materials meet ULC requirements. Openings not in immediate vicinity of working areas are to be firestopped and sealed same day as being opened.
- .2 Examine condition of voids to be filled to ensure suitability for systems. Verify installation of service penetrations and adjacent construction has been completed. Prepare substrates and surfaces to a clean, dry, frost-free condition, and primed to firestop system manufacturer's recommendations to receive firestopping system.
- .3 Install fire stopping and smoke seal materials for each installation in strict accordance with specific ULC certification number and manufacturer's instructions. Comply with local governing building code requirements and obtain approvals from local building inspection department. Ensure that openings through fire separations do not exceed maximum size wall opening, and maximum and minimum dimensions indicated in ULC Guide No. 40 U19 for Service Penetration Assemblies and fire stopping materials.
- .4 Ensure that continuity and integrity of fire separation is maintained and conform to requirements of latest edition of ULC publication "List of Equipment and Materials, Volume II, Building Construction".
- .5 After installation work is complete, arrange for manufacturer's authorized representative to inspect and verify each installation and provide a test report signed by installing trade and manufacturer's representative. Test report to list each installation and respective ULC certification and number.

3.15 SUPPLY OF ACCESS DOORS

- .1 Supply access doors to give access to junction boxes, pull boxes, conductor joints and other similar electrical work which may need maintenance or repair but which is concealed in inaccessible construction.
- .2 Before commencing installation of work, coordinate with other trades and prepare on a set of reflected ceiling plans and wall elevations, complete layouts of access doors. Submit these layouts for Consultant's review and show exact sizes and locations of such access doors. Locate and arrange electrical work to suit.
- .3 Access doors to be installed by trade responsible for particular type of construction in which doors are required. Supply access doors to trade installing same at proper time.
- .4 Wherever possible, access doors to be of a standard size for each application. Confirm exact dimensions and minimum size restrictions with Consultant prior to ordering.
- .5 Coordinate with Mechanical Contractor and General Trades Contractor to ensure that access doors on project are provided by a single manufacturer, installed as part of work of General Trades Contractor and that work involving both mechanical and electrical services should where possible be accessible from common access door. Coordinate work to ensure that common location access doors are not supplied by both Mechanical Divisions and Electrical Divisions.

3.16 INSTALLATION OF FASTENING AND SECURING HARDWARE

- .1 Provide fasteners and similar hardware required for conduit, duct, raceway, conductors, etc. and for equipment hanger and/or support material unless otherwise noted.
- .2 Accurately and properly set concrete inserts in concrete framework. Where multiple type inserts are used, space same to suit requirements of smallest conduit, etc., in group.
- .3 Fasten hanger and support provisions to masonry with expansion shields and machine bolts, or, for light loads, use plugs, and screws.
- .4 In drywall or plaster walls and/or ceilings use two wing toggles and for heavy loads, provide steel anchor plates with two or more toggles to spread load.
- .5 Provide beam clamps for attaching hanging and/or support provisions to structural steel, or where reviewed with Consultant, weld hanging and support provisions to structural steel.
- .6 Explosive powder actuated fasteners are not permitted unless specific written approval for their use and type has been obtained from Consultant.
- .7 Under no circumstances use ceiling suspension hangers or grids for suspension of conduit and conductors. Install supports to permanent structure of building, limited to areas that will not damage structural stability.
- .8 Provide "J" hooks in accessible ceiling spaces where conduit is not provided for structured cabling runs or other telecommunication cabling, as approved by Consultant.
- .9 Comply with J-hook manufacturer's loading limitations and spacing criteria. Do not exceed 1.2 m (4') spacing interval. Add additional J-hooks if cabling sags, at discretion of Consultant. Drill anchors for J-hooks into slab not into post tensioned beams. Do not install more than one system on each J-hook.
- .10 Install Velcro tie wraps on bundled telecommunication cables and do not over tighten. Provide FT6/CMP rated wraps in plenum type spaces as per local building code requirements.
- .11 Comply with Structural Engineer's limitations for maximum penetrations of securing hardware into concrete slabs.

3.17

INSTALLATION OF IDENTIFICATION NAMEPLATES

- .1 For each piece of electrical distribution equipment from electrical source of supply up to and including panelboards, for special control panels and cabinets, and for each other piece of electrical equipment, provide engraved Lamacoid identification nameplates secured to apparatus with stainless steel screws. Nameplates to indicate source of electrical supply and include Consultant's equipment identification number. Identify whether equipment is on "NORMAL POWER SYSTEM" or "EMERGENCY POWER SYSTEM".
- .2 Equip large multiple cell or component apparatus such as switchboards and distribution panels with main nameplates identifying equipment, voltage characteristics, capacity and source of supply, and with sub-nameplates clearly identifying each cell or component and its service.
- .3 Panelboard nameplates to identify panelboard number as designated on drawings, unless otherwise instructed. Nameplates for disconnect switches, control panels, and cabinets to outline their service and source of supply.
- .4 In areas where equipment having removable doors that can be commonly installed on different equipment, ensure that each door is identified to which piece of equipment it is associated with, such that nameplates are with correct equipment.
- .5 Nameplates to be mechanically secured lamacoid and be colour coded as follows:

- .1 Normal Power Black with white letters;
- .2 Emergency Power Red with white letters;
- .6 In pull boxes, junction boxes and at terminations, identify feeders by use of plastic plates indicating system voltage and circuit designations. Plates to be 25 mm (1") in diameter and have letter stamped 9 mm (5/8") high. Colour coding to be:
 - .1 Phase A – red;
 - .2 Phase B – black;
 - .3 Phase C – blue;
 - .4 Neutral – white;
 - .5 Ground - green.
- .7 Confirm print size type and size, colours, sizing and nomenclature of nameplates with Consultant prior to ordering. Submit sample board.

3.18 INSTALLATION OF TERMINAL BACKBOARDS

- .1 Provide specified terminal backboards for communication systems and electrical distribution equipment.
- .2 Securely wall mount each backboard with proper fasteners to suit wall construction.
- .3 Unless otherwise noted, size backboards to sufficiently provide adequate terminal space for each system, plus 20% space for future additions.

3.19 INSTALLATION OF WARNING SIGNS

- .1 Provide warning signs as applicable for following:
 - .1 on doors into transformer vault(s);
 - .2 on doors into high voltage switchgear room(s);
 - .3 on doors to genset room/enclosure;
 - .4 on doors into main electrical rooms;
 - .5 for other applications as noted.
- .2 Secure signs to equipment with stainless steel screws. Number of signs required and sign wording, symbols, and colours to be reviewed with Consultant, and local electrical utility, where applicable.

3.20 INSTALLATION OF ROOFTOP SUPPORT SYSTEM

- .1 Install rooftop support system for conduits/raceways in accordance with manufacturer's instructions and recommendations to suit type of raceway and roofing materials.
- .2 If gravel top roof, remove gravel from around and under pipe support. Coordinate work with building roofing vendor.
- .3 Consult roofing vendor for roof membrane compression capacities and roof loading limitations. Comply with restrictions.
- .4 Use properly sized clamps to suit conduit sizes. Ensure that installation and use of system does not invalidate roof warranties.

- .5 Engage roofing vendor to inspect installation and verify that installation has not damaged roof.

3.21 **BRANCH CIRCUIT BALANCING**

- .1 Connect branch lighting and power circuits to panelboards so as to balance actual loads (wattage) within 5%. If required, transpose branch circuits when work is complete to meet this requirement.
- .2 At request of Consultant, perform necessary tests to show compliance with above requirement. Make such tests after building is occupied.

3.22 **EQUIPMENT BASES AND SUPPORTS**

- .1 Provide equipment bases, supports and concrete housekeeping pads for mounting of floor standing equipment and luminaire pole bases.
- .2 Secure floor mounted equipment in place on 100 mm (4") high concrete housekeeping pads, 100 mm (4") wider and longer than equipment base dimensions. Chamfer edges of bases. Include for seismic restrains as required by local governing building code.
- .3 Supply dimensioned drawings, templates, and anchor bolts for proper setting of equipment on bases and pads. Be responsible for required levelling, alignment, and grouting of equipment.
- .4 Submit to Consultant for review, dimensioned shop drawings of structurally designed concrete pads or bases for support of large, heavy equipment. Indicate on shop drawings total weight of pad or base, reinforcement, and equipment for which it is required.
- .5 Unless otherwise noted, support equipment suspended above floor level with suitable welded or bolted prime coat painted structural steel angles or channels bracketed to wall or secured by hanger rods.

3.23 **EXCAVATION AND BACKFILL**

- .1 General trades are responsible for excavation and backfill outside the building footprint. The Electrical Contractor is responsible for any under-slab excavation, bedding and backfill, within the building footprint for electrical works.
- .2 Before commencement of excavation for work, determine in consultation with Consultant, Municipality and utilities, presence, if any, of existing underground services at site. Engage local utilities to locate and mark out such services. Ensure that trades concerned are aware of their presence.
- .3 Be responsible for any damage done to underground services caused by neglect to determine and mark out location of such services prior to excavation work commences.
- .4 Inverts and locations of existing site services may have been site surveyed and approximate location may be shown on drawings. Be responsible for confirming that inverts and locations are correct, prior to commencing excavation. Where discrepancies are found, immediately inform Consultant, and await a direction.
- .5 Where Work falls under jurisdiction of local governing utility, confirm requirements and comply with utility requirements.
- .6 Provide excavation, backfill, and related work required for your work. Obtain a copy of soil test report if available from Consultant. Depth of excavations must accommodate local governing requirements and local standard practices to compensate for local frost levels of Place of Work.

- .7 Grade bottom of excavation. In firm, undisturbed soil, lay services directly on soil. Backfill excess excavation with 13,790 kPa (2,000 psi) concrete. Grade bottom such that ducts are installed to drain as per Consultant's direction.
- .8 Prepare new bedding under service in unstable soil, in fill, and in cases where bedding has been removed in earlier excavation, particularly near perimeter walls of buildings, and at manholes and catch basins, compact to maximum possible density and support service by means of 200 mm (8") thick concrete cradles spanning full length between firm supports. Refer to detail on drawings.
- .9 Where excavation is necessary in proximity to and below level of any footing, backfill with 13,790 kPa (2,000 psi) concrete to level of highest adjacent footing. Proximity is determined by angle of repose as reviewed with Consultant.
- .10 Do not open trenches ahead of installation of services and backfilling more than weather permits. Break up rocks and boulders and remove by drilling and wedging. Do not use blasting unless specifically reviewed with Consultant.
- .11 Before backfilling, arrange for inspection of work by Consultant. Do not backfill work unless reviewed with Consultant. Remove shoring during backfilling.
- .12 Backfill trenches within building with clean sharp sand in individual layers of maximum 150 mm (6") thickness, compacted to a density of 100% Standard Proctor. Hand compact first layers up to compacted level of 300 mm (12") above top of service. Hand or machine compact balance up to grade using approved equipment.
- .13 Fill depressions to correct grade level with appropriate material, after an adequate period has passed to reveal any settlement. Use maximum possible compaction. Pay costs required to make good damages caused by settlement. Generally, final surface toppings are responsibility of another Division of Work. Coordinate exact requirements with General Contractor to ensure surface toppings are provided as required to match adjacent surfaces.
- .14 Unless otherwise directed in Division 02, store and dispose of excavated materials as follows:
 - .1 during progress of contract, place material as directed in such a manner that minimum damage or disfigurement of ground and which in no causes way impedes progress of work;
 - .2 separately place surplus topsoil and subsoil as directed; leave site clean and unencumbered.
- .15 Provide pumping equipment as required to keep excavations free of water.
- .16 Engage services of independent soils testing agency to test final backfill compaction density of each backfilled location. Compact backfill to satisfaction of testing agency and in accordance with Specification. Submit a copy of testing agency's report to Consultant for review.
- .17 Coordinate requirements for final surface toppings (concrete, asphalt, pavers, grass sod, etc.) with General Contractor.

3.24 **CUTTING, PATCHING AND CORE DRILLING**

- .1 Unless otherwise provided by General Trades, perform cutting, patching, and core drilling required for installation of your work. Perform cutting in a neat and true fashion, with proper tools and equipment. Patching is to exactly match finishes and be performed by tradesmen skilled in particular trade or application. Work is subject to review and acceptance by Consultant.
- .2 Criteria for cutting holes for additional services:

- .1 cut holes through slabs only; no holes to be cut through beams;
 - .2 cut holes 150 mm (6") diameter or smaller only; obtain approval from Structural Consultant for larger holes;
 - .3 keep at least 100 mm (4") clear from beam faces;
 - .4 space at least 3 hole diameters on centre;
 - .5 for holes that are required closer than 25% of slab span from supporting beam face, use cover meter above slab to clear slab top bars;
 - .6 for holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars;
 - .7 submit sleeving drawings indicating holes and their locations for Structural Consultant's review.
- .3 Where core drill or saw cut an opening is required for conduits and/or conductors penetrate construction, size openings to leave 13 mm (1/2") clearance around conduit and/or conductors, and pack and seal and void between opening and conduit and/or conductor for length of opening with ULC listed and labelled material in accordance with article entitled "Firestopping And Smoke Seal Materials" specified herein this Section.
- .4 Prior to drilling or cutting an opening, determine, in consultation with Consultant, and by use of non-destructive radar scan (magnetic scan) of slab or wall, presence of any reinforcement bars concealed behind building surface to be cut and locate openings to suit.
- .5 Fire stop and seal openings as specified, and patch as required before end of workday. No openings are to be left open overnight unless coordinated with Consultant.

3.25 **FINISH PAINTING OF ELECTRICAL WORK**

- .1 Unless otherwise noted, finish painting of exposed Electrical Divisions work is to be performed as part of work of Division 09.
- .2 Provide identification painting for electrical distribution equipment in accordance with application requirements of Division 09. Confirm exact finish colours with Consultant. Equipment requiring special colour identification painting to include but not be limited to following:
 - .1 pull boxes and junction boxes;
 - .2 communication system conduit;
 - .3 genset exhaust piping.
- .3 Spray painting is not permitted unless reviewed and approved by Consultant.

3.26 **PROVISIONS FOR FURNITURE SYSTEMS**

- .1 Ensure that rough-in for electrical devices including but not limited to outlets, switches, thermostats, control devices, fire alarm devices and clocks and communications devices are located to avoid wall mounted systems furniture wall strips. Relocate conduit and devices which do not coordinate with systems furniture requirements identified on systems furniture drawings.
- .2 Coordinate location of electrical conduits/ducts within floor slabs and mounted to underside of floor slabs, with location of free standing work stations and furniture systems.

- .3 Coordinate connection of electrical and communication devices with systems furniture supplier. Generally, supply and installation of power, data and communication wiring and devices are by Electrical Division. Furniture system connection "whips" to be supplied by furniture system vendor and turned over to Electrical Division for installation. Confirm responsibility of supply of whip with General Trades Contractor. Power conductors are to be installed to a wall/ceiling mounted junction box and extended out to furniture system, through empty conduit, raceways, and back boxes provided within furniture system. Branch circuit conductors in furniture system raceways may be AC-90 flexible armoured conductors. Telecommunication (data/voice) conductors are to be complete home runs from LAN closet to work station outlet. Testing and verification of furniture system devices is responsibility Electrical Division. Confirm exact requirements with furniture system trades. Where furniture systems are not supplied with pre-wired devices, be responsible for supply, installation and wiring of required devices.

3.27

CONDUIT PROVISIONS FOR MISCELLANEOUS SYSTEMS

- .1 Provide following components to accommodate future installation of various miscellaneous systems by system installers who are to provide equipment and wiring:
- .1 conduit - diameters as sized on drawings with non-metallic fish wires or pull cords and suitable bushings for conduit terminations, and as specified in Part 2; provide labelling at each end to clearly identify each conduit run with respect to system and path;
 - .2 outlet boxes - standard galvanized steel, each complete with a blank type faceplate, and as specified in Part 2;
 - .3 pull boxes, junction boxes, back boxes and sleeves - and as specified in Part 2.
- .2 Miscellaneous systems are typically as shown on drawings. Unless otherwise noted on drawings, provide dedicated conduit runs for each system. Coordinate sizes of boxes with respective system vendors to ensure proper sizing to accommodate components and that allows for wiring bending radii. Confirm conduit and box requirements also with system vendors.
- .3 Provide pullboxes in conduit runs longer than 30 m (100') or having more than two -90 bends. Size pullboxes to be at least 8 times entering conduit in length. Pullbox sizes to comply with respective system standards.
- .4 Leave conduits free and clear of all obstructions and terminate as required. Equip terminations with bushing, and clearly identify each run. Provide fish wires in all empty conduits. Run telecommunications conduits to comply with separation from sources of electromagnetic radiation as per standard ANSI/TIA/EIA-569. Site bend telecommunications conduit elbows to comply with system conduit bending radii requirements.
- .5 Confirm exact requirements and locations of equipment with Consultant and respective system installers prior to roughing-in.
- .6 Refer to system riser diagrams on drawings.
- .7 Quantities for outlets to be as per floor plan drawings and not riser diagrams.

3.28

DOOR HARDWARE

- .1 Generally, Division 08 or another Division not under scope of Electrical Contractor, is responsible for supply and installation of door alarm contacts, door holders, electric strikes, electromagnetic locks, door operator controls, power supplies, door controllers, central electromagnetic lock release controller and other door hardware. Coordinate and confirm with General Trades Contractor and respective equipment vendors (door hardware / security) exact responsibility of each Division of the Work. Refer to electrical and door hardware scope matrix.
- .2 Confirm product and wiring requirements, back box requirements and wiring installation requirements with door hardware trades and with equipment vendors. Provide required wiring in conduit from each device to respective controllers, between each device, and to central control panel and for power connection to such controls and devices. Provide line level voltage power feeds to equipment as required.
- .3 For controls and interconnections between devices, when such device terminations are responsibility of others, supply and run interconnecting wiring in conduit to devices and allow spare length of 1.8 m (6') coiled wiring at each end for final termination to devices by others.
- .4 For applications of electro- magnetically held closed doors, engage fire alarm system vendor to provide fire alarm type pull station with auxiliary contacts as required for interconnection of electro- magnetic door hardware and fire alarm system for release of doors. Provide required wiring in conduit and connections. Coordinate pull station requirements with fire alarm system vendor.
- .5 Exact type of door alarm contacts to be coordinated with door construction and finishes. Contacts to generally be recessed mounted and wiring be installed in concealed conduits. Confirm exact requirements with door hardware / security vendor and General Trades Contractor.
- .6 Where controls are located remotely from door locations, such as in closets, provide wiring in conduit and extend from local above door junction boxes and devices as required with homeruns back to closet location of equipment and leave slack wiring for terminations by others. Confirm exact requirements with door hardware / security vendor and General Trades Contractor.
- .7 Drawing details issued with electrical drawings are for pricing reference only and are based on assumptions. Obtain detailed design drawings from successful door hardware / security vendors and provide wiring in conduit to coordinate with and accommodate final systems designs. Coordinate with General Contractor.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

- .1 Unless noted otherwise, comply with latest edition, including Amendments, of the following Codes and Standards.
- .2 Ontario Electrical Safety Code (OESC).
- .3 Ontario Building Code (OBC)
- .4 CSA-C22.2 No. 0.3, Test Methods for Electrical Wires and Cables.
- .5 CSA-C22.2 No. 48, Nonmetallic Sheathed Cable.
- .6 CSA-C22.2 No. 51, Armoured Cables.
- .7 CSA-C22.2 No. 52, Underground secondary and service-entrance cables.
- .8 CSA-C22.2 No. 65, Wire Connectors.
- .9 CSA-C22.2 No. 75, Thermoplastic-Insulated Wires and Cables.
- .10 CSA-C22.2 No. 123, Metal Sheathed Cables.
- .11 CSA-C22.2 No. 124, Mineral Insulated Cable; To ULC S139 600V and hose stream; UL 2196; Mineral Insulated Cables.
- .12 CSA-C22.2 No. 131, Type TECK 90 Cable.
- .13 CSA-C22.2 No. 208, Fire Alarm and Signal Cable.

2 PRODUCTS

2.1 GENERAL LOW VOLTAGE POWER CABLES

- .1 CSA approved, ULC labelled and certified. Unless otherwise noted, conductors to be copper in general and be suitable for applications as noted in governing local electrical code.
- .2 Subject to discussion with the construction management team, aluminium alloy conductors are acceptable for feeders of amperage rating 200A above except for life safety emergency feeders. Copper conductors shall be used for service feeders feeding switchboard. Install aluminium alloy conductors with hardware and connected in accordance with conductor manufacturer's instructions and as per requirements of local governing electrical code. Resize conductors and conduits from copper-based sizing as required, maintaining ampacity ratings noted, in compliance with local governing electrical code.
- .3 "RW90" CSA certified, single copper conductor to CSA C22.2 No. 38, 600/1000 volts, maximum 90°C (194°F) conductor temperature, -40°C (-40°F) minimum installation temperature, X-link polyethylene (XLPE) insulation, colour coded.

- .4 "T90 Nylon", CSA certified, single copper conductor to CSA C22.2 No. 75, 600 volts, maximum 90°C (194°F) dry conductor temperature, -10°C (-14°F) minimum installation temperature, PVC insulated, nylon covered.
- .5 "TWU" single copper conductor to CSA C22.2 No. 75, 600 volts, maximum 60°C (140°F) conductor temperature, -40°C (-40°F) minimum installation temperature, PVC insulated suitable for wet and buried installations, colour coded.
- .6 "RWU90" CSA certified, single copper conductor to CSA C22.2 No. 38, 1000 volts, maximum 90°C (194°F) conductor temperature, -40°C (-40°F) minimum installation temperature, extra thickness X-link polyethylene (XLPE) insulation suitable for wet and buried installations, colour coded.
- .7 "AC90" flexible armoured cable with "RW90" conductors and bare copper ground conductor and overall interlocked aluminium tape armour, to CSA C22.2 No. 51 (R2004).
- .8 "AC90 ISO-BX" flexible armoured cable with "RW90" conductors with low temperature Exelene insulation and two additional solid copper bonding conductors (one bare, one insulated) and overall interlocked aluminium tape armour, to CSA C22.2 No. 51(R2004).

2.2 **CONNECTORS**

- .1 Armoured cable connectors must be proper squeeze type connectors and plastic anti-short bushings at terminations.
- .2 Connectors for conductors connecting to devices as per local governing electrical requirements, CSA certified, 600 volts, rated pressure type connectors.
- .3 For conductors sized 3/0 and greater, provide long barrel double crimp, 2 hole compression type lug connectors, unless otherwise noted.

2.3 **FIRE RATED CABLES**

- .1 CSA certified, ULC listed and labelled, FM Specifications tested, 600 V, type "MI", 2 hour fire rated, copper sheathed, copper conductor, highly compressed magnesium oxide mineral insulated power cable. Connectors for copper-sheathed mineral conductors to be cable manufacturer's proper connectors and accessories as recommended by manufacturer to suit specific applications.
- .2 CSA certified as FAS, FAS 90 and FAS 105 cable, ULC listed and labelled, 300 V, type "MI", 2 hour fire rated, copper sheathed, copper conductor, highly compressed magnesium oxide mineral insulated fire alarm and voice communication cable. Connectors for copper-sheathed mineral conductors to be cable manufacturer's proper connectors and accessories as recommended by manufacturer to suit specific applications.
- .3 Manufacturer's termination kits: connectors for MI conductors to be cable manufacturer's proper connectors and accessories as recommended by the manufacturer to suit specific applications.
- .4 Cable clips and straps as recommended by cable manufacturer to suit specific installation application. In applications of dissimilar materials, provide tape to insulate cabling and hardware.
- .5 Brass plates for cable openings in ferrous metal enclosures.
- .6 Include for required cable manufacturer's accessories and identification labelling.

- .7 Include for manufacturer's authorized technician to be present on site for initial coordination with installing personnel on review of proper installation of cabling runs and termination of cabling. After completion of Work, manufacturer's technician to review installation work and provide in writing that installation work has been performed to satisfaction of cable manufacturer.
- .8 Acceptable manufacturer of fire rated MI type cables is Pentair Thermal Management or approved equivalent.

2.4 **STANDARD CONTROL AND COMMUNICATIONS CABLES**

- .1 ULC listed and labelled, CSA certified to C22.2 No. 127, No. 18 AWG "TEW" thermoplastic insulated, solid copper wire rated for 600 volts service, and 105°C (220°F) conductor temperature, complete with required number of copper conductors and colour coding.
- .2 FAS 105, 300 volts, 105°C (220°F) conductor temperature rated fire alarm system flexible armoured cable with solid copper conductor, shielding, flame retardant PVC insulation and red colour outer overall jacket, ULC listed and labelled and CSA certified to C22.2 No. 208.

2.5 **LOW VOLTAGE TECK CABLES**

- .1 Provide cables as follows:
 - .1 certified to CAN/CSA C22.2 No.131, Type TECK 90 Cable;
 - .2 rated for outdoor, weather resistant and wet locations applications;
 - .3 600/1000 V rated;
 - .4 Conductor: Bare, Soft drawn, Class B Compact or Compressed Stranded Copper conductors per ASTM;
 - .5 insulation: chemically cross linked thermosetting polyethylene (XLPE);
 - .6 bonding conductor (1/C Cable): Soft drawn bare copper;
 - .7 inner jacket: sunlight resistant PVC jacket tightly applied over assembly, to prevent slipping of core in a vertical position;
 - .8 armour: flexible interlocked aluminum armour, over inner jacket for mechanical protection;
 - .9 overall PVC jacket rated -40°C (-40°F).
 - .10 barrier tape over shield.
- .2 Acceptable manufacturers are:
 - .1 Nexans;
 - .2 Prysmian Cables (Pirelli);
 - .3 General Cable;
 - .4 Aetna Cables;
 - .5 Kerite Company.

3 **EXECUTION**

3.1 PROJECT CONDITIONS

- .1 If identified in documents, verify that field measurements and conditions are as identified.
- .2 Cable routing on drawings is schematic and approximate. Route cable as required to meet project conditions. Determine exact routing and lengths on site.
- .3 Confirm fire protection ratings of construction to ensure that rooms and paths of conductors are fire rated in accordance with local governing codes requirements. Include fire rated conductors as required to meet local governing codes requirements.

3.2 CO-ORDINATION

- .1 Co-ordinate work with work provided under other electrical work and work of other trades.
- .2 Determine required separation between cable and other work.
- .3 Determine cable routing to avoid interference with other work.
- .4 Submit any alternative cable routing to Consultant for review prior to proceeding with work.

3.3 INSTALLATION OF CONDUCTORS

- .1 Provide required conductors. Ensure fire rated conductors are provided for applications as required by local governing codes, standards and local governing authorities.
- .2 In applications where multiple conductors in conduit are being run, provide a trapeze configuration of metal C-channels and threaded rod hangers to support cable/conduit from ceiling slab. Wall mounted cable/conduit brackets and ring type conduit hangers may also be permitted in applications approved by Consultant. Provide required cable support system accessories which are not specified herein or shown on drawings but are required for proper installation.
- .3 Conductors, unless otherwise noted, to be as follows:
 - .1 underground inside or outside building and for non-climate controlled areas - "TWU" or "RWU90";
 - .2 for connections to electric heating coils in supply air ductwork systems, and for connections to other electric heating equipment where use of 90 degrees C. rated conductors are recommended by heating equipment manufacturer - "RW90";
 - .3 for conductors requiring fire rating by current regulations and local codes including feeders for emergency systems, fire fighter's elevators, fire alarm systems, other life safety systems and for applicable signal and control circuits of these systems - type "MI" CSA approved, ULC listed and labelled, 2 hour fire rated, copper sheathed mineral insulated copper conductors;
 - .4 climate controlled areas branch circuit wiring in accessible ceiling spaces and within stud wall construction consisting of drops down to luminaires and drops down stud walls to devices and in furniture systems - "AC90" flexible armoured cable ("BX") (maximum 6m (20') run permitted);
 - .5 for climate controlled areas wiring except as noted above or specified elsewhere in Specification or as noted on drawings - "T90 Nylon" or "RW90".

- .4 Support flexible armoured cable in ceiling spaces and in stud wall construction with steel 2 hole cable straps to "Code" requirements. Flexible armoured cables must run in a neat manner parallel to building lines. Utilize centralized conduit runs to maintain maximum permitted runs of flexible armoured cables as specified. Provide insulating grommet at cut ends of flexible armoured cable to protect conductor insulation.
- .5 Low voltage conductors to typically be No. 18 AWG "TEW" except for use in fire alarm system applications, unless otherwise noted. Provide specified fire alarm cables for fire alarm system applications or security system applications as approved by Code and local governing authorities. Conductors not installed in conduit or raceways to be fire insulated rated in accordance with latest governing Code Flame Spread requirements.
- .6 Generally, conductor sizes are indicated on drawings. Such sizes are minimum requirements and must be increased, where required, to suit length of run and voltage drop in accordance with applicable conductor voltage drop schedule appended to end of this Section.
- .7 Do not use conductors smaller than No. 12 AWG in systems over 30 volts, unless otherwise noted. Do not use conductors smaller than No. 6 AWG for exterior luminaire wiring unless otherwise noted.
- .8 Colour code conductors throughout to identify phases, neutrals and ground by means of self-laminating coloured tape, coloured conductor insulation, or properly secured coloured plastic discs. Colours, unless otherwise noted, to be as follows:
 - .1 Phase A - red;
 - .2 Phase B - black;
 - .3 Phase C - blue;
 - .4 Ground - green;
 - .5 Neutral - white;
 - .6 Control - orange.
- .9 When pulling wires into conduit use lubricant and ensure that wires are kept straight and are not twisted or abraided.
- .10 Control conductors, in addition, to be numbered.
- .11 Colour code conductors for communications systems in accordance with system component manufacturer's recommendations.
- .12 Neatly secure exposed wire in apparatus enclosures with approved supports or ties.
- .13 Install low voltage conductors in conduits, unless otherwise noted within Documents.
- .14 Comply with local electrical code requirements and conductor manufacturer's recommendations when terminating and connecting aluminium conductors.

3.4 **INSTALLATION OF FIRE RATED CONDUCTORS**

- .1 Submit with shop drawings, copy of manufacturer's detailed installation manual and testing procedures. Provide minimum 2 hour fire rated type "MI" CSA approved, ULC listed and labelled, mineral insulated copper conductors for following:
 - .1 emergency feeders from generators to transfer switches;

-
- .2 feeders to firefighters' elevators;
 - .3 feeders to fire pumps and sprinkler pumps;
 - .4 feeders to smoke venting fans;
 - .5 feeders to emergency lighting panel boards;
 - .6 feeders to fire alarm control panels and transponders;
 - .7 fire alarm risers;
 - .8 feeders as required by Code requirements;
 - .9 applicable local governing code required applications for control and signalling conductor circuits of and between life safety equipment and systems;
 - .10 feeders and conductors as noted on drawings.
- .2 Provide fire rated type "MI" conductors for specific feeders as required and as noted. Install type "MI" copper sheathed, mineral insulated conductors for applications noted above and as shown on drawings in strict accordance with the manufacturer's instructions and recommendations. Installation must be in a neat and professional manner as per manufacturer's approval. Make arrangements for manufacturer's technician to provide onsite services as specified.
 - .3 Provide Unistrut C-channels, clips, wall brackets, etc., as required and as recommended by cable manufacturer to suit the on-site installation conditions. Provide system of Unistrut hangers and rods spaced at minimum 1.2 m (4') but which must be confirmed with cable manufacturer, for running of cables. Where clips and other hardware are in contact with cables, insulate cables/hardware with suitable tape as per cable manufacturer's recommendations for applications of dissimilar metals.
 - .4 Make terminations of "MI" conductors with manufacturer's approved components and in accordance with the manufacturer's recommendations. Obtain proper tools for cable terminals from the cable manufacturer. Terminations must be completed immediately once started to avoid moisture ingress from the surrounding air. Connections to ferrous cabinets for single conductor cables shall incorporate brass plates sized as required and as per cable manufacturer's requirements. Brass plates shall be complete with required drilled and tapped holes. For 99°C applications, cable lugs shall be temperature rated as such.
 - .5 When pulling cable, apply pulling tension to the conductor not in the sheath of the cable. Limit cable pulling tension to as recommended by cable manufacturer.
 - .6 Terminate cable in the equipment with termination kits as per cable manufacturer's instructions.
 - .7 Ground cabling as per cable manufacturer's instructions and as per local governing electrical code requirements.
 - .8 Take necessary precautions when handling cable on reel to ensure that no damage will result in the uncoiling process.
 - .9 Where cables penetrates fire rated construction, provide ULC listed and labelled, fire stopping and smoke seal materials or fittings to protect integrity of fire rated construction. Install work in compliance with ULC standards and where required by local governing codes, provide tray type suitable for plenum environments.

- .10 Test MI cables after installation, in strict accordance with cable manufacturer's instructions. Megger terminations to check that insulation resistance is acceptable to cable manufacturer. Prior to completing each termination, test insulation resistance and follow cable manufacturer's drying procedures until resistance reaches cable manufacturer's listed acceptable level.

3.5 INSTALLATION OF TECK CABLES

- .1 Provide cables as required for specific applications. Handle, install, and terminate in accordance with manufacturer's recommendations and instructions and as herein specified.
- .2 When pulling cable, apply pulling tension to conductor not in sheath of cable. Limit cable pulling tension to as recommended by cable manufacturer.
- .3 Terminate cable in equipment with lugs and termination kits as per cable manufacturer's instructions.
- .4 Installation of cable splices and terminations to be made by personnel skilled in this type of work.
- .5 Ground shielding as per cable manufacturer's instructions.
- .6 Take necessary precautions when handling cable on reel to ensure that no damage will result in uncoiling process.
- .7 No splices are allowed unless justified by cable pulling tension calculations and approved in writing by Consultant. Obtain approval of splice location from Consultant.

END OF SECTION

APPENDIX – VOLTAGE DROP SCHEDULES

MAXIMUM BRANCH WIRING DISTANCE FOR 120 VOLT SYSTEM AT 3% VOLTAGE DROP

WIRE SIZE	BREAKER SIZE (AMPERES)	15	20	30	40	50	60	70	80	100
	MAX LOAD AT 80% (AMPERES)	12	16	24	32	40	48	56	68	80
No. 12	-	24.4	18.3	-	-	-	-	-	-	-
No. 10	-	38.1	29.0	19.1	-	-	-	-	-	-
No. 8	-	59.4	44.2	30.5	22.9	-	-	-	-	-
No. 6	-	91.4	70.1	47.2	35.1	28.2	23.6	-	-	-
No. 4	-	-	109.7	73.2	54.9	42.7	38.1	32.0	27.4	-
NO. 2	-	-	-	114.3	85.3	68.6	57.9	50.3	41.1	35.0
No. 1	-	-	-	-	103.6	85.3	73.2	61.0	54.9	43.4
No. 1/0	-	-	-	-	128.0	102.9	85.3	73.2	64.0	48.8
No. 2/0	-	-	-	-	-	121.9	100.6	86.9	74.7	60.9
No. 3/0	-	-	-	-	-	-	118.1	102.1	88.4	70.1
No. 4/0	-	-	-	-	-	-	-	120.4	102.9	83.8
250 MCM	-	-	-	-	-	-	-	-	114.3	91.4
300 MCM	-	-	-	-	-	-	-	-	-	103.6

Note: Distances indicated in metres from panel to load for single phase.

END OF APPENDIX

PART 1 – GENERAL

1.1 Submittals

- .1 Submit shop drawings for products and accessories.

PART 2 – PRODUCTS

2.1 Basic Materials

- .1 Ground Rods: Copper-clad steel, 20 mm (3/4") diameter circular cross-sectionalized, with driving cap and bronze tip, overall length of 3 m (10') long.
- .2 Ground Conductors: Solid copper, insulated and bare to suit application and code requirements; and bond conductors.
- .3 Ground Busbar: Solid copper busbar, predrilled for two-hole lug connections, of size of 50 mm x 9 mm x 900 mm (2" x 3/8" x 36"), for wall and backboard mounting using standoff insulators.

2.2 Telecommunications

- .1 Telecommunications Equipment Rack And Cabinet Ground Bars: solid copper ground bars designed for mounting on framework of open or cabinet-enclosed equipment racks with minimum dimensions of 6 mm (1/4") thick by 20 mm (3/4") wide; At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks. Where bolting to painted surfaces, use paint piercing type washers.
- .2 LAN Room Ground Bus: 50 mm x 9 mm x 300 mm (2" x 3/8" x 12") copper ground bus with eight (8) drilled taped holes; mounted on walls with standoff insulators.
- .3 Ground Conductor for Grounding Grid and Associated Connections: Number 3/0 AWG bare, 7-strand medium hard-drawn copper unless indicated otherwise.
- .4 Ground Braid: constructed from flat 98% conductivity tinned copper grounding braid.

PART 3 – EXECUTION

3.1 General Grounding and Bonding Requirements

- .1 Provide required grounding and bonding work in accordance with drawings, local governing electrical authority, governing authorities having jurisdiction and local governing electrical inspection authority. Provide local governing electrical utility's grounding requirements for stations, vaults and electrical rooms, as applicable. Confirm requirements with local governing electrical utility.
- .2 Within designated electrical room, provide a ground electrode consisting of minimum four (4) ground rods (unless otherwise detailed or otherwise required by local governing electrical code) driven into grade in an arrangement as required and interconnected with minimum No. 3/0 bare copper conductor. Drive and bury ground rods at depth in accordance with local governing electrical code.
- .3 Provide 50 mm x 9 mm (2" x 3/8") continuous length, copper ground bus around perimeter of electrical rooms, 300 mm (12") above finished floor level. Secure ground bus on 20 mm (3/4")

standoff insulators and follow outline of doorframes at door openings to form a continuous bus. At each door to electrical rooms, provide two (2) independent flexible braided copper ground straps, one (1) bolted to door frame, one (1) bolted to door, each connected to ground bus.

- .4 Connect ground electrode to perimeter ground bus with two (2) minimum No. 3/0 copper conductor connected with approved fittings. Connect each electrical room perimeter ground electrode system back to main electrical room ground electrode with two (2) minimum No. 3/0 copper conductors.
- .5 Do not use conduit systems as ground conductors in patient care areas or in areas as per local governing electrical code requirements.
- .6 Extend grounding from ground bus in isolated power units to ground busses within panelboard serving area. From ground bus extend ground conductors in PVC conduit which is located in a concealed space in a wall or in a concrete floor slab and connect to building grounding station as close as practical to station.
- .7 Confirm exact method of executing grounding for isolated ground system with governing authorities. Generally, method to comply with CSA Standard Z32 and NFPA No. 56. Testing of grounding of isolated ground system to be performed by independent test company specified for "Distribution System Testing And Coordination Study" work.

3.2 Additional Telecommunications Grounding

- .1 Comply with TIA/EIA-607 grounding and bonding requirements.
- .2 Provide wire and hardware required to properly ground, bond, and connect communications raceway, cable tray, metallic cable shields, and equipment to a ground source.
- .3 Ground bonding jumpers to be continuous with no splices. Use shortest length of bonding jumper possible.
- .4 Provide ground paths which are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to building grounding electrode. Resistance across individual bonding connections to be 10 milliohms or less.
- .5 Bonding Jumpers:
 - .1 Use insulated ground wire of size and type if identified on Drawings if not identified, comply with local governing code, but which is to be a minimum of No. 6-AWG insulated copper wire.
 - .2 Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
 - .3 Use compression connectors of proper size for conductors specified. Use connector manufacturer's compression tool.
- .6 Bonding Jumper Fasteners:
 - .1 Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten plain end of a bonding jumper wire by slipping this plain end under conduit strut clamp pad; tighten clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.

- .2 Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover; e.g., zinc-plated acorn nuts, on any bolts extending into wireway or cable tray to prevent cable damage.
- .3 Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.
- .4 Unistrut and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.
- .7 Telecommunications Ground Busbars:
 - .1 Provide communications room telecommunications ground busbar hardware at cable tray height.
 - .2 Connect busbar to building ground busbar located in same room using two-hole compression lugs and a grounding jumper of same size as pigtail extension of main building grounding ring (usually 3/0 AWG).
- .8 Ground metallic conduits, wireways, and other metallic equipment located away from equipment racks or cabinets to cable tray pan or telecommunications ground busbar, whichever is closer, using insulated No. 6-AWG ground wire bonding jumpers.
- .9 Ground metallic conduit at each end using No. 6-AWG bonding jumpers.
- .10 Comply with cable tray manufacturer's grounding and bonding recommendations. Bond metallic structures of wireway to provide 100% electrical continuity throughout wireway system.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 Submit shop drawings for following:
 - .1 cable tray with copy of ULC certificate;
- .2 Submit detail drawings of proposed routing and dimensions.
- .3 Submit sample of trays.

2 PRODUCTS

2.01 BASKET CABLE TRAY

- .1 Legrand-Cablofil, CSA approved and labelled, basket type cable tray system complete with factory made couplers, fittings, tee sections, elbows, universal dropouts, etc., and required supporting and installation accessories. Features include but are not limited to following:
 - .1 minimum 300 mm x 100 mm (12" x 4") unless otherwise noted on drawings;
 - .2 welded wire construction of minimum 5 mm (0.197") diameter carbon steel wires and hardware, conforming to requirements of ASTM A510 Grade 1008 with black powder coated finish paint to ASTM D 3451;
- .2 Prior to start of work, prepare and submit detailed installation drawings, including plans, elevations and sections of proposed tray and routing. Coordinate such drawings with coordination drawings of trades. Include for design calculations to determine load limitations.
- .3 Tray to not have sharp edges that may damage cables during running of cables. Final finish to be smooth with no burrs that may damage cables.
- .4 Use manufacturer's trained and certified installers to perform work. Use tools as recommended by and supplied by tray manufacturer. Utilize manufacturer's supplied cutter for cutting tray. Submit with shop drawings, copies of installing technicians' certificates of training on respective tray systems.
- .5 Where cable tray penetrates fire rated construction, provide ULC listed and labelled, fire stopping and smoke seal materials or fittings to protect integrity of fire rated construction. Install work in compliance with ULC standards and where required by local governing codes, provide suitable for plenum environments.
- .6 Provide tray complete with grounding/bonding provisions, fittings, tee sections, elbows, universal dropouts, expansion fittings, etc., and required supporting and installation accessories. Provide dividers to separate various system cabling to a degree confirmed by Consultant, but typically two (2) dividers in a 300 mm (12") wide tray. Provide conduit fittings where conduits enter tray and provide dropouts at ends where cables exit/enter. Supply cable installation rollers for pulling cables safely into tray. System accessories to be supplied by system manufacturer and be as recommended by system manufacturer for specific applications.

.7 Acceptable manufacturers are:

- .1 Legrand-Cablofil;
- .2 Cooper "Flextray";
- .3 Eaton B-Line;
- .4 Canadian Electrical Raceways;
- .5 Hubbell;
- .6 WBT.

3 EXECUTION

3.01 INSTALLATION OF CABLE TRAY

- .1 Provide sample of tray and detailed drawing layout of work prior to start of work, accurately dimensioned and showing required routing, penetrations, connections, bends, supports, etc.
- .2 Obtain required training from manufacturer's representative on any special installation procedures. Install tray in accordance with manufacturer's instructions to suit specific installation requirements. Use manufacturer's recommended tools for cutting and installing tray.
- .3 Drawings are diagrammatic and do not identify required changes in elevations and architectural features. Site measure exact routing and lengths. Provide detailed drawing layout of work prior to start of work, accurately dimensioned and showing required penetrations, connections, bends, etc.
- .4 Install and hang cable tray at maximum 1.5 m (5') centres and in accordance with manufacturer's published literature employing horizontal bracket supported to ceiling slab by vertical threaded rod hangers. Do not secure assembly from ductwork, suspended ceiling structures, lighting, etc. Secure rod hangers directly to ceiling slab. Locate supports as not to interfere with removal or opening of covers. Typically locate spans at intervals $\frac{1}{4}$ span from supports, as recommended by tray manufacturer. Refer to drawing details and/or manufacturer's instructions. Include for provision of required seismic restraints as to comply with local governing building code requirements.
- .5 Provide proper fittings in cable tray at points of conduit entry. Terminate conduits at or in tray with proper grommetted and bushed terminations.
- .6 Equip tray with necessary wall flanges, dropouts, enclosures, reducers, fittings, and similar accessories required, maintaining effective free cross-sectional area of tray clear of obstructions that might damage conductor insulation during installation.
- .7 Properly secure, adequately support and neatly harness conductors in tray. Seal cable tray penetrations of building fire barriers by means of ULC listed and labelled fire stopping and smoke sealing material.

- .8 Provide continuous paths along entire lengths of cable tray to maintain proper ground continuity. Utilize system manufacturer's proper grounding and bonding fittings and hardware. Ground and bond system as per local governing electrical code requirements.
- .9 File smooth cuts to tray and re-touch with galvanizing compound.
- .10 Install expansion connectors where cable tray crosses building expansion joints.
- .11 After installation is complete, install warning signs on tray in visible locations.
- .12 Inspect tray for rough finishing burrs, sharp edges, and mechanical deficiencies prior to installing of cabling. Eliminate these deficiencies to satisfaction of Consultant, prior to installing cables.

END OF SECTION

PART 1 – GENERAL

1.1 Submittals

- .1 Submit shop drawings for products and accessories.

1.2 General requirements

- .1 Conform to Section 26 01 01, Electrical General Requirements.
- .2 Conform to Section 26 05 01, Electrical Basic Materials and Methods.
- .3 Conform to UHN Design and Construction Guidelines.

1.3 Scope

- .1 Provide identification and warning signs for complete electrical systems as shown, as specified, as intended, and as otherwise required.

1.4 Shop Drawings

- .1 Submit list of nameplates with proposed wording, prior to engraving.
- .2 Submit list of labels with proposed wording, prior to printing.
- .3 Submit representative samples of nameplates, labels and warning signs.

PART 2- PRODUCTS

1.1 Warning Signs

- .1 As required to meet requirements of Electrical Safety Authority.
- .2 Outdoor signs:
 - .1 fibreglass,
 - .2 minimum size 250 mm x 360 mm (10" x 14").
- .3 Indoor signs;
 - .1 fiberglass
 - .2 baked enamel finish,
 - .3 minimum size 180 mm x 250 mm (7" x 10").
 - 1. Acceptance: Brady and Seton

1.2 Equipment Identification

- .1 Nameplates for panels and equipment:

- .1 3 mm (1/8") thick laminated plastic plates,
- .2 engraved lettering,
 - 1. first line: 11 mm (7/16") high lettering,
 - 2. second line: 7mm (1/4") high lettering,
 - 3. third line: 5mm (3/16") high lettering,
- .3 colour coded as per codes and standards and to be confirmed with UHN,
- .4 with bevelled edges,
- .5 mechanically attached with self-tapping stainless steel screws.
- .2 Labels for warnings, instructions etc on panels and equipment:
 - .1 printed on white polyester background,
 - .2 7 mm (1/4") high letters unless specified otherwise,
 - .3 UV resistant inks,
 - .4 clear polyester over lamination,
 - .5 pressure sensitive adhesive.
 - .6 Accepted:
 - 1. Brady
 - 2. Ideal Industries
 - 3. Safety Sign
 - .7 Do not commence manufacture of nameplates and labels until wording has been reviewed by the Consultant and approved by the Hospital.

1.3 Wiring Identification

- .1 Colour coded phasing tapes:
 - .1 7 mil poly vinyl chloride,
 - .2 pressure sensitive adhesive,
 - .3 compatible with wire insulation,
 - .4 permanent colour,
 - .5 electrically insulating,
 - .6 UV and moisture resistant,
 - .7 to CSA C22.2 No. 197

- .8 Accepted:
 - 1. 3M Scotch 35
 - 2. Electro Tape Specialties 103/103C Series
- .2 Wire markers:
 - .1 heat shrink, military grade polyolefin sleeves with permanent printed wire identification.
 - .2 adhesive, self laminating, white vinyl print area, with permanent thermal transfer printing.
- .3 Accepted:
 - 1. Brady
 - 2. Panduit

PART 3- EXECUTION

1.4 Equipment Identification

- .1 Identify electrical equipment with nameplates, directories and labels.
- .2 Nameplates:
 - .1 secure to top exterior of equipment except where indicated otherwise,
 - .2 switchboards: indicate name, voltage and ampacity, source
 - .3 rear of switchboard cubicles or cells: indicate name of cell or cubicle,
 - .4 panelboards: indicate name, voltage and source of power, source, fused ampacity
 - .5 terminal cabinets: indicate name, system and voltage,
 - .6 circuit breakers with fixed trip units: indicate load supplied, voltage and maximum allowable ampere rating of the breaker,
 - .7 circuit breakers with replaceable trip units: indicate load supplied, voltage and maximum allowable ampere rating of the trip unit,
 - .8 circuit breakers with adjustable trip units: indicate load supplied, voltage and maximum allowable ampere setting of the long time pick up,
 - .9 disconnects: indicate load supplied, voltage, type of fuses and maximum allowable ampere rating of fuses, source and location(room number)
 - .10 starters: indicate equipment being controlled, voltage and maximum allowable setting of the overload device, source
 - .11 contactors: indicate equipment being controlled and voltage, source
 - .12 transformers: indicate name, capacity, primary and secondary voltages, source
 - .13 pull boxes and junction boxes: indicate system, circuit numbers and voltage, panel

source

- .14 cabinets for low voltage systems, such as signals and communications: indicate name and system, source of primary
- .15 equipment not listed above, such as, instruments, fire alarm, clock and program equipment and control panels: identify in a similar manner showing name and number of the equipment, voltage and load information.
- .16 typical identification standards:

- 1. Lighting, Receptacle and Power Panels: each identified with an engraved lamicon nameplate secured to top interior trim as follows:

LP-4NW-1EA	11 mm (7/16") high lettering
120/208 volts	7 mm (1/4") high lettering
Fused Ampacity	7 mm (1/4") high lettering
Fed from PP-SBSW-EAA	5 mm (3/16") high lettering

.3 Directories:

- .1 Supply each panelboard with a directory card holder welded to inside of door, complete with a neatly typewritten list showing information as follows:

Panelboard Name LP-4NW-1EA		
Panel Voltage 120/208 Volts		
Circuit Number	Description	Maximum Allowable Rating
1	Lighting Room #34	20 Amps
2	Receptacles Room #34	15 Amps
3	Ice Machine Room #17	30 Amps
4/6	Split Receptacle Room #26	20 Amps
5/7/9	Sub Feed to Receptacle Panel RP-4NW-1EA	60 Amps

- .2 Cabinets for low voltage systems, such as signals and communications: as for panelboards with a directory showing circuit numbers and room locations plus a blank column for "Remarks".
- .3 Cover directory list with a 0.8mm (1/32") minimum thick clear plastic sheet to protect it.
- .4 Warning Labels:

- .1 circuit breakers where the allowable maximum continuous load is less than the breaker rating or the breaker is not marked with a continuous load rating: provide a label stating:
- .2 Caution: maximum continuous load not to exceed XXX Amperes.
- .3 disconnects where the allowable maximum continuous load is less than the switch rating or the switch is not marked with a continuous load rating: provide a label stating:
- .4 Caution: maximum continuous load not to exceed XXX Amperes.
- .5 Pull Boxes and Junction Boxes
 - .1 Identify feeder pull boxes and junction boxes:
 1. lettering stamped on lamacoid
 2. showing the name of the feeder or system,
 3. voltage involved,
 4. data for both termination points whether equipment or panel,
 5. secure tag under box lid screws using steel wire.

1.5 Service Rough-in Identification

- .1 Apply a small dab of paint to inside of each outlet box, pull box and panel as it is installed, using colour code as follows: Colour codes shall be confirmed with UHN prior to ordering and installation.

Red	Fire Alarm System and Emergency Voice Communication System
Dark Blue	Building Automation System
Dark Green	Telephone and Data Systems
Black	Annunciator and Buzzer System
Grey	Clock System
White	Central Dictation
Orange	Nurse Call
Yellow	Spare
Pink	Computer Systems
Light Green	TV Systems

- .2 Junction boxes in furred ceilings to have colour identification on both inside and outside.
- .3 As an alternative to applying paint dabs, prepainted conduit/EMT may be used where applicable.
- .4 Colour coding is not required for lighting and power circuits.

1.6 Wiring Identification

- .1 Identify feeders and branch circuit wiring with wire markers;
 1. at each end of run,
 2. in each junction box,
- .2 wherever they are introduced into ducts or equipment.
- .3 Identify incoming utility service lines by Red - Phase "A", Black - Phase "B", Blue - Phase "C", with colour coded phasing tape.
- .4 Band buswork in each;
 1. switchboard,
 2. unit substation cubicle,
 3. power panel,
 4. lighting and receptacle panel,
 5. with colour coded phasing tape as follows:

Red	Phase A
Black	Phase B
Blue	Phase C
White	Neutral
Green	Ground

- .5 Band feeder and sub-feeder bus and conductors as above.
- .6 Maintain phase sequence and colour coding throughout.
- .7 Connections in equipment to be Phase A, B, C from left to right when viewing from front or accessible direction.
- .8 For control conductors for motors and equipment, schedule and chart marker numbers with corresponding machine numbers and locations and include with Record Drawings and Operation and Maintenance Data.
- .9 Use colour coded wires in communication cables, matched throughout system. Schedule and chart, marker numbers and wire colours with corresponding equipment and include with Record Drawings and Operation and Maintenance Data.

1.7 Conduit and Cable Identification

- .1 Label;
 1. incoming service cables,
 2. bus ducts,

3. feeder conduits/EMT,
4. feeder cables,
5. communications cables.
- .2 Conduit fittings to follow colour code in table 3.2
6. Locate labels as follows:
 1. at every end of every conduit, duct or cable run, adjacent to item of equipment serviced,
 2. on each exposed conduit, duct or cable passing through a wall, partition or floor (one on each side of such wall, partition or floor),
 3. at intervals of not more than 15 m (50') along every exposed conduit, EMT, duct or cable run exceeding 23 m (75') in length,
 4. at every access point on concealed conduit, EMT, duct or cable runs,
 5. visible from 1.5 m (5') above adjacent floor or platform.

1.8 Concealed Services Identification

- .1 For services requiring access, where they are located above an acoustical tile (lay-in) ceiling, provide labels on the main T-Bars, on two sides of the acoustical tile that must be removed in order to gain access.
- .2 Labels:
 1. permanent vinyl,
 2. circular with a diameter equal to the width of the main T-Bar,
 3. orange in colour,
 4. self adhesive,
 5. pressure sensitive adhesive.

1.9 Fire Stopping Identification

- .1 Provide a warning card adjacent to each opening exceeding 25mm (1") in diameter, indicating the following;
 1. a warning that the opening is protected by a fire stopping material,
 2. the fire stop system used, ULC or cUL,
 3. F rating or FT rating,
 4. specific fire stop product(s) used,
 5. name and telephone number of the contact person should any changes to the fire stopping be required.
- .2 Provide warning labels for each fire stopped penetration as follows;

1. permanently attached to walls, floors, underside of slabs, adjacent to the penetration,
2. on each side of the penetration,
3. vinyl panel, white and red background with black lettering,
4. self adhesive with permanent pressure sensitive adhesive,
5. stating:

WARNING
THROUGH PENETRATION FIRESTOP SYSTEM - DO NOT DISTURB
NOTIFY BUILDING MANAGEMENT OF ANY DAMAGE

1.10 Fire Alarm Diagrams

.1 Diagrams:

1. print of an AutoCAD drawing using the latest version of AutoCAD,
2. not less than 600 mm x 600 mm (2' x 2'),
3. in a wood frame,
4. plexiglass covered.

END OF SECTION

PART 1 - GENERAL**1.1 Submittals**

- .1 If formal completion of studies and reports may cause delay in equipment manufacture, approval 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.
- .2 Submit after completion of factory testing, copies of completed product testing reports.
- .3 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.
- .4 Verify form of submittals (submission procedures, number of hard copies and requirements for electronic copies) with Consultant at project start-up. For pricing assume minimum 3 hard coloured copies bound and electronic pdf copy.

PART 2 - PRODUCTS**2.1 General Scope of Work**

- .1 Include for but not be limited to following:
 - .1 product manufacturers providing equipment inspection, testing, start-up, adjustments and verification;
 - .2 independent 3rd party testing of electrical distribution system equipment and associated products;
 - .3 independent 3rd party testing of systems and equipment as noted;
 - .4 electricians/trades people on site to handle equipment, make temporary connections, operate equipment and make repairs and adjustments and assist manufacturer's / testing organization's personnel during on-site inspection, testing, calibration, start-up, verification work and where supplementary commissioning;
 - .5 coordination of work with testing company and equipment/system manufacturer's authorized technician in performing adjustments and start-up procedures to equipment/systems;
 - .6 preparing testing reports and documentation for submission to Consultant.

PART 3 - EXECUTION**3.1 General Electrical Work Testing**

- .1 In addition to tests required by local governing authorities having jurisdiction, local codes and regulations, perform following:

- .1 after luminaires, switches, receptacles, motors, signals, etc., are installed, whether same are installed as part of this Division or by other Divisions (telephone systems excepted), test work to ensure that there are no leaks, grounds or crosses;
 - .2 establish and ensure proper motor rotation - measure full load running currents and check overload elements - report to Consultant any discrepancies which are found; existing motors which have been worked on (disconnected and reconnected) must be checked with rotation meter to ensure proper rotation; be responsible for any damage caused by reverse rotation;
 - .3 demonstrate to Consultant that branch circuit voltage drop is within specified units;
 - .4 ensure that devices are commissioned and operable.
- .2 Document results into distribution system testing report. Report must state that testing was successful and Work complies with project documents, applicable CSA standards, and other applicable governing codes and requirements.

3.2 Systems Inspection, Testing, Start-Up and Verification

- .1 When each system and each major piece of equipment installation is complete and ready for acceptance, include for system and equipment manufacturer or manufacturer's authorized representative to visit site to provide system inspection, testing, start-up, and verification. Perform following:
 - .1 check component connections and overall installation;
 - .2 adjust sound systems for high quality, distortion free performance, free from noise, cross-talk, hum or other interference;
 - .3 test and adjust system and ascertain that components are as specified and ensure that products operate as designed;
 - .4 provide start-up procedures for systems and equipment;
 - .5 verify and certify system component operations;
 - .6 prepare, document and evaluate test results;
 - .7 authenticate test results with signature of authorized testing Engineer/Technician;
 - .8 check and verify nameplates;
 - .9 provide maintenance and operating instructions to Owner's personnel.
- .2 When each system and each major piece of equipment installation is complete and ready for acceptance
- .3 Perform work properly documented, and in accordance with manufacturer's instructions and recommendations.
- .4 Perform work under presence of Owner/Consultant/Commissioning Agent at times approved by Owner and reviewed with Consultant.

3.3 Electrical Distribution System Testing and Verification

- .1 Provide services consisting of on-site engineering inspection, testing and verification of electrical distribution equipment and other systems and equipment. Perform work to

standards of applicable local governing authorities, CSA Z32, local electrical inspection authority and CSA Standards.

- .2 Services to be performed by an approved independent testing company and be initially conducted prior to system/equipment being energized and further testing when energized, and include following items, where applicable:
 - .1 testing, cleaning when necessary, and calibrating relays and circuit breaker trip devices (calibration of protective devices to conform to requirements of approved coordination curves);
 - .2 function test of associated control devices;
 - .3 replacement of fuses destroyed during testing;
 - .4 an acceptance test in presence of Consultant;
 - .5 presence, for length of time required, of qualified and competent equipment manufacturer's service representative during start-up;
 - .6 carry out insulation resistance testing of outgoing feeders with respect to ground;
 - .7 inspection and testing of cables, bus duct, power panels, lighting panels, transformers, power receptacles and switches;
 - .8 inspection and testing of electrical system auxiliary systems
 - .9 inspection and testing of electrical devices and communication system components installed in service consoles, headwalls, furniture systems, etc., whether or not devices are supplied by Electrical Divisions;
 - .10 inspection and testing of motor control centres, starters and variable frequency drives;
 - .11 inspection and testing of lighting control systems including central control systems, low voltage relays, sensors and dimming controls; ensure that devices perform in conformance with ASHRAE 90.1 requirements;
 - .12 verification and certification work of equipment and systems;
- .3 Perform services procedures properly documented, and in accordance with manufacturer's instructions and recommendations.
- .4 Forward to Consultant for review, minimum 3 hard copies and electronic file of engineering and testing report.
- .5 Where relays, breakers, etc., do not perform to Consultant reviewed coordination curves, revise as part of work.
- .6 Adjust and calibrate existing trip units, relays, breakers, etc., which do not perform to approved coordination curves. Where defective or incorrectly applied relays or breakers are found in existing distribution system, identify problem areas clearly on curves of test report and provide recommended course of remedial action. Where replacement of existing devices not identified in Documents to be replaced is necessary to provide coordination, submit estimate of costs to Consultant for review. Where directed by Owner, perform work at additional cost to Contract amount. Clearly show on coordination curves in report and clearly identify recommended remedial course of action.
- .7 Include for grounding testing.

- .8 Provide testing and coordination of emergency power distribution system
- .9 Provide visual and mechanical inspection of ground system and verify that it is in compliance with issued documents and local governing electrical code requirements.
- .10 Additionally, perform testing of lighting control systems and devices to ensure conformance with ASHRAE 90.1 requirements.
- .11 Acceptable companies to provide this work are to be independent of successful manufacturers providing distribution system equipment and include:
 - .1 Eaton Electric Services Division;
 - .2 Schneider Electric Services Division;
 - .3 Siemens Electric Services Division.

3.4 Branch Circuit Wiring Testing for Patient Care Areas

- .1 Provide on-site engineering inspection and testing of branch circuit wiring and branch circuit devices in patient care areas in accordance with CSA Standard Z32.
- .2 Patient Care Areas include applicable critical patient care, intermediate patient care and general patient care areas of renovated and additional areas.
- .3 Branch circuit wiring testing to be performed by an approved independent testing company and be executed immediately upon energizing system prior to occupancy of an area by Owner. Submit to Consultant hard copies and electronic copy of test reports.
- .4 Thoroughly review requirements of CSA Standard and ensure that entire scope of branch circuit wiring to be tested is understood by testing company.
- .5 Testing to be witnessed by Owner and Consultant. Notify Owner and Consultant in writing minimum of 7 working days in advance of proposed testing date.
- .6 Document testing in distribution system testing report.
- .7 Acceptable testing companies are as those listed for distribution system testing work.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

1. Submit shop drawings for products specified in this Section.

1.2 PRODUCT COMPATIBILITY

1. Lighting controls and luminaires when integrated together for control purposes must be 100% compatible with each other. Coordinate with ballast/driver and lamp manufacturers, LV relay panel manufacturers and dimmer/occupancy control manufacturers to ensure that components are compatible with each other and that interconnections do not affect performance, life or any warranties.

2 PRODUCTS

2.1 LIGHTING CONTROL MODULES

1. Provide lighting control modules as indicated or as required to control loads as indicated.
2. General requirements:
 1. Listed to UL 508 as industrial control equipment.
 2. Comply with NFPA 70 requirements for use in other spaces used for environmental air (plenum).
 3. Delivered and installed as listed factory-assembled panel.
 4. Passively cooled via free-convection, unaided by fans or other means; modules that require fan cooling not acceptable.
 5. Mounting: Surface.
 6. Connects to lighting management hub via RS485.
 7. LED status indicators confirm communication with occupancy sensors and daylight sensors.
 8. Contact Closure Input (select models):
 1. Directly accept contact closure input from dry contact closure or solid-state output without interface to:
 1. Activate scenes.
 1. Scene activation from momentary or maintained closure.
 2. Enable or disable after hours.
 1. Automatic sweep to user-specified level after user-specified time has elapsed.

2. System provides occupants visual warning prior to sweeping lights to user-specified level.
 3. Occupant can reset timeout by interacting with lighting system.
3. Activate or deactivate demand response (load shed).
 1. Load shed event reduces lighting load by user-specified amount.
9. Emergency Contact Closure Input:
 1. Turn all zones to full output during emergency state via direct contact closure input from UL 924 listed emergency lighting interface, security system or fire alarm system.
 2. Allow configurable zone response during emergency state.
 3. Disable control operation until emergency signal is cleared.
10. Supplies power for control link for keypads and control interfaces (select models).
11. Distributes sensor data among multiple lighting control modules.
12. Capable of being controlled via wireless sensors and controls.
13. No minimum load requirement.
14. LUTRON Lighting Control Modules:
 1. Provide LUUTRON certified single master application controller.
15. Provide testing capability using manual test buttons.
16. Each LUTRON bus supports:
 1. Control of up to 64 compliant addressable loads, including any combination of static white/tuneable white and device type 6/device type 8 drivers, grouped up to 64 zones.
 2. Up to 250 mA bus power.
17. Contact Closure Input: Directly accept contact closure input from dry contact closure or solid-state output without interface.
18. Emergency Contact Closure Input:
 1. Provides activation of emergency mode; turns all loads on and disables control from other devices.
 2. UL 924 listed.
19. Acceptable manufacturer is Lutron.

2.2 DIN RAIL POWER MODULES

1. General Requirements:

1. Surge Tolerance: Designed and tested to withstand surges of 6,000 V, 3,000 amps according to IEEE C62.41.2 and IEC 61000-4-5 without impairment to performance.
2. Communications: Utilize RS485 wiring for low-voltage communications link.
3. Passively cooled via free-convection, unaided by fans or other means.
4. Provide LED indicators for displaying diagnostic information.
5. No minimum load requirement.
6. Phase Adaptive Power Modules:
 1. Provides forward phase or reverse phase dimming, automatic or manual configuration. Support auto-detect mode to detect and configure forward-phase or reverse-phase dimming for incandescent/halogen, electronic/magnetic low voltage, and neon/cold cathode light sources.
7. Output Zones: One load type per zone.
8. Manual Mode Operation: Provide buttons to turn loads on/off or dim loads up/down for each zone.
9. Emergency Contact Closure Input:
 1. Provides activation of emergency mode; turns all loads on and disables control from other devices.
 2. UL 924 listed.
10. Provide cycle-by-cycle compensation for incoming line variations, including changes in voltage, frequency, harmonics, and line noise; accommodate up to plus/minus two percent change in frequency per second.
11. Systems not providing cycle-by-cycle compensation include external power conditioning equipment as part of dimming system.
12. Comply with NEMA SSL 7A.
13. 0-10 V Power Modules:
 1. Manual Mode Operation: Provide buttons to turn loads on/off or dim loads up/down for each zone.
14. Emergency Contact Closure Input:
 1. Provides activation of emergency mode; turns all loads on and disables control from other devices.
 2. UL 924 listed.
15. Acceptable manufacturer is Lutron.

2.3 DIGITAL WIRELESS FIXTURE MODULES

1. Athena Wireless Node:

1. Products:

2. Enclosure:

1. 28.5 mm wide by 31.2 mm high.
 2. Available in white or black plastic; white lens for sensor models.
3. Mounting: Mounts to lighting fixture. Fits into hole 21.8 mm to 23.0 mm in diameter with fixture wall thickness of 0.4 mm to 2.0 mm, including fixture opening meeting Zhaga Book 20 and standard 1/2-inch trade size, 22.5 mm diameter knockout.

4. RF Range: Maximum of 23 m between Athena Clear Connect - Type X wireless gateway or Athena wireless processor and compatible Clear Connect - Type X wireless devices on same floor; maximum of 7.6 m between each Clear Connect - Type X wireless device and at least two other Clear Connect - Type X wireless devices.

5. UL 2043 plenum rated for use in other spaces used for environmental air (plenums).

6. Support control of:

1. static-white and Type 8 tunable-white drivers.
2. 0-10 V (electronic off) static-white drivers complying with ANSI C137.1.
3. Manufacturers requiring specific drivers for functionality are not acceptable.

7. Occupancy/Vacancy and Daylight Sensing:

1. Disabled by default until programmed in system.

2. Occupancy/Vacancy Sensing:

1. Sensing Mechanism: Passive infrared coupled with technology for sensing fine motions; Lutron XCT Technology. Signal processing technology detects fine-motion passive infrared (PIR) signals without need to change sensor's sensitivity threshold.

2. Sensor Coverage: From 10.6 sq m to 23.8 sq m at mounting height of 2.4 m to 3.7 m; 360 degree field of view.

3. Coordination Between Integral, Wired, and Wireless Sensors: Integral, wired, and wireless sensors work in conjunction for appropriate occupancy and vacancy actions.

3. Daylight Sensing:

1. Automatic calibration.
2. Provide linear response to changes in perceived light level.
3. Closed loop proportional control scheme.

4. Sensor Range: 0 to 1600 lux.
5. Coordination Between Integral, Wired, and Wireless Sensors: Integral daylight sensing is disabled when used with wired or wireless daylight sensors.
8. Supported System Features:
 1. Via Lutron Athena Designer Configuration Setup Software:
 1. Create and modify scenes and simple sequences.
 2. Create and modify schedules for fixtures with static-white and tunable-white capabilities.
 3. Create or modify control groups of fixtures (zones).
 4. Fixture-Level Settings:
 1. Selectable Minimum Light Level: Support applications, such as hallways, that may require lights to never turn off.
 2. Configurable high and low-end trim.
 3. Occupancy and Daylight Sensing with Sensor Models:
 4. Occupancy sensor timeout, sensitivity, and mode (occupancy or vacancy).
 5. Daylight sensor enable/disable and setpoint.
 2. Via Lutron App Mobile Application:
 1. Modify scenes and schedules.
 2. Override selection of scenes, intensities, loads.
 3. Provide Bluetooth mobile iOS or Android app discovery; wireless fixture modules requiring scanning of bar codes are not acceptable.
2. Digital Bus Interface:
 1. Product: Lutron OEM Digital Bus Interface; Model DFC-OEM-DBI.
 2. Provides power for single Athena wireless node (18 VDC, 60 mA maximum).
 3. cULus recognized in accordance with UL 8750.
 4. Fixture control digital interface must be mounted inside fixture; it must not be used for external/remote mounting.
2. Acceptable manufacturer is Lutron.

2.4 LIGHTING MANAGEMENT HUBS AND PROCESSORS

1. Lighting Management Hubs:

1. Lutron Athena Light Management Hub (QP5).
 1. Type _____ - 2-link hub; Lutron Model QP5-2L-POE; one Athena Edge processor and two QS links.
2. Supports connection to QS wired devices via QS links; supports connection to Athena Edge processors and Athena wireless processors via system Ethernet link.
3. Supports communication with Clear Connect - Type X wireless devices, including Athena Wireless Node enabled light fixtures, via Athena wireless processors.
4. Supports outbound cloud connection when connected to Internet. Lighting management hubs that do not support cloud connectivity or that require inbound connection from cloud server are not acceptable. Manufacturers requiring on-site servers requiring annual maintenance are not acceptable. System requiring third-party servers to be pre-approved by IT department before acceptance with written approval.
 1. App connectivity to system for control and monitoring from iOS and Android mobile devices, including creating/editing timeclock events and editing scenes.
 2. Automated firmware updates via outbound HTTPS requests.
 3. Remote access, diagnostics, and service.
 4. Cloud Athena dashboard for energy and occupancy monitoring and reporting from web browser.
5. Signed processor firmware ensures firmware update is authentically from Lutron. Origin of unsigned processor firmware cannot be authenticated and is not acceptable.
6. Supports two-way digital shade control. Lighting management hubs that do not allow two-way digital shade communication are not acceptable.
7. Supports time-dependent conditional programming that allows different sensor and keypad actions at different times of day. Lighting management hubs that do not allow for time dependent conditional programming are not acceptable.
8. Provided in pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.
9. Connects to controls via RS485.
10. Integrates control station devices, shades, and external inputs into single customizable lighting control system with:
 1. Multiple Failsafe Mechanisms:
 1. Power failure detection via emergency lighting interface.
 2. Protection: Lights go to full on if ballast/driver wires are shorted.
 3. Distributed architecture provides fault containment. Single hub failure or loss of power does not compromise lights and shades connected to other lighting management hubs.

2. Manual overrides.
3. Automatic control. Wireless Processor:
 2. Wireless Processor:
 1. Connects to lighting management hub via system Ethernet link; powered by IEEE 802.3-compliant (af or at) Power over Ethernet (PoE) supply (QP5 hub, Q-POE-PNL Ethernet range extender, or PoE supply by others).
 2. Enables lighting control system to communicate with up to 100 Clear Connect - Type X wireless devices, including Athena Wireless Node enabled light fixtures, and up to 50 Clear Connect - Type A wireless devices, including up to 15 occupancy/vacancy sensors and up to 5 daylight sensors.
 3. RF Range: Maximum of 23 m between wireless processor and compatible Clear Connect - Type X wireless devices on same floor; maximum of 7.6 m between each Clear Connect - Type X wireless device and at least two other Clear Connect - Type X wireless devices; 9 m between wireless processor and compatible Clear Connect - Type A RF transmitting devices.
 4. Integrates control station devices and external inputs into single customizable lighting control system with:
 1. Multiple Failsafe Mechanisms:
 1. Power failure detection via emergency shunt devices.
 2. Distributed architecture provides fault containment. Single hub failure or loss of power does not compromise lights and shades connected to other lighting management hubs.
 2. Manual overrides.
 3. Automatic control.
 3. Accessories:
 1. Wire Landing Boards; Lutron Model QS-WLB: Provide as indicated or as required for terminating wiring.
 4. Supports internet connection for automated firmware updates and remote access, diagnostics, and service.
 5. Furnished with astronomical time clock.
 6. Maintains backup of programming in non-volatile memory capable of lasting more than ten years without power.
 7. Acceptable manufacturer is Lutron.

2.5 CONTROL STATIONS

1. Provide control stations with configuration as indicated or as required to control loads as indicated.

2. Touchscreen Control Stations:

1. Product: Lutron Athena Touchscreen; Model Q-TOUCH5.
2. Touchscreen: 135 mm capacitive touch display; 800 x 480 resolution; touch gesture navigation support; dark and light user interface mode options.
3. Connects to lighting management hub via system Ethernet link; powered by Athena QP5 hub or Q-POE-PNL Ethernet range extender; up to 5 touchscreens per processor; maximum of 100 m between touchscreen and lighting management hub with PoE switch or Ethernet range extender.
4. Control:
 1. Lighting Control: Area, scene, and zone-level control, including intensity, color temperature, and full color with fine-tune adjustment.
 2. Shade Control: Area-level control.
 3. Supports access control via admin and user PINs.
5. Programming: On-screen setup through user-guided interface; requires no additional software.
6. Global Language Support: English, Spanish, French, German, Italian, Portuguese, Simplified Chinese.
7. Finish: As specified for wall controls in "Device Finishes" under DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS article above.

3. Wired Control Stations:

1. General Requirements:
 1. Power: Class 2 (low voltage).
 2. UL listed.
 3. Provide faceplates with concealed mounting hardware.
 4. Borders, logos, and graduations to use laser engraving or silk-screened graphic process that chemically bonds graphics to faceplate, resistant to removal by scratching and cleaning.
 5. Finish: As specified for wall controls in "Device Finishes" under DIGITAL NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS article above.
2. Multi-Scene Wired Control:
 1. General Requirements:
 1. Allows control of any devices part of lighting control system.
 2. Allows for easy reprogramming without replacing unit.

3. Communications: Utilize RS485 wiring for low-voltage communications link.
4. Engrave keypads with button, zone, and scene descriptions as indicated on drawings.
5. Software Configuration:
 1. Customizable control station device button functionality:
 2. Buttons can be programmed to perform single defined action.
 3. Buttons can be programmed to perform defined action on press and defined action on release.
 4. Buttons can be programmed using conditional logic off of state variable such as time of day or partition status.
 5. Buttons can be programmed to perform automatic sequence of defined actions.
 6. Capable of deactivating select keypads to prevent accidental changes to light levels.
 7. Buttons can be programmed for raise/lower of defined loads.
 8. Buttons can be programmed to toggle defined set of loads on/off.
 6. Status LEDs:
 1. Upon button press, LEDs to immediately illuminate.
 2. LEDs to reflect true system status. LEDs to remain illuminated if button press was properly processed or LEDs to turn off if button press was not processed.
 3. Support logic that defines when LED is illuminated:
 1. Scene logic (logic is true when all zones are at defined levels).
 2. Room logic (logic is true when at least one zone is on).
 3. Pathway logic (logic is true when at least one zone is on).
 4. Last scene (logic is true when spaces are in defined scenes).
2. Wired Keypads; Lutron seeTouch QS Wallstations:
 1. Style: Architectural Non-Insert Style.
 2. Mounting: Wallbox or low-voltage mounting bracket; provide wall plates with concealed mounting hardware.
 3. Button/Engraving Backlighting:

1. Utilize backlighting for buttons and associated engraving to provide readability under all light conditions.
 2. Backlight intensity adjustable via programming software.
 4. Design keypads to allow field customization of button color, configuration, and engraving using field-changeable replacement kits.
 5. Contact Closure Interface: Provide two contact closure inputs on back of unit which provide independent functions from front buttons; accepts both momentary and maintained contact closures.
 6. Terminal block inputs to be over-voltage and miswire-protected against reversals and shorts.
3. Single-Scene or Zoned Wired Control:
 1. Product: Lutron Pico Wired Control.
 2. Turn individual fixture or group of fixtures on and off.
 3. Raise and lower light levels.
 4. Recall favorite light levels.
4. Wireless (Radio Frequency) Controls:
 1. Products:
 1. Type _____ - 2-Button with Raise/Lower Control; Lutron Pico Wireless Control Model PJ2-2BRL.
 2. Communicates via radio frequency to compatible dimmers, switches, and plug-in modules.
 3. Does not require external power packs, power or communication wiring.
 4. Allows for easy reprogramming without replacing unit.
 5. Button Programming:
 1. Single action.
 2. Toggle action.
 6. Includes LED to indicate button press or programming mode status.
 7. Mounting:
 1. Capable of being mounted with table stand or directly to wall under faceplate.
 2. Faceplates: Provide concealed mounting hardware.
 8. Power: Battery-operated with minimum ten-year battery life.

9. Finish: As specified for wall controls in "Device Finishes" under DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS article above.

5. Acceptable manufacturer is Lutron.

2.6 LOW VOLTAGE CONTROL INTERFACES:

1. Provide low-voltage control interfaces as indicated or as required to control loads as indicated.

2. UL listed.

3. Sensor Modules:

1. Products:

1. Sensor module with both wired and wireless inputs; Lutron Model QSM2-4W-C.

1. Connects to lighting management hub via RS485.

2. Wired Modules:

2. Provide wired inputs for:

1. Occupancy sensors.

2. Daylight sensors.

3. Wired wall stations.

2. Wireless Modules:

1. Provide wireless communication inputs for:

1. Occupancy sensors.

2. Daylight sensors.

3. Manual controls.

2. RF Range: 9 m between sensor module and compatible RF transmitting devices.

3. RF Frequency: 434 MHz; operates in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.

3. Communicate sensor information to wired low-voltage digital link for use by compatible devices.

4. Wireless Gateway:

1. Product: Lutron Athena Clear Connect Gateway - Type X; Model Q-RF.

2. Connects to lighting management hub via system Ethernet link; powered by Athena QP5 hub or Q-POE-PNL Ethernet range extender.

3. Enables lighting control system to communicate with up to 100 Clear Connect - Type X wireless devices, including Athena Wireless Node enabled light fixtures.

4. RF Range: Maximum of 23 m between wireless gateway and compatible Clear Connect - Type X wireless devices on same floor; maximum of 7.6 m between each Clear Connect - Type X wireless device and at least two other Clear Connect - Type X wireless devices.
5. Acceptable manufacturer is Lutron.

2.7 WIRED SENSORS:

1. Wired Occupancy Sensor:
 1. General Requirements:
 1. Connects directly to compatible ballasts/drivers and modules without need of power pack or other interface.
 2. Turns off or reduces lighting automatically after reasonable time delay when room or area is vacated by last person to occupy space.
 3. Accommodates conditions of space utilization and irregular work hours and habits.
 4. Comply with UL 94.
 5. Self-Adaptive Sensors: Continually adjusts sensitivity and timing to ensure optimal lighting control for any use of space; furnished with field-adjustable controls for time delay and sensitivity to override adaptive features.
 6. Provide capability to:
 1. Add additional timeout system-wide without need to make local adjustment on sensor.
 2. Group multiple sensors.
 7. Power Failure Memory: Settings and learned parameters to be saved in nonvolatile memory and not lost should power be interrupted and subsequently restored.
 8. Furnished with necessary mounting hardware and instructions.
 9. Class 2 devices.
 10. Ceiling-Mounted Sensors: Indicate viewing directions on mounting bracket.
 11. Color: White.
 2. Wired Passive Infrared Sensor:
 1. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
 2. Ceiling-Mounted Sensors: Provide customizable mask to block off unwanted viewing areas.
 3. Products:

4. Type _____ - Ceiling-Mounted Passive Infrared Sensor, 140 sq m; Lutron Model LOS-CIR-1500-WH: Coverage of 140 sq m with ceiling height of 2.4 to 3.7 m; 360 degree field of view; self-adaptive
2. Wired Daylight Sensors:
 1. Digital Interior Daylight Sensor:
 1. Product: Lutron Model EC-DIR-WH.
 2. Use Class 2 wiring for low-voltage communication.
 3. Can be replaced without reprogramming.
 4. Open-loop basis for daylight sensor control scheme.
 5. Stable output over temperature from 0 degrees C to 40 degrees C.
 6. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.
 7. Provide linear response from 0 to 500 footcandles.
 8. Mountable on lighting fixtures or recessed acoustical ceiling tiles.
 9. Constructed via sonic welding.
 10. Color: White.
 3. Acceptable manufacturer is Lutron.

2.8 WIRELESS SENSORS

1. General Requirements:
 1. Operational life of 10 years without need to replace batteries when installed per manufacturer's instructions.
 2. Communicates directly to compatible RF receiving devices through use of radio frequency communications link.
 3. Does not require external power packs, power wiring, or communication wiring.
 4. Capable of being placed in test mode to verify correct operation from face of unit.
 5. RF Range: 9 m between sensor and compatible RF receiving device(s).
 6. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
2. Wireless Occupancy/Vacancy Sensors:
 1. General Requirements:

1. Provides clearly visible method of indication to verify that motion is being detected during testing and that unit is communicating to compatible RF receiving devices. Sensors without visible method of indication to verify motion detection during testing are not acceptable.
2. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
3. Sensing Mechanism: Passive infrared coupled with technology for sensing fine motions; Lutron XCT Technology. Signal processing technology detects fine-motion passive infrared (PIR) signals without need to change sensor's sensitivity threshold.
4. Provide optional, readily accessible, user-adjustable controls for timeout, automatic/manual-on, and sensitivity.
5. Turns off lighting after reasonable and adjustable time delay once last person to occupy space vacates room or area. Provide adjustable timeout settings of 1, 5, 15, and 30 minutes.
6. Color: White.
7. Provide necessary mounting hardware and instructions for both temporary and permanent mounting.
8. Provide temporary mounting means to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be designed for easy, damage-free removal.
9. Sensor lens to illuminate during test mode when motion is detected to allow installer to verify coverage prior to permanent mounting. Sensors without lens that illuminates during test mode when motion is detected are not acceptable.
10. Ceiling-Mounted Sensors:
 1. Provide customizable mask to block off unwanted viewing areas.
2. Wireless Combination Occupancy/Vacancy Sensors:
 1. Ceiling-Mounted Sensors: Programmable to operate as occupancy sensor (automatic-on and automatic-off), occupancy sensor with low light feature (automatic-on when less than one footcandle of ambient light available and automatic-off), or vacancy sensor (manual-on and automatic-off).
 2. Products:
 1. Type _____ - Ceiling-Mounted Occupancy/Vacancy Sensor; Lutron Model LFR2-OCR2B-P-WH: Coverage from 30.2 sq m to 62.4 sq m depending on ceiling height from 2.4 to 3.7 m; 360 degree field of view.
3. Wireless Daylight Sensors:
 1. Product: Lutron Model LFR2-DCRB.
 2. Open-loop basis for daylight sensor control scheme.

3. Stable output over temperature from 0 degrees C to 40 degrees C.
 4. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.
 5. Provide linear response from 0 to 10,000 footcandles.
 6. Color: White.
2. Mounting:
1. Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, and compressed fiber ceilings.
 2. Provide necessary mounting hardware and instructions for both temporary and permanent mounting.
 3. Provide temporary mounting means to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be designed for easy, damage-free removal.
4. Acceptable manufacturer is Lutron.

2.9 ACCESSORIES

1. Emergency Lighting Interface:
 1. Product: Lutron Model LUT-ELI.
 2. Provides total system listing to UL 924 when used with lighting control system.
 3. Senses all three phases of building power.
 4. Provides output to power panels or digital ballast interfaces if power on any phase fails and sends all lights controlled by these devices to emergency light level setting. Lights to return to their previous intensities when normal power is restored.
 5. Accepts contact closure input from fire alarm control panel.
2. Provide power supplies as indicated or as required to power system devices and accessories.

2.10 MANUFACTURER'S SERVICES:

1. Manufacturer's authorized technician to provide following:
 1. custom system programming;
 2. inspection of installed system;
 3. adjustments;
 4. start-up procedures;
 5. certify system equipment and operation;

6. instructions on system operating and maintenance.
2. Acceptable Manufacturers are:
 1. Lutron

3 EXECUTION

3.1 INSTALLATION OF TIMERS

1. Provide timers to control lighting and other equipment as required and confirmed by Consultant.
2. Exact type of timers to be verified by manufacturer/supplier to ensure proper compatibility to interconnected equipment and loads. Confirm with respective manufacturers.
3. Install devices in accordance with manufacturer's instructions. Provide wiring in conduit. Provide required power connections and interconnection to luminaires, equipment, and power panels.
4. Programme timers as per schedule confirmed with Owner and/or Consultant.
5. Provide engraved nameplate identifying each timer.
6. After installation, adjust, test, and verify operation.

3.2 INSTALLATION OF WALL BOX DIMMERS

1. Provide flush wall box dimmers in locations and connect to control lighting as indicated. Confirm exact locations prior to roughing-in. Equip each dimmer with a faceplate. Confirm faceplate colour prior to ordering.
2. Install components in accordance with manufacturer's instructions to suit specific installation requirements.
3. Where identified, provide central enclosure cabinet for mounting dimmers within and connect complete. Clearly identify each dimmer and enclosure with engrave Lamacoid nameplates. Confirm exact nomenclature with Consultant prior to ordering.
4. When installation is complete, check and test operation of each dimmer and adjust as required.
5. Ensure that each dimmer is properly sized to suit connected load.

3.3 INSTALLATION OF OCCUPANCY SENSORS

1. Provide occupancy sensors and daylight sensors and associated devices to control lighting in areas as required. Provide power packs as required with suitable voltage and power ratings.
2. Exact type of occupancy sensors and type of lenses to be verified by manufacturer/supplier to ensure proper coverage in sensed areas only, and compatibility to interconnected systems. Confirm with respective manufacturers.

3. Be responsible for providing, locating, and aiming appropriate sensors in correct location required for complete and proper volumetric coverage within range of coverage(s) of controlled areas per manufacturer's recommendations. Rooms to have 90-100% coverage to completely cover controlled area to accommodate occupancy habits of single or multiple occupants at any location within room(s). Locations and quantities of sensors shown and/or noted are illustrations only and should only be used as guidelines. Provide additional sensors if required to properly and completely cover respective room.
4. Verify with manufacturer's factory authorized representative, exact type of sensor to be used in each area, placement of sensors and installation criteria, to best meet requirements of end user. Manufacturer's representative should be consulted for more non-typical installation types. Ensure that sensors connected to dimming system are 100% compatible with dimming system.
5. Where luminaires in rooms/areas are fed from normal and emergency power circuits, provide suitable relays and provisions to ensure that operation of luminaires on emergency power are maintained during loss of normal power.
6. Proper judgement must be exercised in executing installation so as to ensure that best possible installation in available space and to overcome local difficulties due to space limitations or interference of structural components. Also provide, at Owner's facility, training necessary to familiarize Owner's personnel with operation, use, adjustment, and problem solving diagnosis of occupancy sensing devices and systems.
7. Install devices in accordance with manufacturer's instructions. Provide wiring in conduit. Provide required power connections and interconnection to luminaires and power panels. Provide manual switches to override control system in each area/room as shown.
8. Confirm finishes of sensors with Consultant prior to ordering.
9. Confirm mounting heights with Architect and manufacturer prior to roughing-in and installation.
10. Adjust sensitivity and time delays to best suit Owner's furniture layout drawings. Allow for minor adjustments of locations (1 m [3.3']) of sensors.
11. After installation is complete, provide for manufacturer's authorized representative to inspect, test and verify system performance and installation.
12. After completion of project and within 30 days after Owner has taken occupancy and furnishings are in place, provide for manufacturer's authorized representative to revisit site to test and make final adjustments.
13. Refer also to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

3.4 INSTALLATION OF LOW VOLTAGE LIGHTING CONTROLS

1. Provide low voltage lighting components as required. Connect complete.
2. Install components in accordance with manufacturer's instructions to suit specific installation requirements.
3. Flush mount low voltage switches into wall mounted electrical boxes. Provide suitable mounting bracket and faceplate for each switch. Confirm finishes with Consultant prior to ordering.

4. Install power supplies, transformers and relays in barriered electrical boxes/enclosures and locate adjacent to surface mounted panel boards to which lighting loads are connected or in accessible ceiling space above recessed mounted panel boards to which lighting loads are connected. Exact locations to be confirmed with Consultant prior to start of work.
5. Locate locations of boxes on as-builts.
6. Clearly label each box and label low voltage switching circuits.
7. Refer also to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

3.5 INSTALLATION OF LOW VOLTAGE LIGHTING CONTROL PANELS

1. Provide factory assembled low voltage lighting panels as indicated on drawings and as specified to control lighting and integrate to Mechanical Divisions BAS and Fire alarm system. Refer to notes on drawings.
2. Install components in accordance with manufacturer's instructions to suit specific installation requirements.
3. Provide programming of panels in sequence which is to be confirmed with Consultant prior to start of work.
4. Provide relay panels for both emergency power and normal power lighting loads being controlled. Initially install tubs during construction work and install interiors during finishing work. Locate panels with dimmer panels as required. Ensure that wall space is sufficient for proper access for service and maintenance as per code requirements. Advise Consultant where spacing is an issue. Provide power, control and communication wiring in conduit to each panel as required. Confirm exact wiring type and requirements with system manufacturer. Control/communication wiring to generally be daisy chained between panels.
5. Flush wall mount low voltage switches where shown, complete with a mounting bracket and faceplate for each switch. Confirm finishes with Consultant.
6. Locate panels adjacent to branch circuit panelboards to which lighting loads are connected. Clearly identify low voltage switching circuits.
7. Ground and bond system as required by local governing electrical code and authority and system manufacturer.
8. Coordinate work with BAS vendor for required interconnections. Extend wiring in conduit to required interconnection to BAS panels. Typically terminate in junction box adjacent panel, leaving a loop of 3m (10') of un-terminated wiring for final termination by respective system vendors of Mechanical Divisions. Coordinate exact requirements with Mechanical Divisions. Where requested by Mechanical Divisions, provide conduit to terminate at Mechanical Divisions panel.
9. Clearly label each panel and label low voltage switching circuits.
10. Upon completion of installation, provide following:
 1. inspection, testing, and verification of panels;

2. re-verification of failed or replaced components;
 3. signed verification report.
11. Refer also to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

3.6 INSTALLATION OF LOW VOLTAGE LIGHTING CONTROL SYSTEM

1. Provide required components for low voltage control of lighting. Where required, integrate to Mechanical Divisions BAS system. Refer to notes on drawings.
2. Install components in accordance with manufacturer's instructions to suit specific installation requirements.
3. Provide system terminal in location as confirmed with Owner and/or Consultant prior to start of Work. Prepare sample software screens for submission as part of shop drawings. Provide custom programming of system in sequence which is to be confirmed with Owner and/or Consultant prior to start of Work.
4. Provide relay panels for both emergency power and normal power lighting loads being controlled. Initially install tubs during construction work and install interiors during finishing work. Locate panels with dimmer panels as required. Ensure that wall space is sufficient for proper access for service and maintenance as per code requirements. Advise Consultant where spacing is an issue. Provide power, control, and communication wiring in conduit to each panel as required. Confirm exact wiring type and requirements with system manufacturer. Control/communication wiring to generally be daisy chained between panels.
5. Confirm emergency sequence of operation with Consultant prior to start of Work and include required hardware and software and interfaces to other integrated systems. Coordinate interfaces with respective system vendors.
6. Flush wall mount low voltage switches into recessed wall boxes, complete with a mounting bracket and faceplate for each switch. Confirm finishes with Consultant prior to ordering.
7. Locate panels adjacent to branch circuit panelboards to which lighting loads are connected. Clearly identify low voltage switching circuits.
8. Ground and bond system as required by local governing electrical code and authority and system manufacturer.
9. Coordinate work with BAS vendor for required interconnections. Extend wiring in conduit to required interconnection to BAS panels. Typically terminate in junction box adjacent panel, leaving a loop of 3m (10') of un-terminated wiring for final termination by respective system vendors of Mechanical Divisions. Coordinate exact requirements with Mechanical Divisions. Where requested by Mechanical Divisions, provide conduit to terminate at Mechanical Divisions panel.
10. Clearly label each panel and label low voltage switching circuits.
11. Upon completion of installation, provide following:
 1. inspection, testing and verification of system;

2. re-verification of failed or replaced components;
 3. signed verification report.
12. Refer also to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

3.7 INSTALLATION OF DIMMING CONTROL STATION

1. Install dimming systems for dimming control of lighting for areas as identified and confirmed with Consultant. Refer to details on drawings. Circuit dimmers as required and note that no circuits to be loaded greater than rating of dimmers.
2. Install dimmer control station in locations as shown and as required. Provide required power source and connections. Connect normal power feeder and emergency power feeder as required. Interconnect system to BAS and fire alarming system as applicable.
3. Integrate system to fire alarm system, BAS and other systems, as required. Extend wiring in conduit to required interconnection panels of systems. Typically terminate in junction box adjacent panel, leaving a loop of 3m (10') of un-terminated wiring for final termination by respective system vendors of Mechanical Divisions. Coordinate exact requirements with Mechanical Divisions. Where requested by Mechanical Divisions, provide conduit to terminate at Mechanical Divisions panel.
4. Confirm emergency sequence of operation with Consultant prior to start of Work and include required hardware and software and interfaces to other integrated systems. Coordinate interfaces with respective system vendors.
5. Include for and arrange for manufacturer's authorized representative to perform programming work. Final program features must be approved by Owner prior to start of Work.
6. Install recessed, wall mounting control stations and wall box dimmers in locations as shown.
7. ON/OFF pushbuttons and preset buttons to be fade into operation, not instant operation. Where applicable, set cleaning presets to control circuits at levels as directed by Consultant.
8. Luminaire ballasts to be dimmed are to be electronic dimmable types completely compatible with dimming system. Ensure compatibility in writing with respective product manufacturers. Coordinate requirements and connect complete as per manufacturer's instructions.
9. Provide wiring in accordance with manufacturer's instructions and run wiring in conduit. Wiring to be oversized in accordance with manufacturer's instructions.
10. Install components in accordance with manufacturer's instructions to suit specific installation requirements.
11. Confirm exact locations of components prior to roughing-in.
12. Confirm device finishes with Consultant prior to ordering.
13. Ground and bond system as required by local governing electrical code and authority and system manufacturer.
14. Submit with shop drawings, detailed system wiring diagram and system riser diagram.

15. Clearly label low voltage circuits.
16. Upon completion of installation, provide following:
 1. inspection, testing and verification of system;
 2. re-verification of failed or replaced components;
 3. signed verification report.
17. Testing to include check of operation of each dimmer and control station. Adjust and preset devices as required to meet Owner's applications.
18. Refer also to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

3.8 INSTALLATION OF DIMMING SYSTEMS

1. Install dimming systems for dimming control of lighting for areas as identified and confirmed with Consultant. Refer to details on drawings. Circuit dimmers as required and note that no circuits to be loaded greater than rating of dimmers.
2. Install dimmer panels in locations as shown and as required. Ensure that panels are located to allow sufficient access as per code requirements. Provide required power source and connections to panels. Provide schedule of dimmers in plastic sleeve attached to panel. Connect normal power feeder and emergency power feeder as required. Provide relays as required. Interconnect system to BAS and fire alarming system as applicable.
3. Integrate system to fire alarm system, BAS and other systems, as required. Extend wiring in conduit to required interconnection panels of systems. Typically terminate in junction box adjacent panel, leaving a loop of 3m (10') of un-terminated wiring for final termination by respective system vendors of Mechanical Divisions. Coordinate exact requirements with Mechanical Divisions. Where requested by Mechanical Divisions, provide conduit to terminate at Mechanical Divisions panel.
4. Confirm emergency sequence of operation with Consultant prior to start of Work and include required hardware and software and interfaces to other integrated systems. Coordinate interfaces with respective system vendors.
5. Include for and arrange for manufacturer's authorized representative to perform programming work. Final program features must be approved by Owner prior to start of Work.
6. Install recessed, wall mounting control stations and wall box dimmers in locations as shown.
7. ON/OFF pushbuttons and preset buttons to be fade into operation, not instant operation. Set cleaning presets to control circuits at levels as directed by Consultant.
8. Luminaire ballasts to be dimmed are to be electronic dimmable types completely compatible with dimming system. Ensure compatibility in writing with respective product manufacturers. Coordinate requirements and connect complete as per manufacturer's instructions.
9. Provide wiring in accordance with manufacturer's instructions and run wiring in conduit. Wiring to be oversized in accordance with manufacturer's instructions.

10. Install components in accordance with manufacturer's instructions to suit specific installation requirements.
11. Confirm exact locations of components prior to roughing-in.
12. Confirm device finishes with Consultant prior to ordering.
13. Ground and bond system as required by local governing electrical code and authority and system manufacturer.
14. Submit with shop drawings, detailed system wiring diagram and system riser diagram.
15. Clearly label each dimmer/panel and label low voltage circuits.
16. Upon completion of installation, provide following:
 1. inspection, testing and verification of system;
 2. re-verification of failed or replaced components;
 3. signed verification report.
17. Testing to include check of operation of each dimmer and control station. Adjust and preset devices as required to meet Owner's applications.

3.9 INSTALLATION OF CENTRAL LIGHTING CONTROL SYSTEM

1. Submit as part of shop drawings, detailed design drawings, single line drawing, block drawings, equipment literature cuts, station finishes, and proposed sequence of operation of entire integrated system. Confirm sequence with Owner prior to start of Work.
2. Provide required components for low voltage control of lighting. Where required, integrate system such that dimming system and Mechanical Divisions BAS system can provide control as required. Refer to notes on drawings.
3. Dimming control system components and programming to be integrated to occupancy sensors and daylight sensors to perform an integrated lighting control system that provides dimming and ON/OFF control of designated luminaires. Zoning and sequence of operations to be pre-programmed and user friendly in any program changes. Confirm exact zoning and proposed sequence of operation via shop drawings submission stage.
4. Provide relay panels for both emergency power and normal power lighting loads being controlled. Initially install tubs during construction work and install interiors during finishing work. Locate panels with dimmer panels as required. Ensure that wall space is sufficient for proper access for service and maintenance as per code requirements. Advise Consultant where spacing is an issue. Provide power, control, and communication wiring in conduit to each panel as required. Confirm exact wiring type and requirements with system manufacturer. Control/communication wiring to generally be daisy chained between panels.
5. Confirm emergency sequence of operation with Consultant prior to start of Work and include required hardware and software and interfaces to other integrated systems. Coordinate interfaces with respective system vendors.

6. Flush wall mount low voltage switches and mount into recessed wall boxes, complete with a mounting bracket and faceplate for each switch. Confirm finishes with Consultant.
7. Locate relay panels adjacent to branch circuit panelboards to which lighting loads are connected. Clearly identify low voltage switching circuits.
8. Install dimming controls for areas as identified and confirmed with Consultant. Refer to details on drawings. Circuit dimmers as required and note that no circuits to be loaded greater than rating of dimmers.
9. Install dimmer panels in locations as shown and as required. Ensure that panels are located to allow sufficient access as per code requirements. Provide required power source and connections to panels. Provide schedule of dimmers in plastic sleeve attached to panel. Connect normal power feeder and emergency power feeder as required. Provide relays as required. Interconnect system to BAS and fire alarming system as applicable.
10. Include for and arrange for manufacturer's authorized representative to perform programming work and adjustments. Final program features must be approved by Owner.
11. Install recessed, wall mounting control stations and wall box dimmers in locations as shown and as required.
12. ON/OFF pushbuttons and preset buttons to fade into operation, not instant operation. Set cleaning presets to control circuits at levels as directed by Consultant.
13. Luminaire ballasts to be dimmed are to be electronic dimmable types completely compatible with dimming system. Ensure compatibility in writing with respective product manufacturers. Coordinate requirements and connect complete as per manufacturer's instructions.
14. Provide wiring in accordance with manufacturer's instructions and approved manufacturer's system wiring diagrams and run wiring in conduit. Wiring to be oversized in accordance with manufacturer's instructions to compensate for voltage drop. Do not splice wiring between control stations or between dimmer/relay panels/racks.
15. Install components in accordance with manufacturer's instructions to suit specific installation requirements.
16. Confirm exact locations of components prior to roughing-in.
17. Ground and bond system as required by local governing electrical code and authority and system manufacturer.
18. Integrate system to fire alarm system, BAS and other systems, as required. Extend wiring in conduit to required interconnection panels of systems. Typically terminate in junction box adjacent panel, leaving a loop of 3m (10') of un-terminated wiring for final termination by respective system vendors of Mechanical Divisions. Coordinate exact requirements with Mechanical Divisions. Where requested by Mechanical Divisions, provide conduit to terminate at Mechanical Divisions panel.
19. Confirm device finishes with Consultant prior to ordering.
20. Submit with shop drawings, detailed system wiring diagram and system riser diagram.
1. Upon completion of installation, provide following:

1. inspection, testing and verification of system;
 2. re-verification of failed or replaced components;
 3. signed verification report.
-
21. Testing to include check of operation of each relay panel, dimmer and control station. Adjust and preset devices as required to meet Owner's applications.
 22. Provide engraved lamacoid identification nameplate for each station, panel and controller. Clearly label each dimmer/panel and label low voltage circuits.
 23. Confirm nomenclature with Consultant prior to ordering.
 24. Refer also to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

END OF SECTION

PART 1 – GENERAL

1.1 References

- .1 Section 26 00 10 applies to and is a part of this Section.
- .2 Section 26 05 00 contains requirements, products and methods of execution that apply to this Section, and is a part of this Section.

1.2 Shop Drawings

- .1 Submit shop drawings for the following:
 - .1 Additional devices for existing equipment;
 - .2 Panelboards;
 - .3 Splitters;

1.3 Series Rated Combinations

- .1 Comply with OESC Rule 14-014 with regards to series rated combinations of over-current protective devices and ensure that equipment in which the lower rated devices is installed is marked with a series combination interrupting rating at least equal to the available fault current.

1.4 Breakers

- .1 Breakers to be NEMA rated types, for distribution panelboards. Breakers, when frame sized 225 amperes and greater, to be provided with solid state adjustable trip units with long time, short time and instantaneous time (LSI) functions and time delays. Set trip units at ratings as per coordination study as required for proper coordination. Provide ground fault alarm and trip functions at rating above 600A, as coordinated with results of coordination study and as confirmed with Consultant.
- .2 Size breakers as per drawings and/or schedules, but in absence of direction, size breakers to suit intended application, to suit coordination study requirements and in accordance with OESC.

1.5 Inspection, Testing, Start-Up and Verification

- .1 In addition to requirements specified in this Section, refer to requirements of Section 26 05 70.

1.6 Local Electrical Utility Requirements

- .1 Refer to Section 26 10 00.

PART 2 – PRODUCTS

2.1 Additional Devices for Existing Equipment

- .1 Additional breakers and switch and fuses assemblies for existing panelboards and/or switchboards are to match existing device standards and be completely compatible to

board in which they are installed. During Bidding period, check and verify exact requirements of existing equipment to ensure that additional devices are accommodated. Make necessary modifications to equipment to accommodate device and feeder installation. Provide suitable engraved lamacoid identification nameplate on additional components. Revise typed circuit directory cards on branch circuit panelboards. Mount additional devices to standards of existing equipment manufacturer. Refer to notes on drawings.

- .2 When connecting to existing panel circuits, take phase balancing into consideration when deciding what circuits to use.
- .3 For additional breakers and components as noted specifically on drawings, provide following:
 - .1 required contacts;
 - .2 current transformers;
 - .3 potential transformers;
 - .4 wiring in conduits;
 - .5 test blocks and terminals;
 - .6 necessary components for remote connection of alarms and monitoring points to BAS; co-ordinate work with BAS Contractor.
- .4 Provide additional retrofit work to existing equipment as noted on drawings. Delete breakers as noted. Revise mimic bus and nameplates accordingly.
- .5 Products to be of types from existing equipment manufacturers.
- .6 Confirm existing equipment requirements with respective manufacturers of equipment.

2.2 Distribution Transformers

- .1 Hammond Power Solutions, dry type transformers as per drawing schedule, CSA approved and/or ULC listed and labelled, constructed and factory tested in accordance with latest requirements of following:
 - .1 CSA Standard C9-02;
 - .2 CAN/CSA C22.2 No. 47-M90 (R2007);
 - .3 CAN/CSA-C802.2-06;
 - .4 UL 1561;
 - .5 NEMA TP1;
 - .6 Local governing authority codes and standards.
- .2 Dry type transformers to be complete with:
 - .1 minimum EEMAC 3R enclosure with a rigid end frame, removable plates, a terminal compartment; ventilation louvres designed to prevent penetration of water spray from activated sprinklers onto live parts, and gasketed doors and component openings;
 - .2 Class "H", 220°C class, silicone type coil insulation, such that winding temperature rise to not exceed 150C°(270F°) and enclosure temperature rise not exceed

- 65C°(117F°) under full load in a 40°C (104°F) ambient temperature;
- .3 factory painted drip shield.
- .3 Features for each transformer include:
 - .1 copper windings;
 - .2 core construction consisting of stacked laminations of high permeability silicone steel;
 - .3 vacuum impregnated polyester or epoxy resin;
 - .4 lugs or pressure type terminals to suit primary and secondary conductors;
 - .5 four (4) 2-1/2% full capacity taps; two (2) above normal and two (2) below normal; taps located on primary winding;
 - .6 an integral vibration dampening system with anti-vibration pads used between core and enclosure;
 - .7 seismic restraint requirements to suit local governing authority requirements and codes;
 - .8 unless otherwise noted, sound level and basic impulse level to meet CSA C9-02 requirements;
 - .9 factory painted with an ANSI grey enamel finish;
 - .10 K factor 13 and 20 rating as per ANSI/IEEE C57-110, for transformers as scheduled;
 - .11 electrostatic shielding, for transformers as noted;
 - .12 an aluminum nameplate indicating impedance rating, weight, connection diagram, style and serial number, riveted to front of enclosure.
- .4 Where medical equipment (diagnostic imaging/scanning) requires specific impedance level, confirm impedance requirements with diagnostic imaging/scanning vender and ensure transformer complies with requirements.
- .5 Acceptable manufacturers are:
 - .1 Hammond Power Solutions;
 - .2 Delta Group;
 - .3 Schneider Electric;
 - .4 REX Power Magnetics;
 - .5 Bemag Transformer;
 - .6 Siemens;
 - .7 STI Power.

2.3 Distribution Panelboards

- .1 Eaton (Cutler-Hammer), "Pow-R-Line" series factory assembled dead front panelboards as per drawing schedules, manufactured to CSA Standard C22.2. No. 29. Generally, interrupting capacities are scheduled, but in absence of direction, provide to capacity to

suit intended application to suit local governing electrical code.

- .2 Circuit breaker type "PRL4B" distribution panelboards to be single or double row as required and complete with moulded case, bolt-on circuit breakers calibrated for 40°C (104°F) ambient temperature and conforming to CSA Standard C22.2 No. 5 (Note No. 1). Locate both main lugs and neutral bar at same end. Shield main lugs through a removable cover. Identify each circuit breaker adjacent breaker handle. Refer to Part 1 for requirements of breakers to be provided with solid-state adjustable trip units. Group mount circuit breakers.
- .3 Switch and fuse type "PRL4F" distribution panelboards, complete with quick-make, quick-break, visible contact load break switches with operating handles projecting through dead front panel and interlocked with switch mechanism, facilities for padlocking in either ON or OFF position, and, unless otherwise noted, HRC Form I, Class "J" fuses.
- .4 Distribution panelboards of rating greater than 1200 amperes rating to be series "Pow-R-Line C" switchboard types.
- .5 Panelboard interior to have three flat bus bars stacked and aligned vertically with insulators laminated between phases. Insulators support and provide phase isolation to entire length of bus. A solidly bonded equipment ground bar and a neutral bar to be provided.
- .6 Bus bars (phases, grounds and neutrals) to be hard drawn electrical grade copper, silver plated and extend throughout panel.
- .7 Interior trim to be of dead-front construction to shield user from energized parts. Main circuit breaker and main lug interiors to be field convertible for top or bottom incoming feed.
- .8 Panelboard boxes to be constructed of code gauge, hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements, complete with removable ends and wiring gutter space on sides in accordance with CSA requirements.
- .9 Floor mounted enclosures to be free-standing type, reinforced as required to provide adequate strength.
- .10 Include main breakers for panelboards as scheduled. Main breakers to be automatic moulded case breakers with solid state trip units as specified in Part 1 article.
- .11 Enclosures to be minimum NEMA 1 or 12, with sprinkler-proof provisions including gasketed openings and complete with drip shield. Ventilation louvres to be designed to prevent penetration of water spray onto live components. Units to be factory painted in ANSI enamel colour coded accordingly, Red-Emergency, Blue-Normal. Recessed backboxes (tubs) need not be finished painted.
- .12 Distribution panelboards surface mounted in secure areas do not require doors. Panelboards located in insecure areas to be complete with doors, latches, and keyed alike locks. Locks to be cylindrical tumbler type with larger enclosures requiring sliding vault locks with 3-point latching. Supply 2 keys with each lock. Doors to be gasketed.
- .13 Panelboards to include for future breaker provisions as noted on schedules. Make provision for space for breakers, bussing for full panel size and where spare breakers are scheduled, breakers with required connector kits. Unused spaces provided, unless otherwise specified, to be fully equipped for future devices, including appropriate connectors and mounting hardware.

- .14 Panelboards as scheduled to be complete with integral surge protective devices (SPD) and filtering. Unit to be factory installed and connected onto bussing through integral disconnect/breaker as recommended by manufacturer. Unit to include diagnostic package with status indicators on each phase, LCD surge counter display, audible alarm with silence button and Form C alarm contacts. Unit to be maintenance free. SPD features include:
 - .1 in accordance with ANSI/UL 1449 3rd Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;
 - .2 maximum voltage protection rating to not exceed 700 V (120/208 V) (L-N, L-G, N-G);
 - .3 peak surge current 120 KA per phase;
 - .4 standard manufacturer's minimum 5 years parts and labour warranty.
- .15 Acceptable manufacturers are:
 - .1 Eaton (Cutler-Hammer);
 - .2 Schneider Electric (I-Line Series);
 - .3 Siemens Electric Ltd.

2.4 Branch Circuit Panelboards

- .1 Eaton (Cutler-Hammer), "Pow-R-Line" series, factory assembled dead front panelboards as per schedules, manufactured to CSA Standard C22.2 No. 29 and local governing electrical code, and designed for sequence phase connection of branch circuit breakers.
- .2 As scheduled, panelboards are of types:
 - .1 "Pow-R-Line 1", 120/208 V, 3-phase and single phase with minimum "BAB" frame, bolt-on moulded case circuit breakers with a minimum interrupting capacity of 10 KA symmetrical at 208 V, unless otherwise scheduled. Where panelboards are scheduled to include series rated provisions, provide breakers as recommended by panel manufacturer;
 - .2 "Pow-R-Line 2" 347/600 V, 3-phase panelboards with minimum "GBH" frame, bolt-on moulded case circuit breakers with an interrupting capacity as scheduled or in absence of direction to be of capacity for intended application to local governing electrical code requirements.
- .3 Where ground fault type breakers are required by code and/or scheduled, provide "Quicklag" ground fault, CSA Class "A", Group 1, combination thermal magnetic bolt-on circuit breakers with solid-state ground fault interrupters.
- .4 Panelboards to be equipped with one (1) continuous bus bar per phase. Each bus bar to have sequentially phased branch circuit connectors limited to bolt-on branch circuit breakers. Bussing to be fully rated and of plated copper construction.
- .5 Panelboards are to be complete with:
 - .1 Minimum NEMA 2 or 12, sprinkler-proof box constructed of code gauge galvanized steel with removable box ends, wiring gutter space on sides;
 - .2 dead-front construction to shield user from energized parts;

- .3 enclosure constructed of code gauge, hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements; trim for flush or surface wall mounting as shown; front panel to not be removable with the door locked;
- .4 hinged door with concealed fasteners, concealed hinge, chrome plated door latch and keyed alike lock with key;
- .5 a steel frame holder and circuit directory card protected by clear acetate and secured to back of door, and Mylar circuit breaker identification strips;
- .6 drip shield for surface mounted panelboards;
- .7 copper neutral bars;
- .8 200% sized neutrals for panels equipped with SPD units and for panels as scheduled;
- .9 solidly bonded equipment copper ground bar;
- .10 high strength, set screw type, anti-turning wire connectors;
- .11 current-carrying parts be insulated from ground and phase-to-phase by high dielectric strength thermoplastic;
- .12 isolated ground bus for panelboards feeding electrically sensitive equipment;
- .13 filler plates covering unused mounting space;
- .14 non-automatic and automatic main breaker to function as an isolating switch, where shown and as required;
- .15 ground fault interrupting circuit (GFCI) breakers to feed devices in whirlpools and pool areas, as scheduled or as required by local governing electrical code;
- .16 arc fault circuit interrupter (AFCI) breakers in residential applications, as scheduled and/or for applications required by local governing electrical code.
- .6 Panels, doors and trim are to be factory painted with ANSI enamel finish. Units to be factory painted in ANSI enamel colour coded accordingly, Red-Emergency, Blue-Normal. Recessed backboxes (tubs) need not be finished painted.
- .7 Equip breakers of frame size 225 amperes and greater, with solid state adjustable trip units.
- .8 Equip circuit breakers connected to dedicated equipment or devices with handle locks.
- .9 Panelboards as scheduled to be complete with integral surge protective devices (SPD) and filtering. Unit to be factory installed and connected onto bussing through integral disconnect/breaker as recommended by manufacturer. Unit to include diagnostic package with status indicators on each phase, LCD surge counter display, audible alarm with silence button and Form C alarm contacts. Unit to be maintenance free. SPD features include:
 - .1 in accordance with ANSI/UL 1449 3rd Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;
 - .2 maximum voltage protection rating to not exceed 700 V (120/208 V) (L-N, L-G, N-G);
 - .3 minimum peak surge current 100 KA per phase;

- .4 standard manufacturer's minimum 5 years parts and labour warranty.
- .10 Include spare breakers as sized on schedules and future breaker provisions as noted on schedules. Future breaker provisions to include space for breakers, bussing for full panel size and where future breaker sizes are scheduled, required breaker connector kits.
- .11 In addition to these requirements, for each 100 m² of floor space, panels to include additional provisions as follows:
 - .1 additional normal power spare 15A – 125VAC breaker circuit consisting of breaker and branch circuit feeder in conduit run, installed and connected to spare breaker as designated by Consultant and consisting of 100' (30 m) 2-No. 12 plus ground in 1/2" (13 mm) EMT, with termination to loads to be determined at time of construction;
 - .2 additional emergency power spare 15A – 125VAC breaker circuit consisting of breaker and branch circuit feeder in conduit run, installed and connected to spare breaker as designated by Consultant and consisting of 100' (30 m) 2-No. 12 plus ground in 1/2" (13 mm) EMT, with termination to loads to be determined at time of construction;
- .12 Acceptable manufacturers are:
 - .1 Eaton (Cutler-Hammer);
 - .2 Schneider Electric (Square D);
 - .3 Siemens Electric Ltd.

2.5 Distribution Conductors

- .1 Conductors as specified in Section 26 05 00.
- .2 Drawings identify feeder runs in concrete encasement. Refer to Section 26 10 00 for concrete encased ducbank requirements of feeders and provide work to similar standards and requirements.

2.6 Disconnect Switches

- .1 Eaton Cutler-Hammer, heavy duty, CSA approved, front operated with a handle suitable for padlocking in the "OFF" position and arranged so that the enclosure cover cannot be opened while the handle is in the "ON" position. Operating mechanisms shall be quick-break, positive acting with visible blades and a line terminal shield. Fusible units shall be complete with fuse clips suitable for HRC fuses, unless otherwise noted. The ampere rating, number of poles and fuse requirements shall be as indicated on the drawings. Switch enclosures shall be factory primed and painted.
- .2 Disconnects for variable speed drives shall be suitable for use with such drives and include auxiliary switch/contact to de-energize the control power circuit, as required and as applicable.
- .3 Enclosures for disconnects interior mounted shall be EEMAC2 with sprinkler-proof features. Exterior enclosures shall be minimum EEMAC 3R.
- .4 Acceptable manufacturers are Eaton Cutler-Hammer, Siemens Electric Ltd. and Schneider Electric (Square D).

PART 3– EXECUTION

3.1 Installation of Distribution Transformers

- .1 Locate transformers into position. Ensure adequate clearance is provided as per code requirements and as required for access for operation and maintenance. Comply with manufacturer's instructions and recommendations.
- .2 Secure transformers 75 KVA and larger to a concrete housekeeping pad on Vibro-Acoustics Ltd. type "RSR" vibration isolation pads. Provide seismic restraints as required by local governing codes.
- .3 Secure transformers smaller than 75 KVA in place on an angle wall mounting bracket support assembly located approximately 12" (300 mm) below ceiling. Provide support assembly and adequately secure to wall and/or ceiling construction.
- .4 Ensure that transformers are equipped with lugs or connections suitable for primary and secondary connections. Isolate primary and secondary connections from transformer enclosures by means of 12" to 18" (300 mm - 450 mm) of liquid-tight flexible conduit.
- .5 Ground and bond equipment to ground electrode grids as per local governing Code requirements.
- .6 Provide engraved Lamacoid nameplates and warning signs with nomenclature confirmed with Consultant.
- .7 When installation is complete, test and check secondary voltages. Make all required adjustments and submit to Consultant a test report indicating secondary voltage readings and any adjustments made to achieve proper voltages. Furthermore, when building is in normal use, re-check voltages and make any required adjustments.

3.2 Installation of Distribution Panelboards

- .1 Provide distribution panelboards and install into locations and connect complete. Ensure adequate clearance is provided as per code requirements and as required for access for operation and maintenance.
- .2 Install floor mounted panelboards on concrete housekeeping pads. Provide seismic restraints as required by local governing authorities and codes. Surface wall mount other panelboards, unless otherwise noted, independent of connecting conduit.
- .3 Equip each panelboard with suitable lugs to accommodate main and branch conductors as scheduled. Identify panelboard and breakers with Lamacoid identification nameplate with nomenclature to Consultant's approval.
- .4 Connect SPD in accordance with manufacturer's instructions and with dedicated breaker.
- .5 Ground and bond equipment as per local governing electrical code and inspection authority requirements.
- .6 Refer to distribution system testing and coordination study article specified herein this Section.
- .7 Comply with Owner's custom painting identifications standard.

3.3 Installation of Branch Circuit Panelboards

- .1 Provide factory assembled branch circuit panelboards and install into locations and connect complete. Ensure adequate clearance is provided as per code requirements and as required for access for operation and maintenance. Load panels with breakers as scheduled.
- .2 Support cabinets and enclosures independent of connecting conduit, and accurately install with reference to wall finishes.
- .3 Equip panelboards with suitable lugs or provisions to accommodate main and branch conductors scheduled.
- .4 Ground and bond equipment as per local governing electrical code and inspection authority requirements.
- .5 Turn over to Consultant, prior to application for a Certificate of Substantial Performance of Work, a quantity of two (2) panelboard cabinet or enclosure keys per panelboard.
- .6 Where two (2) or more panelboards are installed in one (1) cabinet, equip panelboards with double lugs and increase gutter capacity to accommodate additional cabling.
- .7 Identify panelboard breakers in a permanent manner, and complete typed panelboard circuit directories identifying circuit number and type and location of loads supplied from each breaker to Consultant's approval.
- .8 Include future breaker spaces, spare breakers and additional breakers for miscellaneous mechanical loads and BAS. Confirm BAS requirements with Mechanical Divisions.
- .9 Install and connect SPD in accordance with manufacturer's instructions and with dedicated breaker. Test SPD as per manufacturer's instructions.
- .10 Test and verify ground fault interrupting breakers as follows:
 - .1 demonstrate in presence of Consultant that protected circuits will "trip" when a simulated ground fault is applied to "load" side of each circuit breaker/ground fault interrupter combination;
 - .2 megger load side neutral on GFI protected branch circuits to ensure that neutral is not grounded on load side of GFI;
 - .3 verify GFI operation with a temporary load (100 watt lamp in an insulated socket with pigtail leads);
 - .4 provide a written report confirming that tests have been performed and that system is functioning properly.
- .11 Provide applicable requirements of distribution system testing and coordination study article specified herein this Section.
- .12 Comply with Owner's custom painting identifications standard.

3.4 Installation of Distribution Conductors

- .1 Provide all required low voltage distribution wire and cable. The conductors, unless otherwise noted, shall be of type installed in conduit as specified in Section 26 05 00.
- .2 Provide all required cable support system accessories which are not specified herein or shown on the drawings but are required for proper installation.
- .3 Provide concrete encased ductbank runs for low voltage conductors as shown. Refer to

Section 26 10 00 for duct bank specifications.

3.5 Installation of Contactors

- .1 Provide contactors in enclosures for required devices and outside lighting control as shown on the drawings and/or as required for specific applications and connect complete. Identify each contactor enclosure with engraved nameplate.
- .2 Wall mount each enclosure independent to the panelboard to which the loads are connected.

3.6 Installation of Disconnect Switches

- .1 Provide safety switches (disconnects) as follows:
 - .1 wherever shown on the drawings and/or specified herein;
 - .2 wherever required by starter schedule drawings;
 - .3 for motorized equipment which cannot be seen from the motor starter location or is more than 30' (9 m) from the starter location;
 - .4 for all "packaged" equipment fed from a motor starter panel.
- .2 Ensure that enclosures for safety switches located outside the building are EEMAC 3. Ensure that enclosures for safety switches located in sprinklered areas are EEMAC 2. All other enclosures shall be EEMAC 1, unless otherwise noted. Provide a lamacoid identification nameplate for each enclosure.

3.7 Grounding and Bonding

- .1 Connect grounding conductors to motors 10 hp and above or circuits 20A or above, with a solderless terminal and a bolt tapped to motor frame or equipment housing. Connect to smaller motors or equipment by fastening terminal to a connection box. Connect junction boxes to equipment grounding system with grounding clips mounted directly on box or with machine screws. Completely remove paint, dirt, or other surface coverings at grounding conductor connection points so good metal-to-metal contact is made.
- .2 Ground metal sheathing and any exposed metal vertical structural elements of buildings. Ground metal fences enclosing electrical equipment. Bond any metal equipment platforms which support electrical equipment to equipment ground. Bond rooftop equipment.
- .3 Ground and bond various telecommunications, audio visual systems, security, life safety and control systems in accordance with respective system manufacturer's recommendations and in accordance with local governing electrical code requirements.
- .4 Do not use conduit systems as ground conductors in patient care areas or in areas as per local governing electrical code requirements.
- .5 Provide minimum no. 3/0 AWG insulated copper ground conductors and LAN Room copper ground bus mounted on walls with standoff insulators in each LAN room. Connect ground bus to computer equipment racks and to building ground system.
- .6 Ground conductors not sized on drawings are to be sized in accordance with local governing electrical authority requirements. Ground conductor size is to be no smaller than requirements specified herein this article or on drawings.

- .7 Ground and bond telecommunication components as required. Comply with TIA/EIA-607 grounding and bonding requirements.
- .8 Provide conductors as sized on drawings and in accordance with OESC requirements, but which shall be of size no smaller than the requirements specified herein this article or on drawings.
- .9 Provide LAN Rooms ground busses consisting of 16" x 4" x 1/4" (400 mm x 100 mm x 6 mm) copper ground bus with eight (8) drilled taped holes; mounted on walls with standoff insulators. Connect busbar to building ground busbar located in same room using two-hole compression lugs and a grounding jumper of same size as pigtail extension of main building grounding ring (usually 3/0 AWG).

3.8 Electrical Connections for Mechanical, Owner's, Etc., Equipment

- .1 In addition to providing electrical feeders and connections to equipment provided by Electrical Divisions, provide required electrical connections to apparatus provided and/or supplied by Mechanical Divisions, Owner and as part of other Divisions.
- .2 Unless otherwise noted, provide electrical connections including power and control wiring for equipment supplied by Owner or by other Divisions, and except where specified for control wiring of Mechanical Divisions automatic control systems specification Section. Provide complete wired and empty conduit systems with fish cord, junction boxes, pull boxes, outlet boxes, faceplates, sleeves, etc. Provide disconnect switches, receptacles and other required wiring and connection accessories. Coordinate work with respective Consultants and suppliers of equipment to be provided with electrical connections.
- .3 Refer to Division 11, and include for coordination and interconnections of Division 11 requirements and equipment schedule.
- .4 Coordinate with trades of other Divisions to ensure provision of proper electrical requirements. Unless otherwise noted or directed by Consultant, be responsible for provision of interconnect wiring between remote operator devices, controllers, and equipment being controlled by operator devices, whether or not such devices/controllers are supplied by Electrical Divisions. Where equipment is of split unit design and line voltage is required to both units, be responsible for feeders to each unit as coordinated with equipment manufacturer and Division responsible for equipment. Provide disconnect switches, receptacles and other required wiring and connection accessories. Provide system/equipment power feeds with hard wired or receptacle type connections, as required. Coordinate exact requirements prior to start of work, at time of shop drawing submissions and prior to roughing-in of work. Coordinate work with suppliers of equipment to be provided with electrical connections which may include but not be limited to following:
 - .1 audio visual systems;
 - .2 telecommunication systems;
 - .3 mechanical systems and equipment.
- .5 For Mechanical Divisions supplied fire pumps and sprinkler pump controllers, and transfer switches, provide power and control wiring in conduit from emergency power plant (gensets) to equipment. Conductors to be 2-hour fire rated types. Control wiring between genset control panel and respective equipment to initiate start of gensets (start of emergency power sequence) when loss of normal power is sensed at equipment. Coordinate exact requirements with Mechanical Divisions.

- .6 Provide coordination of alarm connections of equipment with Mechanical Divisions BAS Contractor. Refer to drawings of both Electrical Divisions and Mechanical Divisions for BAS points to be connected. Include for wiring in conduit, contacts, termination/junction boxes, etc., as required for inter connection.
- .7 Provide electrical connections to door hardware as coordinated with General Contractor, security vendor and door hardware schedule of Division 08.
- .8 Mechanical Divisions are responsible for supply of motor control centres (MCCs), motor starters and variable frequency drives (VFDs) (also known as variable speed drives – VSDs), for motorized apparatus supplied by them and is to provide Lamacoid identification throughout. Motor starters, VFDs and/or MCCs are to be as scheduled. Generally starters are supplied in following manner:
 - .1 loose starters for mounting adjacent to apparatus or on motor starter panels;
 - .2 mounted starters in factory assembled and pre-wired motor control centres;
 - .3 mounted starters on factory assembled and pre-wired packaged equipment.
- .9 Be responsible for following work:
 - .1 mounting loose starters and providing "line" and "load" power connections;
 - .2 providing motor starter panels - conduit work at motor starter panels to be horizontally and vertically plumb; plan installation to avoid crossovers;
 - .3 making "line" side power connections to motor control centres and "load" side connections to motors or other apparatus supplied power from motor control centres - where applicable, sub-feed refrigeration machine starter from double lugs furnished in adjacent motor control centre for refrigeration equipment;
 - .4 making "line" side power connections to starters on "packaged" equipment;
 - .5 coordinating feeder entries to starters and starter assemblies with Mechanical Divisions;
 - .6 providing additional disconnect switches (complete with identification) detailed on drawings, or required by Code, or for apparatus which cannot be seen from its starter or is in excess of 30' (9 m) from its starter;
 - .7 connections to thermistors and provision of additional relays as required for connections to starters; generally, Mechanical Divisions are to supply required thermistors and relays necessary for starters; review Mechanical Divisions specifications and/or drawings defining these requirements and include necessary work, wiring, conduit and components not being supplied by Mechanical Divisions;
 - .8 performing required motor starter interlocking in accordance with requirements specified and as outlined on starter schedules; coordinate interlocking requirements with Mechanical Divisions;
 - .9 ensure that an identification nameplate is provided on each motor starter or disconnect;
 - .10 ensure that an identification nameplate is provided on each motor control centre nameplate is to identify name, for example, MCC No. 1, and voltage, for example, 600 V;

- .11 ensure that an identification nameplate is provided and attached with stainless steel screws to each separately mounted 3-phase motor starter or group of 3-phase motor starters a suitably sized black-white-black Lamacoid nameplate engraved to read:
- "MOTOR(S) IS CAPABLE OF MAKING TWO (2) STARTS IN SUCCESSION, COASTING TO REST WITH APPROXIMATELY 15 MINUTES ELAPSED TIME BETWEEN STARTS, WITH MOTOR INITIALLY AT AMBIENT TEMPERATURE, OR OF MAKING ONE (1) START WITH MOTOR INITIALLY AT A TEMPERATURE NOT EXCEEDING ITS RATED LOAD OPERATING TEMPERATURE, IF $\Omega K2$ OF LOAD, LOAD TORQUE DURING ACCELERATION, APPLIED VOLTAGE AND METHOD OF STARTING ARE THOSE FOR WHICH MOTOR WAS DESIGNED."
- .10 Where supplied by Mechanical Divisions and connected by Electrical Divisions, connect VFDs in strict accordance with manufacturer's instructions. Provide manufacturer's recommended conductors and connectors to suit respective VFDs. Maintain separation of power and control conductors as per manufacturer's requirements to minimize effects of electromagnetic interference. Properly ground and bond equipment.
- .11 You will be liable for replacing motors due to abuse of above prior to acceptance of work. If additional starts are required, it is recommended that none be made until conditions affecting motor operation have been thoroughly investigated and apparatus examined for evidence of excessive heating. Note: Keep number of motor starts to absolute minimum since life of motor is affected by number of starts.

3.9 Provisions for Medical Equipment

- .1 Medical equipment to be provided under responsibility of another Division. Refer to Divisions 11 and 13 and to any issued equipment vendor drawings and review requirements necessary for their equipment installation and required power and control requirements, and conduit and boxes requirements. Comply with equipment vendor limitations to material composition of devices being installed in vicinity of equipment. Review equipment drawings to determine locations of respective raceways/boxes that may be provided for various system installations. Coordinate with vendor.
- .2 Provide required power feeders, raceways, conduits, feeders, boxes, wiring as per drawing notes and schedules, and as coordinated with respective equipment vendors.
- .3 Mount and connect controls in accordance with equipment manufacturer's instructions, recessed into wall boxes as required. Provide power and control wiring in conduit and connect to equipment. Provide transformers if required to revise voltages to meet equipment specifications.
- .4 Note any special power requirements such as transformer impedances and power/voltage regulation.
- .5 Provide required grounding and bonding of equipment.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 Submit shop drawings for products specified in this Section.

2 PRODUCTS

2.01 BRANCH CIRCUIT PANELBOARDS

- .1 Eaton (Cutler-Hammer), "Pow-R-Line" series, factory assembled dead front panelboards as per schedules, manufactured to CSA Standard C22.2 No. 29 and local governing electrical code, and designed for sequence phase connection of branch circuit breakers.
- .2 As scheduled, panelboards are of types:
 - .1 "Pow-R-Line 1", 120/208 V, 3-phase and single phase with minimum "BAB" frame, bolt-on moulded case circuit breakers with a minimum interrupting capacity of 10 KA symmetrical at 208 V, unless otherwise scheduled. Where panelboards are schedule to include series rated provisions, provide breakers as recommended by panel manufacturer;
 - .2 "Pow-R-Line 2" 347/600 V, 3-phase panelboards with minimum "GBH" frame, bolt-on moulded case circuit breakers with an interrupting capacity as scheduled or in absence of direction to be of capacity for intended application to local governing electrical code requirements.
- .3 Where ground fault circuit interrupting (GFCI) type breakers are required by code and/or scheduled, provide "Quicklag" ground fault, CSA Class "A", Group 1, combination thermal magnetic bolt-on circuit breakers with solid-state ground fault interrupters.
- .4 Panelboards to be equipped with one (1) continuous bus bar per phase. Each bus bar to have sequentially phased branch circuit connectors limited to bolt-on branch circuit breakers. Bussing to be fully rated and of plated copper construction.
- .5 Panelboards are to be complete with:
 - .1 NEMA 1, box constructed of code gauge galvanized steel with removable box ends, wiring gutter space on sides; conduit entries sealed water-tight;
 - .2 dead-front construction to shield user from energized parts;
 - .3 enclosure constructed of code gauge, hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements; trim for flush or surface wall mounting as shown; front panel to not be removable with the door locked;
 - .4 hinged door with concealed fasteners, concealed hinge, chrome plated door latch and keyed alike lock with key;
 - .5 a steel frame holder and circuit directory card protected by clear acetate and secured to back of door, and Mylar circuit breaker identification strips;
 - .6 drip shield for surface mounted panelboards;

- .7 copper neutral bars;
- .8 200% sized neutrals for panels equipped with SPD units and for panels as scheduled;
- .9 solidly bonded equipment copper ground bar;
- .10 high strength, set screw type, anti-turning wire connectors;
- .11 current-carrying parts be insulated from ground and phase-to-phase by high dielectric strength thermoplastic;
- .12 isolated ground bus for panelboards feeding electrically sensitive equipment;
- .13 filler plates covering unused mounting space;
- .14 non-automatic and automatic main breaker to function as an isolating switch, where shown and as required;
- .15 ground fault circuit interrupting (GFCI) type breakers to feed devices as scheduled and for applications required by local governing codes;
- .16 arc fault circuit interrupter (AFCI) type breakers to feed devices as scheduled and for applications required by local governing codes.
- .6 Panels, doors and trim are to be factory painted with ANSI grey enamel finish. Recessed backboxes (tubs) need not be finished painted.
- .7 Equip breakers of frame size 225 amperes and greater, with solid state adjustable trip units.
- .8 Equip circuit breakers connected to dedicated equipment or devices with handle locks.
- .9 Include spare breakers as sized on schedules and future breaker provisions as noted on schedules. Future breaker provisions to include space for breakers, bussing for full panel size and where future breaker sizes are scheduled, required breaker connector kits.
- .10 Acceptable manufacturers are:
 - .1 Eaton (Cutler-Hammer);
 - .2 Schneider Electric (Square D);
 - .3 Siemens Electric Ltd.

2.02 LOAD CENTRES

- .1 Eaton (Cutler-Hammer), CSA approved, type BR load centres as follows:
 - .1 NEMA 1 enclosure manufactured from cold rolled 16 gauge steel and complete with ANSI grey enamel finish;
 - .2 front panel with hinge door and locking operator; front cover with trim to mount flush with wall onto recessed enclosure;

- .3 single phase, 3-wire, 120/240 VAC; 10 KA IC;
- .4 copper bussing and bars;
- .5 main non-automatic breaker;
- .6 plug in type BR series breakers;
- .7 100 amp main bussing rating;
- .8 minimum sized to accommodate at least 20 breakers;
- .9 Type BR-AFCI arc fault circuit interrupting type breakers to feed devices as scheduled and as required by local governing codes;
- .10 Type BR-GFCI ground fault circuit interrupting type to feed devices as scheduled and as required by local governing codes;
- .11 twin neutral with insulated cross strap for bonding applications as required by Code;
- .12 drip shield for surface mounted panels;
- .13 typed circuit directing card.
- .2 Acceptable manufacturers are:
 - .1 Eaton (Cutler-Hammer);
 - .2 Schneider Electric (Square D);
 - .3 Siemens Electric Ltd.

2.03 ENCLOSED CIRCUIT BREAKERS

- .1 Eaton (Cutler-Hammer), moulded case, front operated, flush mounted, non-automatic circuit breakers sized on drawings, each secured in NEMA 1 wall mounting enclosure with steel front panel and arranged so that circuit breaker can be padlocked in OFF position. Cover interlocked such that cover cannot be opened if breaker is in ON position.
- .2 Eaton (Cutler-Hammer), moulded case, front operated, flush mounted, automatic circuit breakers sized on drawings, each secured in NEMA 1 wall mounting enclosure with steel front panel and arranged so that circuit breaker can be padlocked in OFF position. Cover interlocked such that cover cannot be opened if breaker is in ON position.
- .3 Acceptable manufacturers are:
 - .1 Eaton (Cutler-Hammer);
 - .2 Schneider Electric (Square D);
 - .3 Siemens Electric Ltd.

3 EXECUTION

3.01 INSTALLATION OF PANELBOARDS

- .1 Provide factory assembled branch circuit panelboards and install into locations and connect complete. Ensure adequate clearance is provided as per code requirements and as required for access for operation and maintenance. Load panels with breakers as scheduled.
- .2 Support cabinets and enclosures independent of connecting conduit, and accurately install with reference to wall finishes.
- .3 Equip panelboards with suitable lugs or provisions to accommodate main and branch conductors scheduled.
- .4 Coordinate with Mechanical Division trades and Consultant to determine extra mechanical loads and BAS panels requiring use of specified additional 15A circuits and connect complete.
- .5 Ground and bond equipment as per local governing electrical code and inspection authority requirements. Refer also requirements of Section entitled – Grounding and Bonding.
- .6 Turn over to Consultant, prior to application for a Certificate of Substantial Performance of Work, a quantity of two (2) panelboard cabinet or enclosure keys per panelboard.
- .7 Where two (2) or more panelboards are installed in one (1) cabinet, equip panelboards with double lugs and increase gutter capacity to accommodate additional cabling.
- .8 Identify panelboard breakers in a permanent manner, and complete typed panelboard circuit directories identifying circuit number and type and location of loads supplied from each breaker to Consultant's approval.
- .9 Include for spaces for future breakers, spare breakers and additional breakers for miscellaneous mechanical loads are included as per schedules and as specified.

3.02 INSTALLATION OF LOAD CENTRES

- .1 Provide factory assembled load centres and connect complete. Ensure adequate clearance is provided as per code requirements and as required for access for operation and maintenance. Load panels with breakers as scheduled.
- .2 Support enclosures independent of connecting conduit, and accurately install with reference to wall finishes.
- .3 Equip enclosures with suitable lugs or provisions to accommodate main and branch conductors scheduled.
- .4 Identify breakers in a permanent manner, and complete typed panelboard circuit directories identifying circuit number and type and location of loads supplied from each breaker to Consultant's approval.
- .5 Include for spaces for future breakers and spare breakers as per schedules.
- .6 Test and verify ground fault interrupting breakers as follows:

- .1 demonstrate in presence of Consultant that protected circuits will "trip" when a simulated ground fault is applied to "load";
 - .2 side of each circuit breaker/ground fault interrupter combination;
 - .3 megger load side neutral on GFI protected branch circuits to ensure that neutral is not grounded on load side of GFI;
 - .4 verify GFI operation with a temporary load (100 watt lamp in an insulated socket with pigtail leads);
 - .5 provide a written report confirming that tests have been performed and that system is functioning properly.
- .7 Ground and bond panel as per local electrical code requirements. Refer also to requirements of grounding and bonding article.
 - .8 Additionally, refer to testing, coordination and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

3.03 INSTALLATION OF ENCLOSED CIRCUIT BREAKERS

- .1 Provide wall mounted enclosed, circuit breakers for equipment. Include required accessories. Secure to wall construction and connect complete.
- .2 Confirm exact locations prior to roughing-in.
- .3 Ground and bond equipment as per local governing electrical code and inspection authority requirements. Refer also to requirements of grounding and bonding article.
- .4 Provide a lamacoid identification nameplate for each enclosure. Confirm exact nomenclature with Consultant prior to manufacturer.
- .5 Additionally, refer to testing, coordination and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

END OF SECTION

PART – GENERAL

1.1 Submittals

- .1 Submit shop drawings for products specified in this Section.
- .2 Submit samples of each typical wiring device, faceplates, finishes and colours. Mount to sample board, clearly labelling devices and finishes. Submit for review by Owner and Consultant. Do not order any device unless finishes have been reviewed and approved by Consultant.

PART 2 – PRODUCTS

2.1 Receptacles

- .1 Receptacles to be CSA approved, ULC listed, certified and labelled devices.
- .2 Hubbell Canada Inc., No. HBL 8200, extra heavy duty hospital grade with green dot symbol, back and side wired, flush, thermoplastic polyester face/body construction, duplex U-ground, 15 ampere, 125 V, 2-pole, 3-wire grounding receptacles complete with one piece nickel-plated brass mounting strip with integral grounding clips, ground retention clips, nickel-plated brass wiring clamps with nickel-plated brass screws, front circuit identification area and reinforced thermoplastic base.
- .3 Hubbell Canada, No. GFR8200SNAP / GFR8300SNAP "AUTOGUARD" Series, extra heavy duty hospital grade, 15/20 ampere, 125 V, duplex, ULC Class "A", Group One, tamper resistant, weather resistant ground fault circuit interrupting receptacles complete with right angled pigtailed terminal with 150 mm (6") leads, automatic self-test diagnostics, green power ON LED, red ground fault LED and 10ka short circuit current rating.
- .4 Hubbell Canada Inc., No. HBL5262 / HBL5362 CSA approved, ULC listed, extra heavy duty, specification grade, back and side wired, flush, nylon face/body construction, duplex U-ground, 15/20 ampere, 125 V, 2-pole, 3-wire grounding receptacles complete with one piece nickel-plated brass mounting strip with integral grounding clips, ground retention clips, nickel-plated brass wiring clamps with nickel-plated brass screws, front circuit identification area and reinforced thermoplastic base.
- .5 Hubbell Canada, No. GFR 5262SG / GFR 5362SG "AUTOGUARD" Series, extra heavy duty grade, 15/20 ampere, 125 V, duplex, ULC Class "A", Group One, tamper resistant, weather resistant ground fault circuit interrupting receptacles complete with automatic self-test diagnostics, green power ON LED, red ground fault LED and 10ka short circuit current rating.
- .6 Hubbell Canada, No. GFR 5262TR / GFR 5362TR "CIRCUIT GUARD" Series, extra heavy duty grade, 15/20 ampere, 125 V, duplex, ULC Class "A", Group One, tamper resistant, weather resistant ground fault circuit interrupting receptacles complete with red ground fault LED and 10ka short circuit current rating.
- .7 Hubbell Canada Inc., No. HBL 415H, "4-PLEX", CSA approved, ULC listed, hospital grade, high impact resistant polycarbonate construction, 4 outlet, 15 ampere, 125 V, 2-pole, 3-wire grounding receptacles complete with brass contacts, plated steel ground plate, brass screws, and suitable for mounting to 100 mm (4") square box; where mounting to 1 or 2 gang box include adapter plate;
- .8 Hubbell Canada Inc., No. HBL 415, "4-PLEX", CSA approved, ULC listed, specification grade, high impact resistant polycarbonate construction, 4 outlet, 15 ampere, 125 V, 2-pole, 3-wire grounding receptacles complete with brass contacts, plated steel ground plate, brass screws, and

suitable for mounting to 100 mm (4") square box; where mounting to 1 or 2 gang box include adapter plate;

- .3 Hubbell Canada Inc., No. HBL2172 / HBL2182 "Style Line", CSA approved, ULC listed, Hospital grade with green dot symbol, back and side wired, nylon face/body construction, 15/20 ampere, 125 V, 2-pole, 3-wire grounding, duplex, decorative receptacles complete with one piece nickel-plated brass mounting strip with integral grounding clips, ground retention clips, nickel-plated brass wiring clamps with nickel-plated brass screws, front circuit identification area and reinforced thermoplastic base.
- .4 Hubbell Canada Inc., No. USB 15X2 "Style Line" series, CSA approved, ULC listed, tamper resistant, back and side wired, 15 ampere, 125 V
- .5 Legrand - Pass & Seymour, No. 2122, 15 ampere, 125 V, recessed, ivory clock hanger receptacles and wall plates.
- .6 Hubbell Canada Inc., No. 9430, EEMAC type 14-30R, 30 ampere, 125/250 V, 3-pole, 4-wire single electric clothes dryer receptacles with steel faceplates.
- .7 Hubbell Canada Inc., No. 9450, EEMAC type 14-50R, 50 ampere, 125/250 V, 3-pole, 4-wire single electric range receptacles with steel faceplates.
- .8 Hubbell Canada, No. IG 5262, heavy duty, specification grade, 15 ampere, 125 V, duplex, orange colour, nylon construction, back, and side wired isolated receptacles.
- .9 Hubbell Canada, No. BR15TR series, specification grade, 15 ampere, 125 V, 2-pole, 3-wire, tamper resistant, safety shutter receptacles.
- .10 Hubbell Canada, No. 4710, specification grade, 15 ampere, 125 V, single, 2-pole, 3-wire grounding twist lock receptacle.
- .11 Hubbell Canada, No. 15 ampere and 50 ampere receptacles complete with neutral and ground conductors required for indicated number of phases as shown.
- .12 Crouse-Hinds ENR series hazardous location explosion proof receptacles. Devices to be suitable for Class 1 Division 2 applications, unless otherwise noted by Consultant. Exact classification to be confirmed with Consultant prior to ordering. Coordinate receptacle requirements with Owner to ensure compatibility with plugs.
- .13 Where noted that 20 A receptacles are required, include for "T" slot type of respective series of receptacles.
- .14 Colour of special switches and receptacles (unless specified above), to be as specified in PART 3 of this Section of Specification.
- .15 Special switches and receptacles not specified above are to be specified on drawings. Low voltage lighting controls are specified in Section entitled Lighting Control.
- .16 Acceptable manufacturers are:
 - .1 Hubbell Canada Inc.;
 - .2 Cooper Wiring Devices (Arrow Hart);
 - .3 Legrand - Pass & Seymour;

.4 Leviton.

2.2 Faceplates

- .1 Grade 18 8, type 302/304, 1 mm (0.032") thick stainless steel, satin, brushed or natural finish, complete with a peel off protective plastic film, and stainless steel screws.
- .2 Hubbell Canada, high impact strength, and flame resistant hospital wall plates of nylon or thermoplastic construction. Standard and mid sizes are to be provided in various colour finishes, to suit specific applications.
- .3 Legrand - Pass & Seymour, "Jumbo" 302 stainless steel wall plates.
- .4 Galvanized steel stamped faceplates for equipment rooms.
- .5 Hubbell Canada Inc., forged brass "S" Series faceplates with flip open doors for receptacles.
- .6 Colours and finishes of faceplates are specified in Part 3 of this Section.
- .7 Acceptable manufacturers are as per switches and receptacles.

PART 3 – EXECUTION

3.1 Installation of Receptacles

- .1 Provide receptacles and install in electrical outlet boxes. Refer to drawings to determine flush or surface mounting requirements. Generally, flush mount devices in finished areas. Size electrical boxes to suit device requirements as per device manufacturer's recommendations. Properly ground device to box and ground system as per code requirements and manufacturer's instructions.
- .2 For pricing only, receptacles to be ivory for devices connected to normal power circuits, red for devices connected to essential power circuits including isolate power centres. Isolated ground receptacles connected to circuits fed from uninterruptible power supply units to be orange colour. Generally, install receptacles in Patient Care Areas vertically with ground pins up.
- .3 Safety shutter type receptacles to be located where shown and required by code and CSA Z32.
- .4 Provide a separate insulated ground wire for each isolated ground receptacle. Do not install isolated ground receptacles in patient care areas.
- .5 Install USB charger receptacles in extra deep boxes in accordance with manufacturer's recommendations.
- .6 Install exterior receptacles located in landscaped grounds in accordance with drawing detail.
- .7 Confirm receptacle finishes via submission of sample board to Consultant. Do not order any devices unless final finishes have been approved by Consultant.
- .8 In patient care areas, 15A/20A straight blade receptacles to be hospital grade.
- .9 Comply with requirements of CSA Standard Z32, with regards to identifying circuit number and supplying panelboard, permanently identified at outlets. Identify this information in areas on front of each receptacle. In addition, provide typed label on wall below each device faceplate, identifying circuit number and panelboard from where each device is fed. Confirm nomenclature with Consultant prior to printing of labels and nameplates. Turn over label maker to

Consultant/Owner prior to application for Certificate of Substantial Performance of the Work.

- .10 Within special imaging/scanning unit type rooms, devices including mounting screws and hardware must be of non-ferrous construction as per unit manufacturer's instructions.
- .11 Where receptacles are indicated in counters and benches, box cut-out to be provided in counter and bench. Provide a box, receptacle, plate and branch circuit wiring. Branch circuit wiring within counters and benches to be flexible armoured cable, under requirements of local governing electrical code and standards. Install and connect complete.
- .12 Confirm final receptacle finishes with Consultant as per sample board submission specified in Part 1. Do not order any devices unless final finishes have been approved by Consultant.
- .13 Additionally, refer to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

3.2 Installation of Faceplates

- .1 Provide each switch and receptacle with a faceplate with an opening or openings suitable for device it conceals and covers openings around boxes. Secure faceplates to device frames with screws to match faceplates. Provide larger than standard type faceplates for devices that require engraved nomenclature to define special purpose for that device.
- .2 Provide stainless steel faceplates in operating rooms, laboratories, treatment rooms, test rooms, etc.
- .3 Provide nylon type faceplates for switches and receptacles circuited to emergency power sources and/or isolated power centres. For flush mounted devices, provide oversized faceplates as required to properly cover wall openings around recessed boxes. Provide faceplates with suitable identification label. Colour finish to be red, but to be confirmed with Consultant.
- .4 Within special imaging/scanning unit type rooms, devices including mounting screws and hardware to be of non-ferrous construction as per unit manufacturer's instructions.
- .5 Confirm exact material, finish, and colour of faceplates for devices in any particular area with Consultant prior to ordering. Submit sample board as per requirements of Part 1.
- .6 Provide faceplates with printed self-adhesive label on inside face identifying circuit number and panel feeding device. Turn over label maker to Consultant prior to application for Certificate of Substantial Performance of the Work.

END OF SECTION

PART 1 – GENERAL

1.1 References

- .1 Section 26 00 10 applies to and is a part of this Section.
- .2 Section 26 05 00 contains requirements, products, and methods of execution that apply to this Section.
- .3 Appendix A - Schedule of Luminaires as appended to end of this Section, includes lighting fixture requirements.

1.2 Submittals

- .1 Submit shop drawings for products of this Section and as identified in Schedule of Luminaires.
- .2 Include photometric data, lamp, and ballast information for each luminaire. Include ballast data identifying maximum circuit loading limitations.
- .3 Photometric data to include: total input watts, candlepower summary, candela distribution zonal lumen summary, luminaire efficiency, CIE type, coefficient of utilization, lamp type and lumen rating in accordance with IESNA testing procedures.
- .4 Include copy of certification that lenses and louvers comply with local governing building code requirements for flame spread ratings.
- .5 Refer to Section 26 00 10 for general submission requirements.

1.3 Warranty

- .1 Warranty requirements are as follows:
 - .1 unless otherwise noted, LED and LED drivers for a period of five (5) years from date of acceptance of Work by Owner for its intended use;

1.4 Inspection, Testing, Start-Up And Verification

- .1 In addition to requirements specified in this Section, refer to requirements of Section 26 05 70.

PART 2 – PRODUCTS

2.1 Luminaires

- .1 Luminaires are to be CSA approved or have special local electrical authority approval.
- .2 Provide tunable lighting and ensure fixture are compatible to achieve the tunable lighting system.
- .3 Some luminaires as noted or directed by Consultant or identified in other Division documents may be supplied by Owner or under another Division of Work. Include in Bid, Work and materials to accommodate such fixtures, including:
 - .1 receiving and inspecting fixtures;

- .2 complete installation;
 - .3 providing basic installation hardware not supplied by luminaire manufacturer;
 - .4 aiming and connecting;
 - .5 providing power feeders and conduit/boxes;
 - .6 cleaning, adjusting and testing;
 - .7 providing lamps where documented or as scheduled, unless otherwise noted or directed by Consultant or supplied with fixture by fixture manufacturer;
 - .8 provide required power connections and where luminaires are controlled via remote low voltage controller;
 - .9 include for installation of controller and providing required low voltage wiring in conduit and necessary connections;
 - .10 coordination of exact requirements with supplier of fixtures and Consultant prior to installation.
-
- .4 Unless otherwise noted, linear and continuous linear architectural LED luminaires bodies to be constructed of extruded aluminum and of rigid construction. Unless otherwise noted, provide body finishes of corrosion resistant, chemically treated and electrostatically applied post powder coat finish. Efficiency not to be less than 69%.
 - .5 Fabricate housings to allow for easy accessibility and replacement of parts.
 - .6 Fabricate fixtures with a minimum number of joints. Make unexposed joints by acceptable method such as welding, brazing, screwing or bolting. Soldered joints are unacceptable. Do not use blind metal tapping methods or rivets for fastening parts which must be removed during service, or for fastening electrical components and supports. Cast parts, including die-cast members, to be of uniform quality, close grained, rigid, true to pattern, free from blow holes, pores, discoloration, hard spots, shrinkage defects, and cracks or other imperfections that affect strength and appearance or are indicative of inferior metals or alloys.
 - .7 Reflectors and reflecting cones or baffles to be free of any tooling marks, spinning lines or marks by other assembly techniques. Finishes to be equal to first quality polished, baffled, and anodized "Alzak".
 - .8 Lenses and louvres to comply with local governing building code and other local governing code flame spread rating requirements.
 - .9 Unless otherwise noted, construct acrylic lens from 100% virgin acrylic and not less than 0.125" (3.22 mm) thick. Glass lenses to be minimum 0.375" (9.5 mm) thick.
 - .10 Recessed luminaries with replaceable/serviceable parts such as driver, lamps, etc., must be accessible from lens side (ie. room side) of fixtures to allow for proper accessibility.
 - .11 Luminaires to be factory assembled and tested prior to delivery on site.

- .12 Exposed parts and hardware of luminaires located in non-climate controlled areas to be corrosion resistant and weather resistant. Hardware to be tamper-proof. Manufacturer exterior luminaire poles with corrosion resistant finish and construction. Pole suppliers to ensure that poles supplied are suitable for steady wind velocity and gust velocity of area of installation, and suitable for total effective projected area of lighting equipment. Submit verification of this with shop drawings.
- .13 When requested, submit luminaire samples.
- .14 Dimensions for coves, valances, and strips as shown on drawings are for bidding purposes only. Job measure for exact dimensions of louvres, lenses and strips.
- .15 Dimensions for linear and continuous linear LED as shown on drawings are for bidding purposes only. Job measure for exact dimensions requirements to suit installation location.
- .16 Confirm exact colours and finishes of luminaires with Consultant after award of contract but prior to ordering. Obtain information in time to meet installation schedule.
- .17 Comply with local governing building code requirements with regards to tandem wired connection of fluorescent luminaires and ballasts to eliminate unnecessary use of single lamp ballasts.
- .18 Coordinate with driver manufacturers and dimmer/occupancy control manufacturers to ensure that components are compatible with each other and that interconnections do not affect performance, life or any warranties.
- .19 Products of same specified type to be of same manufacturer.

2.2 LEDs and Drivers

- .1 General features include:
 - .1 CSA approved, ULC listed and labelled;
 - .2 Operating temperature:
 - .1 Luminaires for applications in non-climate controlled area: operating temperature range through -40°C (-40°F) to 60°C (140°F);
 - .2 Luminaires for applications in climate controlled area: operating temperature range through -20°C (-4°F) to 50°C (122°F);
 - .3 With rapid and changing development of LED technology, provide most technically proven and most advanced and successfully tested LED technology at time of installation;
 - .4 Specification standards to meet requirements of IES LM 79 and LM-80.
 - .5 LEDs and drivers to be 100% compatible to lighting dimming and control systems specified in Section 26 09 00, such that dimming and control systems can be integrated to connected luminaires for full control and dimming of luminaires as required. Drivers to be dimmable and addressable types to meet operations and performance requirements of Section 26 09 00, drawings and Schedule of luminaires.
- .2 Light emitting diodes (LEDs) features to include:

- .1 LEDs to be selected from same colour bin size for consistency in chromaticity and meet ANSI C78 377A as a minimum;
- .2 generally, colour temperature range to be from 2700 K to 6500 K; specific temperature requirements to be identified on Schedule of Luminaires;
- .3 minimum CRI of 80 ;
- .4 rated life (based on 70% lumen depreciation level) from 50,000 to 70,000 hours.
- .3 Driver (ballast) features to include:
 - .1 Operate from 60 Hz input source of 120 VAC with sustained variations of $\pm 10\%$ (voltage and frequency) with no damage to driver;
 - .2 Output regulated to $\pm 5\%$ across load range;
 - .3 Power factor greater than 0.90;
 - .4 Total harmonic distortion less than 20%;
 - .5 Class A sound rating;
 - .6 Comply with ANSI C62.41 Category A for transient protection.
- .4 Acceptable manufacturers to be as recommended by luminaire manufacturers.

PART 3– EXECUTION

3.1 Installation of Luminaires

- .1 Provide luminaires as per Luminaire schedule. Coordinate installation work with requirements of Section 26 09 00 as required.
- .2 Before placing luminaire orders:
 - .1 verify quantity requirements;
 - .2 thoroughly review ceiling types, finishes and construction details; verify ceiling types with latest Architectural Drawings; order luminaires to suit correct ceiling type;
 - .3 ensure that required mounting assemblies, frames, rings and similar features are included;
 - .4 confirm colours and finishes with Consultant.
- .3 Include for assembly and mounting of luminaires and lamps, complete with:
 - .1 wiring and connections;
 - .2 fittings and hangers;
 - .3 aligners;
 - .4 box covers;
 - .5 other accessories required for a complete, safe and fully operational assembly.
- .4 Where outlet boxes locations are shown on drawings, they are diagrammatic only. Position outlet boxes to coincide with suspension hangers and knockouts.

- .5 Install ceiling fixtures in centre of tiles unless dimensioned otherwise on Reflected Ceiling Plans. Locate hangers on tile centres or intersections. Mount recessed downlights, troffers, and surface mounted luminaires in or on full tiles. Install fixtures in and on acoustical tile ceilings in alignment with tile joints. Where holes are cut for luminaires,
- .6 Cut holes for recessed luminaires to exact size so that gaps are not visible or luminaire trims cover gaps.
- .7 Mount surface ceiling luminaires perfectly level or plumb, tightly to ceiling without showing a space or light leak between frame and ceiling.
- .8 Carefully align linear luminaires shown in continuous lines or rows, so that rows appear as straight lines. Variation in alignment not to exceed 1/4" (6 mm) for any 16' (5 m) run.
- .9 Provide spacers for fixtures mounted on low density ceiling material.
- .10 Provide plaster frames for recessed fixtures in plaster or gypsum board ceilings.
- .11 Prepare fixtures, trim and poles and standards required to be painted.
- .12 Protect wiring with tape or tubing at all points where abrasion may occur. Conceal wiring within fixture construction except where design or mounting dictates otherwise.
- .13 Splices:
 - .1 Minimize number of splices.
 - .2 Make with approved mechanical insulated steel spring type connectors, suitable for temperature and voltage conditions to which splices are to be subjected.
 - .3 Splices are not to be made unless properly terminated in accessible identified junction boxes.
- .14 Support luminaires directly by ceiling slab structure and not to formed steel decking, ceiling hangers, ductwork, piping, cable trays, etc.
- .15 Do not tighten wing nuts, bolts, or screws that allow fixture adjustment for recessed adjustable fixtures.
- .16 Install spread lenses only where called out on Schedule of Luminaires and Specifications.
- .17 Use cloth gloves when handling reflector cones, louvers, halogen lamps, glass, sconces and all exposed surfaces of fixtures.
- .18 Co-ordinate luminaire installation with work of other trades to ensure that necessary recessing depths and mounting spaces are provided.
- .19 Install luminaires in accordance with applicable architectural drawing reflected ceiling plans and/or wall elevations and/or field instructions issued by Consultant. Confirm luminaire locations prior to roughing-in. In equipment rooms, shafts and similar secondary areas, install luminaires after mechanical and other major work is roughed in and adjust luminaire locations as required.
- .20 Align and position all adjustable luminaires, and ensure that luminaires with adjustable lamp holders are properly positioned to correspond to lamps specified.
- .21 Comply with requirements of local governing electrical code regarding support of luminaires in suspended ceilings.

- .22 Connect luminaires to power circuits and controls as required. Refer to drawings notes and schedules.
- .23 Locate exit signs in final locations confirmed with Consultant and approved by local building code authority. Connect to power circuits as required. Where applicable for emergency power requirements, connect to emergency battery units. Relocate exit sign and re-direct direction arrows to suit local building code authority requirements and Consultant's directions.
- .24 Notify Consultant immediately and relocate if necessary as directed by Consultant, if:
 - .1 fixture placement is in conflict with a structural beam, mechanical duct, plumbing pipe, etc.;
 - .2 space above ceiling is not sufficient;
 - .3 any reason that a fixture cannot be located where it is dimensioned or shown on construction documents.
- .25 Provide seismic restraints to suspended luminaires, in accordance with latest local governing building code requirements.
- .26 Ground and bond luminaires as per local governing electrical code requirements.
- .27 If requested, demonstrate operation of luminaires intended for special applications such as building floodlights and other decorative purposes. Adjust their locations within a reasonable distance to obtain effects desired.
- .28 Test and adjust exterior luminaires at times after sunset, in presence of Consultant and at times acceptable to Consultant.
- .29 Prior to turn over of Work to Owner, clean luminaires in manner recommended by manufacturer and to satisfaction of Consultant.
- .30 Lamps to be new and intact when project is complete and ready for acceptance.
- .31 Include a full lamp listing in Operating and Maintenance Instruction Manuals.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 Submit shop drawings for products specified in this Section.

2 PRODUCTS

2.01 EMERGENCY LIGHTING UNITS

- .1 Emergi-lite "ESL" Series, CSA approved, 120 VAC/12 VDC emergency lighting battery units. Units are complete with batteries, charger, dual lamp heads per unit (where shown); cabinet and 1.2 m (4') AC cord and plug set. Units to also be complete with automatic testing and self-diagnostic circuitry, and remote monitoring provisions. System to be designed to provide emergency lighting levels in accordance with local governing building requirements.
- .2 Chargers are fully automatic, solid-state type that automatically and instantaneously energizes lamp load upon failure of AC supply. Battery protection circuit automatically shuts down lamp load when battery reaches full discharge. Chargers to fully recharge battery in 12-24 hours and be current limited and short circuit proof.
- .3 Batteries to be long life sealed lead, maintenance free and have a capacity to supply sufficient output power to lamp loads and to exit sign emergency loads for a period of time in accordance with latest requirements of local governing building code but be a minimum of 30 minutes. Batteries to be designed for and guaranteed for at least 10 years of life expectancy.
- .4 Cabinets are constructed of No. 18 gauge steel, finished in white enamel. Front cover is removable to provide easy and full access to battery and charger connections. Knockouts are provided on top for lamp heads. Cabinet includes protective wire-guard, where required and/or where identified with "WG" designation on drawings.
- .5 Units include "PUSH-TO-TEST" switch, AC and high charge pilot lights and AC cordset.
- .6 Integral lampheads are 12V, 6 W MR16 LED lamps, decorative design, high impact plastic, adjustable heads.
- .7 Unless otherwise scheduled in Schedule of Luminaires, provide remote lamp heads as follows:
- .1 remote surface mounted heads in climate controlled areas to be type EF40 series, vandal resistant heavy duty, clear, UV resistant polycarbonate lens type, die cast aluminum back plate, single and double adjustable head, 181 mm L x 117 mm W x 95 mm D (7-1/8" x 4-5/8" x 3-3/4"); complete with 12V, 6 W MR16 LED lamps;
- .2 remote surface mounted heads in climate controlled areas to be type EF26 series, vandal resistant, frosted polycarbonate cube type, single or double adjustable heads, complete with 12V, 6 W MR16 LED lamps; single unit approximately 121 mm L x 124 mm W x 121 mm D (4-3/4" x 4-7/8" x 4-3/4");

- .3 remote surface mounted heads in climate controlled equipment rooms and building maintenance/service areas to be No. EF9 series, single, double or triple adjustable swivel fire retardant thermoplastic heads with 12V, 6 W MR16 LED lamps; single unit approximately 114 mm L x 184 mm H x 89 mm D (4.5" x 7.25" x 3.5"); fixtures identified with "WG" to be complete with wire guard;
- .4 remote surface mounted heads in climate controlled equipment rooms and building maintenance/service areas to be No. EF18 series, single, double or triple, large adjustable swivel fire retardant thermoplastic heads with 12V, 6 W MR16 LED lamps; single unit approximately 114 mm L x 184 mm H x 89 mm D (4.5" x 7.25" x 3.5"); fixtures identified with "WG" to be complete with wire guard;
- .5 remote recessed mounted heads in climate controlled areas to be type EF15 series gimbal ring adjustable "eyeball"; overall ring diameter of 200 mm (8") and in-ceiling depth of 86 mm (3-3/8"), with 12V, 6 W MR16 LED lamps;
- .6 remote surface mounted heads in non-climate controlled areas to be type EF39 series, NEMA 4X certified, weather-proof, vandal resistant fully gasketed cast aluminium back plate with polycarbonate lens, single and double adjustable head complete with 12V, 6 W MR16 LED lamps;
- .7 retractable units to be "Retract-a Lite" series head complete with motorized lamp assembly and be completely concealed in wall or ceiling during normal power conditions; upon a power failure, door to automatically rotate 180 degrees to expose emergency lighting heads and power on heads; upon restoration of normal power or at end of battery discharge, lamps turn off and assembly rotates back to normal concealed position with heads retracted; lamp-door assembly of modular construction with quick connect plugs for easy installation; does not require presence of AC power in order to open or close door; lamps to be 12V, 6 W MR16 LED;
- .8 remote surface mounted heads in hazardous areas to be type EFXPR series as follows:
 - .1 CSA certified for Class I, Divisions 1 and 2, Groups A, B, C, D; Class II, Divisions 1 and 2, Groups E, F, G; Class III, Divisions 1 and 2;
 - .2 die cast aluminum body with grey epoxy powder coat finish;
 - .3 weather-proof, vandal resistant fully gasketed;
 - .4 clear, impact and heat resistant prismatic glass globe;
 - .5 bi-pin halogen lamps;
 - .6 6, 12, 24 and 120 V operation;
 - .7 ceiling/wall/pendant mounting;
 - .8 tungsten/halogen lamps of wattage from 12w to 70w.
- .9 remote in suspended ceiling type battery units to be provided as per Schedule of Luminaires; remote heads connected to these battery units to be provided as per drawing Schedule of Luminaires;

- .10 remote heads to be of tamper proof construction;
- .11 wire-guards where identified with "WG" designation on drawings.
- .8 Include for manufacturer's authorized representative to perform on-site after installation inspection, testing, adjusting, and verification of equipment. Such work to be performed during premium after hours' time. Refer to Part 3 for additional requirements.
- .9 Acceptable manufacturers are:
 - .1 Emergi-lite;
 - .2 Lumacell;
 - .3 Beghelli (supplied by Omnilumen);
 - .4 Read-lite
 - .5 Aimplite.

2.02 T-BAR CEILING EMERGENCY LIGHTING UNITS

- .1 Emergi-lite "TS" Series, CSA approved, 120 VAC/12 VDC emergency lighting battery units suitable for flush mounting in T-bar type suspended ceilings. Units to be complete with integral lampheads, batteries, charger, recessed housing and T-bar ceiling mounting hanger assembly. Units to also be complete with automatic testing and self-diagnostic circuitry.
- .2 Chargers to be fully automatic, solid-state type that automatically and instantaneously energizes lamp load upon failure of AC supply. Battery protection circuit automatically shuts down lamp load when battery reaches full discharge. Chargers to fully recharge battery in twelve (12) to twenty-four (24) hours and be current limited and short circuit proof. Units to include test switch and status indicator light.
- .3 Batteries to be long life sealed lead, maintenance free and have a capacity to supply sufficient output power to lamp loads and to exit sign emergency loads for a period of time in accordance with latest requirements of local governing building code but which is to be a minimum of sixty (60) minutes. Batteries to be designed for and guaranteed for at least ten (10) years of life expectancy.
- .4 Housing backboxes are constructed of No. 20 gauge steel, finished in white enamel. Back cover is removable to provide easy and full access to battery and charger connections. Front cover to include diagnostic indicator lights, test switch and provisions to mount light heads. Housing with batteries and charger are installed concealed above ceiling level.
- .5 Integral and remote surface mounted lampheads in climate controlled areas to be decorative design, high impact plastic, adjustable units with 12V, 6 W MR16 LED lamps.
- .6 Remote recessed mounted lampheads in climate controlled areas to be type EFR designer series white powder coated head with overall ring diameter of approximately 100 mm (4") and with housing having in-ceiling depth of approximately 150 mm (6"), with 12V, 6 W MR16 LED lamps.

- .7 Include for manufacturer's authorized representative to perform on-site after installation inspection, testing, adjusting, and verification of equipment. Such work to be performed during premium after hours' time. Refer to Part 3 for additional requirements.
- .8 Acceptable manufacturers are:
 - .1 Emergi-lite;
 - .2 Lumacell;
 - .3 Read-i-lite
 - .4 Beghelli (supplied by Omnilumen).

2.03 COMBINATION EMERGENCY LIGHTING BATTERY UNITS AND EXIT SIGNS

- .1 Emergi-lite "Premier" Series, CSA C22.2 No.141 certified, CSA-C860 approved, combination emergency lighting battery units and exit signs. System to be designed to provide emergency lighting levels in accordance with local governing building requirements.
- .2 Units are complete with batteries, charger, dual lamp heads per unit and features as follows:
 - .1 dual120/347VAC input and12 VDC output;
 - .2 one-piece unit frame and face plates made of injection-moulded white durable high-impact thermoplastic;
 - .3 snap in/out chevrons; no screws are necessary to hold the faceplate or backplate to housing;
 - .4 faceplates feature uniformly illuminated legend using LEDs to provide illumination in normal and emergency operation and mounted inside housing; LED-sensitive diffuser is mounted behind legend to provide the 150 mm (6") high by 20 mm (3/4") stroke letters with even illumination;
 - .5 equipped with self-testing / self-diagnostic features that automatically self-tests for one minute every 30 days, 10 minutes in 6th month and 30 minutes annually; when a fault is detected, bi-colour pilot light turns from green to red and flash, identifying source of failure (battery, charger circuitry, lamp load, LED strip);
 - .6 vandal-resistant shield with tamper-proof screws;
 - .7 unit suitable for wall or ceiling mount.
- .3 Chargers are fully automatic, solid-state type that automatically and instantaneously energizes lamp load upon failure of AC supply. Battery protection circuit automatically shuts down lamp load when battery reaches full discharge. Chargers to fully recharge battery in 12-24 hours and be current limited and short circuit proof.

- .4 Batteries to be long life sealed lead, maintenance free and have a capacity to supply sufficient output power to lamp loads and to exit sign emergency loads for a period of time in accordance with latest requirements of local governing building code but be a minimum of 60 minutes. Batteries to be designed for and guaranteed for at least 10 years of life expectancy.
- .5 Units include test switch and a green pilot light, located on face plate above legend.
- .6 Integral lampheads are 12 V, 6 W, LED, decorative design, high impact plastic, tool-less adjustable swivels, dual heads.
- .7 Include for manufacturer's authorized representative to perform on-site after installation inspection, testing, adjusting, and verification of equipment. Such work to be performed during premium after hours' time. Refer to Part 3 for additional requirements.
- .8 Acceptable manufacturers are:
 - .1 Emergi-lite;
 - .2 Lumacell;
 - .3 Aimlite;
 - .4 Beghelli (supplied by Omnilumen);
 - .5 Read-lite.

3 EXECUTION

3.01 INSTALLATION OF EMERGENCY LIGHTING UNITS

- .1 Provide emergency lighting battery units and lighting heads as specified herein and on Schedule of Luminaires, and mount where required. Connect battery units complete to dedicated emergency circuit of local power panels designated for this purpose or where identified on drawings, plug into designated adjacent receptacle. Provide wiring in conduit and connections to remote lamp heads and extend to central battery unit serving area.
- .2 Install units such that units to be automatically actuated upon failure of power supply to normal lighting in area covered by that unit equipment.
- .3 Connect exit signs to battery units circuits in applications where exit signs require backup DC supply.
- .4 Install combination units in locations and connect complete.
- .5 Obtain required training from manufacturer's representative on any special installation procedures. Install units in accordance with manufacturer's instructions to suit specific installation requirements.

- .6 Note that drawings identify location for battery units and generally identify circuiting of remote heads. In absence of direction of circuiting, provide wiring in conduit to feed remote heads and exit lights from nearest battery unit with sufficient capacity in area, in accordance with application requirements, manufacturer's requirements, and applicable codes. Multiple battery units may be required to accommodate connection of remote heads in some areas. Provide sufficient battery units to accommodate connected lamp loads and system design time of operation. Where more than one battery unit is installed in same immediate location, only one unit is required to be provided with integral lampheads.
- .7 Where battery model number is noted, it is for general reference and exact capacity may be required to be increased to suit connected loads and required battery output time duration to suit local governing codes. Ensure that emergency lighting operates at lighting levels and for duration to meet local governing codes.
- .8 For units serving genset room, provide SPD unit to line side of power supply to battery unit and install and connect in accordance with manufacturer's instructions.
- .9 Provide remote mounting lamp heads as specified and refer to Schedule of Luminaires where additional requirements may be identified. Provide remote mounting lampheads in locations to provide system performance in compliance with requirements of Documents and where applicable, local governing building code. Connect complete to battery units. Be responsible for revisions to system, including relocations, aiming and additional remote heads as determined by testing results. Generally, provide wiring in accordance with manufacturer's requirements but be minimum No. 10 AWG, and increased to suit voltage drop requirements recommended by system manufacturer to comply with local electrical code requirements. Confirm finish requirements with Consultant prior to ordering.
- .10 Provide hazardous location type heads in areas to suit local governing authority hazardous classification requirements.
- .11 Provide wiring in conduit and install devices in accordance to manufacturer's instructions. Comply with local governing codes and authority requirements with regards to providing fire rated conductors (MI) for life safety applications.
- .12 When installation of emergency lighting equipment is complete, and in conjunction with manufacturer's authorized representative, inspect and test entire system, adjust as required, and certify in writing to Consultant that system is complete, have been tested, adjusted, and are in proper operating condition. Also, be responsible for engaging emergency lighting manufacturer to perform an illumination level test in presence of Consultant, throughout all areas of building. Manufacturer's technician to be responsible for properly aiming remote light heads, recording light level readings on a record set of floor plans and calculating light level readings. Co-ordinate and arrange for local authority building inspector approvals. Prepare and submit to Consultant a letter on manufacturer's letterhead and signed by manufacturer's authorized technician, stating that emergency lighting levels meet requirements of local building code requirements and applicable CSA Standards. Notify Owner and Consultant at least 10 days prior to propose testing date. Testing dates and times to be reviewed with Consultant.
- .13 Provide minimum one hard bound copy and electronic copy of signed test report.

3.02 INSTALLATION OF T-BAR EMERGENCY LIGHTING UNITS

- .1 Provide emergency lighting battery units for recessed mounting to T-bar ceiling system, and mount where required. Connect battery units complete to dedicated emergency circuit of local power panels designated for this purpose or to designated power circuits where identified on drawings.
- .2 Obtain required training from manufacturer's representative on any special installation procedures. Install units in accordance with manufacturer's instructions to suit specific installation requirements.
- .3 Install housing backbox recessed in ceiling construction as per manufacturer's instructions. Install with suitable T-bar hangers.
- .4 Provide remote mounting lamp heads as specified and refer to Schedule of Luminaires where additional requirements may be identified. Provide remote mounting lampheads in locations to provide system performance in compliance with requirements of Documents and where applicable, local governing building code. Connect complete to battery units. Be responsible for revisions to system, including relocations, aiming and additional remote heads as determined by testing results. Generally, provide wiring in accordance with manufacturer's requirements but be minimum No. 10 AWG, and increased to suit voltage drop requirements recommended by system manufacturer to comply with local electrical code requirements. Confirm finish requirements with Consultant prior to ordering.
- .5 Provide wiring in conduit and install devices in accordance to manufacturer's instructions. Provide wiring in conduit to feed remote heads and exit lights, where applicable. Comply with local governing codes and authority requirements with regards to providing fire rated conductors (MI) for life safety applications.
- .6 When installation of emergency lighting equipment is complete, and in conjunction with manufacturer's authorized representative, inspect and test entire system, adjust as required, and certify in writing to Consultant that system is complete, have been tested, adjusted, and are in proper operating condition. Also, be responsible for engaging emergency lighting manufacturer to perform an illumination level test in presence of Consultant, throughout all areas of building. Manufacturer's technician to be responsible for properly aiming remote light heads, recording light level readings on a record set of floor plans and calculating light level readings. Co-ordinate and arrange for local authority building inspector approvals. Prepare and submit to Consultant a letter on manufacturer's letterhead and signed by manufacturer's authorized technician, stating that emergency lighting levels meet requirements of local building code requirements and applicable CSA Standards. Notify Owner and Consultant at least 10 days prior to propose testing date. Testing dates and times to be reviewed with Consultant.
- .7 Provide minimum one hard bound copy and electronic copy of signed test report.

3.03 TRAINING

- .1 Manufacturer's trained technician to perform onsite training of each user (including the provision of user guides) prior to project completion to ensure that users are properly trained in the operation and maintenances of system.
- .2 Refer to Instructions to Owner specified in Section entitled Electrical Work General Instructions.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

- .1 Submit shop drawings for products specified in this Section.
- .2 Include data sheets for cabling, faceplates, terminal cabinets, racks, etc., and proposed cabling testing sheets.
- .3 Submit following:
 - .1 proof that final installation drawings have been reviewed by a Registered Communications Distribution Designer (RCDD);
 - .2 samples of each type of data/voice jack complete with faceplate;
 - .3 samples of patch cord;
 - .4 sample of fibre optic cabling with proposed terminations, and horizontal copper cabling;
 - .5 sample of proposed labelling of components and wiring;
 - .6 sample of proposed test sheet;
 - .7 copy of tester calibration certificate;
 - .8 written confirmation that telecommunication system vendor is manufacturer's valid certified system vendor for at least duration of contract work and is in good standing at time of Bid submission;
 - .9 copy of system manufacturer's warranty.

1.2 REFERENCE STANDARDS

- .1 Comply with latest editions of following, as applicable for project:
 - .1 ANSI/TIA-568-D., family of Telecommunications Standards, including:
 - .1 ANSI/TIA-568.0-D - Generic Telecommunications Cabling for Customer Premises;
 - .2 ANSI/TIA-568.1-D - Commercial Building Telecommunications Infrastructure Standard;
 - .3 ANSI/TIA-568.2-D - Balanced Twisted-Pair Telecommunication Cabling and Components Standard;
 - .4 ANSI/TIA-568.3-D - Optical Fiber Cabling Components Standard;
 - .5 ANSI/TIA-568.4-D - Broadband Coaxial Cabling and Components Standard;
 - .6 Issued addendums.
 - .2 ANSI/EIA/TIA 606-C (CSA T528) - Administration Standard for Telecommunications Infrastructure;
 - .3 ANSI/EIA/ TIA-607-C (CSA T527) – Generic Telecommunications Grounding and Bonding (Earthing) for Customer Premises;
 - .4 ANSI/EIA/TIA-569-D (CSA T530) - Telecommunications Pathways and Spaces;
 - .5 ANSI/TIA/EIA-526-7-A - Measurements of Optical Power Loss of Installed Single-mode Fiber Cable Plant;
 - .6 Latest Building Industry Consulting Service International (BICSI) standards;
 - .7 Applicable local Building Codes.

- .2 Work to be installed by system manufacturers certified system installers/vendors who are certified and experienced in implementing selected data cabling system and to perform related testing programs.
- .3 System final installation layout to be designed and/or reviewed by a RCDD. Submit shop drawings verifying this requirement.

1.3 WARRANTY

- .1 System manufacturers to provide a minimum twenty (25) year full parts, labour, and performance warranty on all passive components including structural cabling system. These warranties to be provided in written certificate form and that guarantee following:
 - .1 passive system components, e.g. patch panels, UTP cable and outlet jacks, are free from manufacturing defects in material or workmanship;
 - .2 approved cabling systems exceed specifications of TIA-EIA 568-D standards for specified category, in particular for attenuation and near-end cross-talk, loss and bandwidth requirements;
 - .3 installation supports applications for which it was originally designed as well as future versions of system performance specifications and any future applications using TIA/EIA 568-D component and cabling standards;
 - .4 replacement or repair of any originally installed registered system component to be completed at no cost for parts and labour to Owner during warranty period. Any components repaired or replaced to be warranted for remainder of warranty.
- .2 System manufacturers to provide in writing to Owner that in event of demise or failure or change in approved status of installing certified system installer/vendor, manufacturer to be responsible for providing another certified system installer/vendor to fulfil remainder of warranty conditions.
- .3 Claim for repair procedure to comprise of contractor being notified of a problem and who will conduct necessary tests and repairs to correct problem. Should contractor be unable to resolve problem, contractor to contact system supplier who will take necessary action and provide any technical support to correct problem.
- .4 Initial response time to a repair claim for a registered system to be within four (4) hours from time Contractor was notified of system fault.
- .5 Ensure that selected network cabling component manufacturer includes a system warranty that is a true "end-to-end" structured cabling system warranty from a single manufacturer, which includes data/voice communications outlet and patch cord at workstation, horizontal copper cabling, and patch panel and patch cords at Telecom room. In addition, this warranty is to be valid with selected fibre optic cabling solution.

1.4 SCOPE OF WORK

- .1 This Section provides minimum standards for provision of a structured cabling system to network computer systems for complex. Requirements for network electronics are responsibility of Owner's Network Integrator. Work includes but is not to be limited to following:

- .1 provision of fibre optic cabling system; provision of fibre optic cabling for risers and intra-building backbone between telecom rooms and for applications as noted on drawings; use of fibre optic backbone cabling to augment system if more than one (1) network switch is used and distance between switches exceeds 90 m (295') and for applications as shown and as required by BICSI standards;
 - .2 provision of category grade rating Category 6A cabling system for a complete networking within complex which can support use of intelligent network switches with Network Management capabilities;
 - .3 organized wiring in a structured cabling system using point to point distribution system incorporating modular terminations;
 - .4 provision of data and voice cabling, data and voice communications outlets, patch panels and associated equipment;
 - .5 system testing and verification;
 - .6 coordination of system requirements and integration requirements with integrated systems.
- .2 The local area network system must be "protocol neutral" and provide users access into a variety of resources from any location within the Building. An Ethernet backbone shall be utilized for the system with intelligent network switches coordinating and managing data flow. The wiring configuration is based on a "physical star" topology in which cabling runs emanate in a radial pattern from the main data communications room in which the intelligent switches are located.
- .3 Technical features of the structural cabling plan include:
- .1 use of Category 6A cabling to each data/voice outlet;
 - .2 use of modular Category 6A jacks at workstation ends of data/voice cabling run;
 - .3 backward compatibility to categories 5e, 5 and 3.
- .4 The network cabling system vendor shall coordinate with Electrical Contractor to ensure that properly sized conduits, back boxes outlet boxes, junction boxes and floor boxes are provided of sufficient size as per EIA/TIA Standards to accommodate CAT 6A system wiring and devices, with particular emphasis on bending radii of cabling. Conduit and boxes not meeting Cat 6A standard requirements must be replaced.
- .5 Backbone fibre optic cabling infrastructure to be capable to support 100 Gbps for distances up to 10 km (6.2 mi) for single-mode fibre.
- .6 System to be designed to support minimum 802.11a/b/g/n/ac standards.

1.5 SYSTEM SUPPLIER QUALIFICATIONS

- .1 System supplier qualifications include:
 - .1 being an established communications and electronics contractor that has and currently maintains a locally run and operated business for at least five years and holds applicable provincial and local licenses;
 - .2 be an Authorized Distributor or established franchisee for manufacturer of product/system proposed with full manufacturer's warranty privileges and be capable of providing post warranty service;
 - .3 employ technicians who have attended and successfully completed manufacturer's technical certification classes for proposed system;
 - .4 show satisfactory evidence, upon request, that they maintain a fully equipped service organization capable of furnishing adequate inspection and service to system on a 24-hour/7-day basis;

- .5 maintain at their facility necessary spare parts in proper proportion as recommended by manufacturer to maintain and service equipment being supplied.
- .2 Submit written evidence of qualifications to Consultant for approval.

2 Products

2.1 FIBRE OPTIC CABLE AND TERMINATION EQUIPMENT

- .1 Various fibre optic cabling types and number of strands are required for network cabling infrastructures supporting various systems and equipment. Refer to drawings and specifications for additional requirements and confirm exact requirements with successful system vendors and Consultant prior to start of work.
- .2 Intrabuilding (within buildings): single-mode graded-index fibre optic cabling with following specification:
 - .1 ULC listed, OFNR/CMR riser rated, tight buffered;
 - .2 multi-strand single-mode laser optimized fibre optic cabling; (refer to drawings for number of strands);
 - .3 single-mode fibre to be 8/125 µm (900 µm).
- .3 Interbuilding (between buildings): single-mode fibre optic with following specifications:
 - .1 ULC listed for outdoor application;
 - .2 loose tube;
 - .3 3 mm gel filled buffer tubes, stranded around a central strength member and overall polyethylene outer jacket;
 - .4 multi strand – refer to drawing for number of strands.
- .4 Provide flexible PVC inner duct for installation in conduit, between cabinets within telecommunication space or cable run within large conduit which might contain any other cable for fibre optic cabling installations.
- .5 Provide plenum CMP rated cabling for applications as required by local authorities and codes.
- .6 Provide rack mount fibre optic termination patch panel in each telecommunication room/closet. Provide panel loaded with adapter strips to suit rack space, quality of fibre strands being terminated, and allowing for a quantity of 30% additional spare adapters. Include for required accessories, such as cable entry brackets, offset bracket kits, front cover, and standard supplied accessories. Provide panel and accessories in black colour finish. Mount in racks in accordance with manufacturer's instructions.
- .7 Fibre optic patch cords to be factory terminated with fibre connectors (exact type to be confirmed prior to start of work with Consultant/Owner) and of length to suit application. Colour requirements to be reviewed with Consultant/Owner prior to ordering.
- .8 Fibre optic cabling and component terminations to be type LC which must be confirmed with Owner and/or Consultant prior to start of work.

- .9 Tracer wire to be CSA approved/ULC listed and labelled, high-strength copper-clad steel conductor insulated with high-density, high molecular weight polyethylene (HDPE) insulation, and rated for direct burial use. Conductor to be minimum 20% conductivity for locating purposes. Insulation colour to meet local industry colour code standard for identification of buried utilities. Install in duct with fibre optic cabling as per manufacturer's instructions.
- .10 Acceptable fibre optic cabling infrastructure manufacturers are:
 - .1 Corning equipment as follows:
 - .1 Corning Landscape fibre optic patch panels
 - .2 Corning Fuselite LC connectors
 - .3 Corning Gold patch cables
 - .2 No accepted alternates.

2.2 HORIZONTAL CABLING

- .1 Horizontal cabling to data/voice outlets to be ULC listed and labelled, UTP cable and to comply with SNSI TIA/EIA-568A requirements for Category 6A transmission, ETL tested and verified to exceed Category 6A component performance. Cable minimum specifications to be:
 - .1 conductors: 23 AWG. copper conductor in twisted with four pairs contained in a flame retardant PVC jacket separated by a divider;
 - .2 cable grade: Category 6A;
 - .3 overall sheath: riser rated CMR / plenum rated CMP; WHITE outer sheath;
 - .4 PVC outer jacket colour to be of different colours to distinguish different systems as per Owner's direction; confirm colours with Consultant prior to Ordering.
- .2 CAT 6A system to exceed ANSI/EIA/TIA 568.2-D standard for an enhanced CAT 6A 4-connector channel. Demonstrate that proposed manufacturer's solution is guaranteed to exceed CAT6A requirements across entire swept frequency range of 1–500 MHz. Submit with shop drawings, ETL test reports to verify full channel performance of above specified measurements.
- .3 For multi-pair Cat 5e copper backbone riser cabling, provide Cat 5e, UTP cabling consisting of multi- unshielded twisted pairs of 24 AWG solid copper conductors insulated with colour coded PVC and CMR/CMP rated. Refer to drawings for number of pairs.
- .4 Incoming copper cabling to be provided with suitable lightning protection devices. Refer to additional requirements later in this Section.
- .5 Acceptable horizontal cabling infrastructure manufacturers are:
 - .1 Belden 10GXS13 0091000
 - .2 No accepted alternates.

2.3 OUTLETS

- .1 Data/voice outlets to meet or exceed category 6A performance and meets following specifications:

- .1 flush wall mounting faceplate to fit on single gang recessed outlet box, complete with device bracket or provisions that hold jacks securely in place;
 - .2 configuration: Category 6A, eight-position, RJ-45 modular jacks, T568B pinned; confirm exact requirements with Owner prior to ordering;
 - .3 constructed of high impact, flame retardant, thermoplastic;
 - .4 copper wires and connectors;
 - .5 faceplates: moulded PVC, finish to Consultant's direction, mounted to outlet box and bracket with matching screws;
 - .6 icons with suitable data and voice identifications.
- .2 Wall mounted telephone outlets to include features as follows:
- .1 required Category rating modular jack;
 - .2 wall plate of stainless steel construction;
 - .3 mounting studs on plate which are positioned to mount standard wall mount telephones with keystone adaptation flush to wall surface;
 - .4 accept wall mountable phones with short patch cord connections to jack module.
- .3 Jacks colours and faceplate colours to be different to distinguish different systems as per Owner's requirements. Confirm exact colour finishes and T568 pinning arrangement with Consultant prior to ordering.
- .4 Quantity of jacks and configuration of faceplates are as detailed on drawings.
- .5 Provide snap-in plastic dust covers on blank outlets and unused outlets.
- .6 Acceptable outlet manufacturers are:
- .1 Belden Keyconnect
 - .2 No accepted alternates.

2.4 PATCH PANELS

- .1 Modular rack patch panels with features as follows:
- .1 Cat 6A certified, 110 IDC technology;
 - .2 rack mounting hardware for patch panels to be rack mounted;
 - .3 wall mounting brackets and hardware for wall mounted units;
 - .4 48 port RJ45 jacks, in 1u configuration;
 - .5 circuit identification designation strip, snaps onto wiring block;
 - .6 horizontal trough for cables;
 - .7 distribution rings and ancillary devices as required.
 - .8 Patch panels to be BLACK;
 - .9 All ports to be numbered on the front and back of the panels.
- .2 Each jack connector module to have a T568B eight pin RJ 45 jack on front and 110 connectors on back. Panels to mount onto standard EIA 19 inch racks or cabinets and have capability to be stacked in larger systems. Horizontal data and voice cabling for various telecom rooms to terminate onto patch panels provided into floor standing or wall mounting equipment enclosures, as detailed and as required.
- .3 Patch panel system to include required accessories such as bezels, harnesses, pigtails, connectors, jumpers, and retaining rings, interlay racking panels, horizontal wire managers etc., to provide for patch cord management.

- .4 A wall mounted NEMA 2 enclosure with removable covers to be provided on wall near fibre patch panel and innerduct to be provided for fibre cabling extending from this enclosure to fibre patch panel. This slack enclosure to be sized to accommodate a length of approximately 20 m (60') of slack at each end of runs. Ensure that fibreglass centre member is secured to enclosure's designed anchor points according to products design.
- .5 Acceptable patch panel manufacturers are:
 - .1 Belden KeyConnect AX103121
 - .2 No accepted alternates.

2.5 PATCH CORDS AND CABLES

- .1 Copper data patch cords to be modular, 28 AWG solid copper conductor, Category 6A, CMR, BLUE.
- .2 Copper patch cords to be factory terminated and tested, and be provided in lengths from 600-2100 mm (2'-7') at patch panel end to suit specific applications. Lengths to meet manufacturer's requirements to comply with required category grade performance standards. Provide patch cords in quantities to accommodate requirement that all ports are active.
- .3 Unless otherwise noted, patch cords at workstation ends are to be 10ft and 7 ft for each workstation/drop.
- .4 Fibre optic patch cords to match and be of same manufacturer as fibre optic cabling and be with required terminations. Patch cords to be provided to suit end to end structured cabling system and to accommodate network electronics as directed by Consultant and Owner. Connector terminations to be LC type, confirm with Consultant and Owner prior to ordering.
- .5 Patch cords to be of different colours to distinguish different systems as per Owner's requirements. Confirm exact colour finishes with Consultant prior to ordering.
- .6 Acceptable patch panel manufacturers are:
 - .1 CAT6A Patch cords:
 - .1 , Belden CAT6A, 10GXS, BLUE, CAD1106007 (1 per data drop)
 - .2 Belden CAT 6A, 10GXS, BLUE, CAD1106010 (1 per data drop)
 - .3 No accepted alternates.
 - .2 Fiber Optic Patch cables:
 - .1 Corning OM4 LC/LC duplex 4 x 2m, 4 x 4m
 - .2 No accepted alternates

2.6 EQUIPMENT CABINETS

- .1 Enclosed type, equipment cabinets to be heavy duty type, complete with but not be limited to following requirements:

- .1 steel construction frame work with steel or aluminum construction sides, backs, tops and bottom panels;
 - .2 ventilation fans and louvers;
 - .3 minimum 1800 mm (70") in height;
 - .4 polyurethane finish or enamel painted finish to Consultant's approval;
 - .5 double sided 12/24 tapped holes;
 - .6 sized and spaced for standard EIA 19" racking;
 - .7 heavy duty base with provision for bolting to floor;
 - .8 high capacity cable organizer channel with snap on cover;
 - .9 full height front and back hinged lockable doors with handle operators with locks and keys; keys to be keyed alike as per Owner's direction;
 - .10 full height vertical cable channels on both sides of rack;
 - .11 horizontal cable management channel – minimum one for each patch panel;
 - .12 front and rear cable management provisions (typically only last 150 mm (6") of cabling to connector to be loose and not in channel);
 - .13 rack mounted multi- outlet power strips with surge protection, integral breaker, pilot light and power cord with twist lock type plug and receptacle provisions; number of outlets to be same as number of active devices housed in equipment enclosure;
 - .14 required mounting hardware, label kits, Velcro style fasteners and ancillary devices.
- .2 Include independent grounding to TGB provisions for each cabinet, to meet previously listed standards, which include but are not limited to following provisions:
- .1 copper ground strip mounted on side rail extending full height of rack;
 - .2 equipment jumper kits, to bond network equipment to rack ground strip;
 - .3 common bonding network to rack jumper kit, to bond rack to room common bonding network;
 - .4 hardware including, copper compression HTAPS, paint piercing washer kits, bonding screws and electrostatic discharge port kits.
- .3 Wall mounted equipment enclosures to be provided where required with similar applicable features as per specified floor mounted products, but sized to suit application and complete with wall mounting hardware and hinged feature to allow access to rear of cabinet.
- .4 Cabinets to be of size and quantity to accommodate respective number of patch panel ports to suit number of required drops, quantity of network electronic components as directed by Owner's network integrator, uninterruptible power supply unit, and an additional 20% spare capacity for future expansion.
- .5 Acceptable manufacturers are:
- .1 Belden 45U Distribution Rack Part # XDR8419-3102836
 - .2 Belden Part # BHVL012 (vertical cable manager between racks)
 - .3 Belden Part # BHVL006 (vertical cable manager on rack ends)
 - .4 No accepted alternates

2.7 ACCEPTABLE CONTRACTORS

- .1 Contractor selected for installation of structured cabling system to provide confirmation of following:
 - .1 detailed knowledge and experience in fibre optic cabling and category grade rating copper UTP wiring installations;

- .2 detailed knowledge and experience in installation of Intelligent equipment;
 - .3 experience in troubleshooting and problem solving in data communication networks.
 - .4 ability to provide system manufacturer's certified warranties;
 - .5 certified and valid proof of being system manufacturer's authorized vendor.
- .2 Refer also to supplier requirements specified in Part 1.

3 Execution

3.1 INSTALLATION OF NETWORK CABLING – GENERAL

- .1 Properly handle and install structured network cabling in accordance with manufacturer's specifications. Avoid undue pulling tension, abrasion, or rough handling to ensure that cables will permit transmission up to required category rating design speed for cables. Install cables without splices or cuts to ensure elimination of reflections, discontinuities, impedance mismatches, etc. maximum horizontal length of copper cabling from workstation to network switch is not to exceed 90 m (295') or less if recommended by system manufacturer to meet required category grade rating performance standards. Maximum length of patch cables (either cross connects or interconnecting with electronic equipment to connect devices at work area outlet), to be a total of 10 m (30'). Maintain system manufacturer's minimum channel lengths as confirmed with system manufacturer. Provide cable loops in accordance with manufacturer's instructions.
- .2 Unless otherwise noted or where cable tray is shown for such use, run cabling in conduit. Install pull cords for future use, in conduits extending between floors.
- .3 Generally, no more than two (2) 90-degree changes in direction are recommended for cable installed in conduit without pull boxes and not more than 40% fill ratio. Confirm exact conduit bending radii restrictions and fill ratios with system manufacturer and comply with those standards.
- .4 With consideration in minimizing alien crosstalk to levels as per BICSI standards and manufacturer's standards, dress cables in a neat and orderly fashion from entrance of communications closet to relay racks using vertical and horizontal cable management trays and paths. Do not exceed manufacturer's distance limitations to maintain required category rating performance standards.
- .5 Care to be taken to ensure that during installation, nicks, abrasions, burning and scuffing of cable is prevented. Replace cables found to be damaged regardless of whether cable passes category grade rating or fibre performance testing standards.
- .6 Secure bundled cables transitioning between floors via ladder cable tray, to vertical ladder sections with Velcro wraps. Use waterfall (rounded transition) fittings for cable changing from a horizontal path to a vertical one. This is to maintain minimum bend radius for cabling system. Support cables running through risers between floors such that they are properly supported for their weight, especially in situations with high pair count cables and large bundles.
- .7 Electrical Contractor and telecommunication system vendor to provide coordination of structured cabling system with other systems as required.
- .8 Required necessary drilling and anchoring components to be installed before any horizontal cable is installed.

- .9 Route horizontal cable into equipment racks/enclosures and neatly bundle with Velcro cable ties. Maximum number of cables per bundle to be 25.
- .10 Securely mount fire retardant plywood on wall in each telecommunications room or closet.
- .11 Review installation of conduits and boxes and advise Electrical Contractor where products do not comply with CAT 6A Standards. Ensure that products are replaced as required to meet standards.
- .12 Cables wraps are to be Velcro type and are not to be over tightened.
- .13 Provide grounding and bonding requirements as specified in Section entitled Grounding and Bonding.

3.2 INSTALLATION OF FIBRE OPTIC CABLE

- .1 Provide fibre optic cable and inner duct for running in conduit between main/secondary equipment room and each telecom room, as well as between buildings. Install in strict accordance with manufacturer's specifications. Refer to riser drawing for run requirements.
- .2 Comply with manufacturer's minimum installation bend radius. Allow slack at sharp turns in cable run and immobilize cable at point of bend. Monitor tension on cable during installation when pulling winches are used and do not exceed tensile rating of cable. After installation, only allowable tensile force on cable to be that of its own weight. Terminate onto equipment terminations in accordance with manufacturer's instructions.
- .3 Attachments and grips for cable and installation temperature requirements to be provided as specified by manufacturer.
- .4 Terminate cable, install termination shelf panel on rack and splice/breakout fibres as required in accordance with manufacturer's recommendations to suit Owner's directions. Provide patch cords as required.

3.3 INSTALLATION OF PATCH PANELS AND ACCESSORIES

- .1 Provide patch panels onto racks in locations. Provide terminating hardware and connectors to suit incoming and outgoing cabling. Clearly identify each port. Provide patch cords as required. Install devices in accordance with system manufacturer's requirements.
- .2 Terminate both data and voice horizontal cabling onto patch panel punch downs using manufacturer's recommended tools. Bundle cabling in neat configuration and secure to patch panels and rack assemblies. Typically dedicated separate patch panels are required for data and voice.
- .3 Install rack enclosures on walls. Neatly bundle wiring within wiring management channels. Do not over tighten Velco straps. Ground racks as required.

3.4 INSTALLATION OF TERMINATION HARDWARE

- .1 For main telephone service incoming conductors to main communication closets, provide 110 connectors and mounts on hardwood backboards on walls or on racks. Refer to drawing details. Design system layout to best suit incoming and outgoing cables. Properly punch down cabling with manufacturer's required tool and label each connector as required.

- .2 Run interconnect cables neatly secured and bundled across connectors and between banks of mounts. Use D-rings to their full advantage. Neatly bundle pigtails and secure to 110 connectors.
- .3 Where wall mounted, align mounts in straight formations to provide a neat installation and to minimize interconnect wiring lengths.
- .4 Co-ordinate with Owner's network integrator to determine exact requirements for telephone service interconnections.

3.5 COPPER CABLE INSTALLATION

- .1 Run horizontal, UTP cables continuous from end to end with no splices. Install horizontal cables in Star topology, emanating from rack mounted patch panel(s) and terminating on data outlet faceplates in rooms or other workstation locations. maximum length for horizontal cables to not exceed 90m (295'). Maximum length for patch cords at patch panel to not exceed 3m (10').
- .2 Install conductors in cable tray and conduit runs designated for data and voice conductors. Do not fasten conductors and conduit to suspended ceiling support systems. Support conduit to building structure slab independent of other support.
- .3 Terminations to involve as little outer jacket removal as possible and cable pairs "untwisting" is to not exceed 6 mm (¼").
- .4 Provide slack cable to allow for minor workstation relocations. Provide a coil of slack cable of an approximate 2 m (6') length for each workstation outlet run.
- .5 For main voice backbone cabling from main telecom room, provide 110 connectors and mounts on hardwood backboards on walls, as required. Design system layout to best suit incoming and outgoing cables. Properly punch down cabling with manufacturer's required tool and label each connector as required.
- .6 Run interconnect cables neatly secured and bundled across connectors and between banks of mounts. Use D-rings to their full advantage. Neatly bundle pigtails and secure to BIX/110 connectors.
- .7 Align mounts in straight formations to provide a neat installation and to minimize interconnect wiring lengths.
- .8 Coordinate with Owner's network integrator to determine exact requirements for telephone service interconnections.
- .9 Provide jumpers/pigtails to interconnect backbone wiring to rack mounted voice patch panels where horizontal voice cabling is terminated.
- .10 For horizontal copper backbone cabling, multi- pair conductor cabling is preferred. If available only in limited number of pair cabling, provide multiple runs to provide quantity as identified on drawings, and increase conduit diameters to suit exact number requirements, in accordance with of standards and codes.

3.6 PENETRATION THROUGH FIREWALLS

- .1 Provide a conduit sleeve where horizontal cables penetrate firewalls. Size conduit sleeve at 40% fill ratio with a plastic bushing at both ends.
- .2 After conduit sleeve is installed, fill opening around conduit with firestop and smoke seal materials.

3.7 INSTALLATION OF OUTLETS

- .1 Connect each data/voice outlet with a 4-pair, UTP cable. Test and identify each outlet and faceplate. Wire and connect data/voice jacks back to respective dedicated racks in telecom rooms. As detailed, extend voice cabling from voice patch panels to wall mounted 110 connectors, using patch cords, cross connects/jumpers, etc. as required.
- .2 Provide outlet jack/faceplate configuration as detailed on drawings.
- .3 Drawings identify data jacks for wireless access point receivers (antennae). These locations are approximate. Confirm exact locations during onsite radio frequency studies. Allow for jacks to be repositioned up to 4m (15') to suit results of studies. Perform studies after completion of construction of interior structures. If studies are not performed at discretion of Owner, obtain direction from Consultant to leave slack coiled length of cable on each run, allowing for repositioning.

3.8 SEPARATION OF DATA COMMUNICATION CABLES FROM SOURCES OF ELECTROMAGNETIC INTERFERENCE

- .1 Separate data communication cables from sources of electromagnetic radiation in accordance with TIA Standard Proposal SP-2072 and following:
 - .1 FT-6 rated data cabling raceway and power conductors (2 KVA power circuits) raceway require 125 mm (5") clearance;
 - .2 for fluorescent luminaires, required clearance is 300 mm (12");
 - .3 clearance increases up to 600 mm (24") for power circuits over 5 KVA.
 - .4 for large motor, transformers, power panels, etc., required clearance is 1m (39");
 - .5 route cables to avoid direct contact with steam piping, hot water piping or other heat sources to avoid thermal degradation.

3.9 INSTALLATION OF RACKS

- .1 Provide racks and secure to floor with bolts and concrete anchors.
- .2 In locations where more than one rack is required, butt multiple racks together. Provide wiring channel interconnection such that wiring from rack to another is not exposed.
- .3 For open racks, provide metal raceway chimney channel for conductors extending down from ceiling, such that wiring is not exposed. Secure channel to rack and ceiling.
- .4 Run wiring neatly bundled within wiring management channels. Do not over tighten Velcro tie wraps such that they deform cable jacket. Velcro straps to easily slide along length of cable. Velcro tie wraps used in plenum spaces to be CMP/FT-6 rated.
- .5 Protect cable from any obstructions using appropriate grommeting in roof of rack.
- .6 Properly ground and bond rack and equipment to room ground bus as per specifications and to standards of TIA/EIA 607.

3.10 INSTALLATION OF EQUIPMENT ENCLOSURES

- .1 Provide equipment enclosures and secure to wall/floor/ceiling as required with suitable anchors.
- .2 In locations where more than one enclosure is required, butt multiple enclosures together. Provide wiring channel interconnection such that wiring from enclosure to another is not exposed.
- .3 Provide metal raceway chimney channel for conductors extending down from ceiling, such that wiring is not exposed. Secure channel to enclosure and ceiling.
- .4 Provide suitable power supply to cabinets having fans and other active components or designated as such.
- .5 Run wiring neatly bundled within wiring management channels. Do not over tighten Velcro tie wraps such that they deform cable jacket. Velcro straps to easily slide along length of cable. Velcro tie wraps used in plenum spaces to be CMP/FT-6 rated.
- .6 Protect cable from any obstructions using appropriate grommeting in roof of enclosure.
- .7 Properly ground and bond enclosure and equipment to room ground bus as per specifications and to standards of TIA/EIA 607.

3.11 SYSTEM IDENTIFICATION

- .1 Provide a complete identification system that clearly designates following:
 - .1 horizontal cable;
 - .2 workstation (or faceplate);
 - .3 horizontal/passive patch panel port;
 - .4 switch/active patch panel port;
 - .5 patch cords;
 - .6 switch rack.
- .2 Obtain Owner's approval of identification format, prior to start of work. Format to comply with Owner's standards. Submit proposed identification system and nomenclature with shop drawing submission.
- .3 Labels:
 - .1 Labels for outlet and patch panel identification to be typewritten/computer printed self-adhesive type with white printing area at outlet location and on face of patch panel; legible permanent marker on inside of outlet box cover; use minimum font size Arial 10 point.
 - .2 Number and identify each computer hub rack with a 20 mm x 50mm (¾" x 2") engraved lamacoid plate, with white letters on black background. For letters and numbers use Arial 24 font size. Fasten nameplates with minimum two metal screws.
 - .3 Cable Identification:
 - .1 Permanently identify horizontal UTP cables at both ends of cable, placed within 13mm (½") at outlet location and 50 mm (2") at rack location and inside of outlet cover in following manner:

"CABLE # / RACK # / PATCH PANEL PORT # / OUTLET #"

- .4 Faceplate:
 - .1 Label data ports: "Closet / Patch Panel/Port Number", where closets to be numerically assigned, patch panels to be sequentially alphabetically assigned beginning at top of rack and ports sequentially numerically assigned related to number of ports per patch panel.
 - .2 Label voice ports: "Port Number/Level/Closet", where ports are sequentially numerically assigned, level refers to floor level on which communication closet is located and closets to be numerically assigned as per data ports.
- .5 Patch panel And Patch Cord Identification:
 - .1 Identify patch panel ports in simple numeric form approved by Consultant/Owner.
 - .2 Identify patch cords at both ends in simple numeric form, not necessarily corresponding to port numbers and be approved by Consultant/ Owner.
- .4 Identification Log:
 - .1 Record cable and workstation identification in a hard copy "CABLE IDENTIFICATION LOG" which is to be handed over to Owner after cable testing and certification is complete. Forward duplicate copy to Consultant.

3.12 CABLE TESTING AND SYSTEM CERTIFICATION

- .1 Structured cabling system certification to include 100% cable testing and verification for an EIA/TIA required category grade rating solution.
- .2 Perform verification of each cable and document on a cable testing sheet forming part of hard and soft copy documentation supplied at end of installation. Testing sheets to list detailed performance test measurements as requested and as required to prove compliance with referenced standards. Also include summary sheet of passes, failures and rectified failures. Submit sample of test sheet with shop drawings.
- .3 Comply with system manufacturer's testing and certification procedures.
- .4 Testing Procedures:
 - .1 Perform testing using Category 6A testers such as Fluke Networks Versiv family, or equivalent Microtest or Scope Communications. Tester to meet TIA/ISO certification standards for Levels IIe, III, IIIe, IV and V. Submit with shop drawings copy of calibration certificate issued by tester manufacturer's authorized technician identifying calibration within one year of use for testing on this project. Testing to include, but not be limited to following:
 - .1 wire map;
 - .2 cable length;
 - .3 attenuation;
 - .4 near end crosstalk (next);
 - .5 power sum near end crosstalk (PSNEXT);
 - .6 equal level far end crosstalk (ELFEXT);
 - .7 power sum equal level far end crosstalk (PSELFEXT);
 - .8 return loss;
 - .9 ACR;
 - .10 power sum ACR;

- .11 end to end continuity;
 - .12 opens or shorts;
 - .13 pair polarity.
 - .2 Field testing units for singlemode fibre optic cabling to comply with ANSI/TIA/EIA-526-7.
 - .3 Tester to include required modules for certification testing of fibre optic cabling. Perform fibre testing on each fibre in completed end-to-end system. Do not splice cables except where approved by Consultant. Testing to consist of an end-to-end power meter test performed per TIA/EIA-455-53A and. Provide system loss measurements at 1310 and/or 1550 nanometers for single mode fibres. These tests also include continuity checking of each fibre.
 - .4 Test backbone 1310 and 1550 nm for single mode in at least one direction.
 - .5 Conduct test set-up and performance in accordance with ANSI/TIA/EIA-526-7 and/or ANSI/TIA/EIA-526-14 Standards, and to manufacturer's application guides.
 - .6 Perform attenuation testing with a stable launch condition using two-meter jumpers to attach test equipment to cable plant. Light source to be left in place after calibration and power meter moved to far end to take measurements.
 - .7 Replace cable not passing testing procedure, in its entirety. No splicing is permitted in repair of any defective cable.
- .5 Reports:
- .1 Submit test results to system manufacturer and obtain manufacturer's certificate of approval of system. Submit detailed indexed test report in a 3 - ring binder with manufacturer's certificate of approval and covering letter from company responsible for installation and testing of system stating accuracy of report. Letter to be signed by company's authorized testing technician. Document testing and reports with date and time of testing, testing technician's name and signature and specification Section number that test fulfilled.
 - .2 Submit copy of report including test reports in digital format loaded on USB type memory flash drive.

3.13 SYSTEM TRAINING AND INSTRUCTIONS

- .1 Provide training of Owner's designated staff on principles of connections and operations to system. Clearly instruct on procedures of disconnections and reconnections to accommodate changes and relocations of connected equipment.

END OF SECTION

1 GENERAL

1.1 REFERENCES

- .1 Division 26, 27, and 28 specifications
- .2 All other contract documents

1.2 SECTION INCLUDES:

- .1 Detailed design, manufacture, supply, install, inspection, and testing of the overhead paging systems.

2 PRODUCTS

2.1 REQUIREMENTS:

- .1 Products to be CSA approved and/or ULC listed and labelled as required by local governing authorities.

2.2 OVERHEAD PAGING

- .1 Acceptable Manufacturers:
 - .1 Biamp Vocia
 - .2 Quam
 - .3 Atlas IED
 - .4 Other approved alternates
- .2 General System Features:
 - .1 System to be a networked decentralized architecture with addressable speaker zones with control units and control components connected and distributed throughout installation areas.
 - .2 System to use digital signal processing (DSP) technology. General Paging output shall be adjustable on a “system” basis, with selective audio source and volume control per floor. System components to be addressable and Ethernet- enabled.
 - .3 System shall have the ability to integrate with facility VoIP telephone system allowing paging from telephones.
 - .4 System includes fixed wall-mounted paging station.
 - .5 System to provide a priority page override function that:
 - .1 temporarily sets all loudspeakers to a predetermined paging input and volume level;
 - .2 Is integrated with Fire Alarm system outputs
 - .6 System to provide electronic security measures, including:

- .1 password-protected access levels
- .2 user-definable access to functions available;
- .3 continuous monitoring of communications with each networked device;
- .4 storage of settings in non-volatile memory in control panel component, which is be maintained during power outages.
- .7 System to be equipped with automatic failure notification. In event of a failure, system to send an email notification to operations, IT and maintenance of such failure. Notifications alert to be displayed in real time on master control and monitoring screen.
- .8 System to maintain record/schedule of all pages, failures, system start up and shut down. Submit proposed schedule for review by Owner.
- .9 System to be equipped to record and store emergency broadcast messages. These messages may be programmed to be played as reviewed by Owner.
- .3 Sequence of Operations:
 - .1 In the event of emergency alert from the Fire Alarm panel, paging system will receive emergency mute override(s) so that the audible announcement will be heard through the separate Fire Alarm public address system.
 - .2 When not in use for Paging, system shall allow Background Music playback through audio sources provided by Owner. During a page event, those respective zones will mute all other audio sources to allow Paging audibility. Zones outside of the page event will not be affected.
 - .3 Customizable page codes will be entered into facility VoIP phones to enable live paging into specific zones.

2.3 SUBMITTALS

- .1 Action Submittals
 - .1 Product data sheets.
 - .2 Shop drawings.
 - .3 Product schedules.
 - .4 Product test reports.
- .2 Informational Submittals

- .1 Field test reports.
- .2 Manufacturers' warranties.
- .3 Maintenance data.
- .4 Record drawings.

2.4 GENERAL DESCRIPTION

- .1 Provide all detailed design, supply all products, services, installation, software, programming, inspection, testing and commissioning of background music and paging system for a complete and functional system and sub-systems as intended in this specification.
- .2 All products and components for the complete system may not be listed in these documentations.
- .3 Some products and components may be discontinued at the time of procurement. It will be the responsibility of the proponent to provide the most current replacement model for all discontinued product that meet the requirements of these specifications. Provide a complete detailed design of all systems for review and approval; expect several revisions.
- .4 Errors, discrepancies and/or omissions not identified during the bid period shall remain as requirement to the most stringent requirement specified within this document or in subsequent drawings to form a complete and functional system. discrepancies and/or omissions not identified during the bid period shall remain as requirement to the most stringent requirement specified within this document or in subsequent drawings to form a complete and functional system.

2.5 MANUFACTURERS/VENDORS

- .1 All products shall be sourced from a single manufacturer to ensure an end-to-end solution is provided.
- .2 Approved manufacturers:

- .1 Belden (Preferred)
- .2 Panduit
- .3 Chatsworth
- .4 Leviton
- .5 Middle Atlantic
- .6 Commscope
- .7 Corning (fibre optic components only)

3 PRODUCTS

3.1 FUNCTIONAL DESCRIPTION OF SYSTEM

- .1 System Functions
 - .1 System shall be installed an independent private network.
 - .2 System shall be connected through Ethernet based LAN connections between floors TIA/EIA 568-C family of standards.
 - .3 Selectively connect any zone to any available signal channel.
 - .4 Selectively control sound from microphone outlets and other inputs.
 - .5 "All-call" feature shall connect the all-call sound signal simultaneously to all zones regardless of zone or channel switch settings.
 - .6 telephone paging adapter shall allow paging by dealing an extension from any local telephone instrument and speaking into the telephone.
 - .7 Produce multiple channels of high-quality background music, individual channels of background music shall be selectable by zone
 - .8 Produce a program-signal tone that is amplified and sounded over all speakers, overriding signals currently being distributed.
 - .9 Play pre-recorded messages triggered by either controllers or telephone handsets via the telephone paging adapter. Pre-recorded messages shall be selectable by zone
 - .10 Reproduce high-quality vocal reproduction that is free of noise and distortion at all loudspeakers at all times during equipment operation including standby mode with inputs off; output free of non- uniform coverage of amplified sound
- .2 The overhead paging/ background music system shall utilize distributed amplification through network topology.
- .3 Provide end of line monitoring on all speaker zones
- .4 All audio video equipment other than power amplifiers shall be powered by uninterruptable power supplies (UPS) to provide line filtering for AV signals and provide

minimum 5min back up

- .5 Provide Warranty as follows, provide 3 years on all software and hardware provided, with scheduled semi-annual site visits to verify system performance as specified.

3.2 GENERAL EQUIPMENT & MATERIALS REQUIREMENTS

- .1 Compatibility of Components
 - .1 Coordinate component features to form an integrated system. Match components and interconnections for optimum performance of specified functions
- .2 Equipment
 - .1 Comply with UL813. Equipment shall be modular, using solid—state components, and fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

3.3 VOIP PAGING INTERFACE

- .1 VOIP Telephone Interface Module
 - .1 The telephone interface module shall provide an interface between the zone paging system and the local Private Branch Exchange (PBX) or Key Switch.
 - .2 Integrate with phone and custom schedule.
 - .3 Volume Control: Individual Control for each speaker zone and all background music Sources
- .2 The VoIP paging adapter device shall be designed exclusively network distributed paging systems. It shall integrate with SIP-based VoIP call managers as a third-party SIP extension.
- .3 Front panel indicators shall provide fault and status indications as well as status and in-use indication for each VoIP line.
- .4 The unit shall support two or four VoIP lines with software-configurable level controls for inputs, preambles, and prompts.
- .5 Signal processing shall include five-band parametric equalization, compression, and PIN code access per line.
- .6 The device shall permit call actions to be associated with virtual control actions to enable DTMF control of events.
- .7 Programmable voice prompts shall be available for menu-driven call prompts. The device shall allow paging preambles to be applied and shall support page stacking and store-and-forward functionality.
- .8 Full logging of the unit status shall be reported to the network.
- .9 Warranty shall be five years

3.4 DESKTOP PAGING STATION

- .1 Submit shop drawings for products specified in this Section.
- .2 Provide as per locations aggregated upon with client during final design
- .3 Provide disconnection plate and cable pass-through through desk, confirm approach with Architect.
- .4 The desktop paging station shall provide paging audio and control data via audio network and receive
- .5 Power over Ethernet (PoE+) utilizing a single (CAT6A) network cable to a bottom panel RJ-45 connector.
- .6 Ten buttons shall be provided on the front panel for recalling page codes with preambles
- .7 Multiple desktop paging stations may be connected to audio network system by means of ethernet switches
- .8 Four software configurable priority paging levels shall be available
- .9 The desktop paging station shall include override, store and forward, and lock-out capabilities.
- .10 Each desktop paging station shall provide local digital audio signal processing, local storage of configuration data and standard and uploaded preambles in .WAV format.
- .11 Desktop paging stations shall have a backlit LCD screen, PIN code accessibility and a gooseneck cardioid microphone.

3.5 NETWORKED POWER AMPLIFIER

- .1 Amplifier shall be modular and software configurable.
- .2 Comply with Ethernet based audio transport protocols.
- .3 Comply with TIA/EIA SE-101-A.
- .4 Mounting: Rack mounted. Number of Channels: 8 Output Power: 150W.
- .5 Rated Load Impedance: 25V, 70V and 100V operation Frequency Response: +0.25 dB (20 Hz to 20 kHz.)
- .6 Minimum Signal-to-Noise Ratio: <105 dB (A-Weighted, below rated output power (20 Hz — 20 kHz)) Total Harmonic Distortion (THD): <.35% (at full rated power (20 Hz — 20 kHz))
- .7 Crosstalk (Below rated power, 2- Hz — 1 kHz): >80dB
- .8 Controls: On/off, input levels, reset, and high-pass/low-cut filter, mode switch (Dual or Bridge-Mono)

- .9 Input Sensitivity: Matched to preamplifier and providing full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on speaker microphone or handset transmitter.
- .10 Input Impedance: 10 k Ohms (nominally balanced)/ 5 k Ohms (nominally unbalanced).

3.6 MICROPHONE

- .1 Length 215mm (8.5")
- .2 Type Condenser (back electret)
- .3 Polar Pattern Cardioid
- .4 Frequency Response 50 Hz - 18 KHz
- .5 Sensitivity -37dB +/- 3dB at 1 KHz (0dB = 1 V/Pa)
- .6 Impedance 200 Ohms
- .7 S/N Ratio 69dB (A)
- .8 Maximum Sound Pressure Level 125dB 1% THD
- .9 Power Requirements 9 - 48 volts phantom power
- .10 Termination Male 3 Pin XLR
- .11 Supplied Accessories W2 Foam windshield included 12 Finish Satin Black or White
- .12 Dimensions 12mm (0.5")

3.7 MESSAGE SERVER:

- .1 LAN: Separate ports for TCP/IP Control and Audio Over IP protocol
- .2 Internal memory for recorded message storage and playback
- .3 Time server support
- .4 Remote 3rd party control capability via IP or RS232
- .5 UL Listed

3.8 AMPLIFIED LOUDSPEAKERS

- .1 General

- .1 Approved Manufactures where noted:
 - .1 Community
 - .2 JBL
 - .3 QSC
 - .4 Tannoy Submit shop drawings for products specified in this Section.
- .2 Speaker — Type 1
 - .1 Finish: Corrosion-resistant zinc plated steel can, white paintable ABS baffle, matched dual-layer powder-coated steel grille
 - .2 Nominal Beamwidth (H x V): 125° Conical
 - .3 70V/100V Autoformer: 60W, 30W, 15W, 7.5W (@70V only)
 - .4 Continuous Max Output: 114 dB (120 dB Peak)
 - .5 Operating Range: 65 Hz — 22 kHz
 - .6 Sensitivity (1W/1m): 94 dB
 - .7 Power Handling: 100W continuous @ 8 ohms
 - .8 Dimensions (H x Dia): 6.8" x 11.2" (173 x 286 mm)
 - .9 Transducers: LF - 1 x 6.5", HF — 1 x 1" exit compression driver

3.9 CONDUCTORS AND CABLES

- .1 Jacketed, twisted pair and twisted multipair, untinned solid copper.
- .2 Insulation for Wire in Conduit: Thermoplastic, not less than 1/32 inch (0.8 mm) thick.
- .3 Audio Cables: Overall foil shield with stranded TV drain. available with 24, 22, 20, 18 AWG twisted pair bare stranded conductors
- .4 Microphone Cables: Neoprene jacketed, not less than 2/64 inch (0.8 mm) thick. over shield with filled interstices. Shield No. 34 AWG, tinned, soft-copper strands formed into a braid or approved equivalent foil. Shielding coverage on conductors is not less than 60 percent
- .5 All Cabling shall be Plenum Rated Cable: Listed and labeled for plenum installation

3.10 LOUDSPEAKER CABLING

- .1 Cabling routed within return air plenums shall be plenum-rated unless installed in conduit.
- .2 Install signal cables secured to ceiling hanger support or building structure per local code and electrical inspector requirements. Cabling shall not contact ceiling tiles or inhibit their removal for access to the plenum. Provide adequate service loop for convenient access to loudspeaker.

- .3 Connect no more than 8 loudspeakers/home run.
- .4 Install no more than 200' of cable between amplifier unit and last loudspeaker on each home run.

3.11 NETWORK CABLING

- .1 All system network cabling shall be Category 6A UTP
- .2 Cables and Termination Hardware: Test 100 percent for defects in installation and verify cabling system performance under installed conditions in accordance with ANSI/TIA-568-C.0.
 - .1 Verify all pairs of each installed cable before system acceptance.
 - .2 Defects in cabling system installation, including but not limited to cables, connectors, patch panels, and connector blocks shall be repaired or replaced to ensure 100 percent useable conductors in all cables installed.
- .3 Test all cables in accordance with this specification section, ANSI/TIA-568-C.2 standard, and manufacturers instructions.
 - .1 If any of these are in conflict, bring discrepancies to the attention of the Architect for clarification and resolution.
- .4 Cables, Jacks, Connecting Blocks, and Patch Panels:
 - .1 Verify all pairs of each installed cable before system acceptance.
 - .2 Defects in cabling system installation, including but not limited to cables, connectors, patch panels, and connector blocks shall be repaired or replaced to ensure 100 percent useable conductors in all cables installed
- .5 Testing Unshielded Twisted-Pair Cables
 - .1 Test twisted-pair copper cable links for continuity, pair reversals, shorts, opens, and performance as specified.
 - .2 Additional testing is required to verify Category performance.
 - .3 Test horizontal cabling using approved certification tester for Category 6a performance compliance in accordance with ANSI/TIA-568-C.2
 - .4 Basic Tests Required:
 - .1 Wire map
 - .2 Length (feet)
 - .3 Insertion loss (dB), formerly attenuation
 - .4 NEXT (Near end crosstalk) (dB)
 - .5 Return loss (dB)
 - .6 ELFEXT (dB).
 - .7 Propagation delay (ns)
 - .8 Delay skew (ns).
 - .9 PSNEXT (Power sum near-end crosstalk loss) (dB).
 - .10 PSEL FEXT (Power sum equal level far-end crosstalk loss) (dB)
- .6 Test Category 6A by auto test to 500 MHz

3.12 SYSTEM TESTS AND ADJUSTMENTS

- .1 Initial Test and Adjustments: Perform and record results of the following tests:
 - .1 Loudspeaker Operation: Near field output of each loudspeaker shall match the zone average within +/- 1.5 decibels. Listen directly below each installed loudspeaker to confirm it is operating. For any loudspeakers found to be inoperative, or possibly operating at an incorrect level, use a sound level meter set to A-weighting and slow response to check the output. Place the microphone so as to contact each grille.
 - .2 Replace any defective loudspeakers or cabling, or otherwise correct cause for any loudspeakers found to be operating outside this range.
 - .3 Buzzes, Rattles, and Distortion: With system operating at maximum level, listen for any buzzes, rattles, and objectionable distortion in all areas covered. Correct *all* causes of these defects.
 - .4 Paging Settings: Adjust all spectrum and level controls for normal operation. Measure the A- weighted sound pressure level using a sound level meter set to A-weighting and slow response at representative locations within each zone. Adjust average initial levels in open plan areas to 68 dBA at normal occupants' locations and in closed offices or rooms to 54 dBA during a page.
 - .5 Measure and average the STI measurements from 4 evenly spaced locations per zone to verify coverage meets the specified STIPA performance.

3.13 PROGRAMMING AND CONFIGURATION

- .1 Document all discussions with the owner.
- .2 Provide all necessary programming to provide a complete and operational system.
- .3 Identify any input on potential efficiencies or improvements to the scope defined in this document that will provide benefit to the end users
- .4 All control programming will be done by the manufacturer certified programmer with +5 years of comparable experience
- .5 Meet with the owner or owner s representative team and end users to establish audio system baseline functionality and operational requirements. Take baseline requirement to draft an alpha system program
- .6 Demonstrate the Program with owner representative and end users with the specified system touch panel to show functionality, page flips and GUI for approval
- .7 Demonstrate system functionality to owner and end users and correct any deficiencies.
- .8 Provide small laminated "Quick Start Guides" cards for operation of the system paging, to be left with the owners designated personnel
- .9 Provide in depth system manual and software flow diagrams for record and close out submissions.

3.14 GROUNDING

- .1 Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments
- .2 Signal Ground Terminal : Locate at main equipment cabinet. Isolate from power system and equipment grounding
- .3 Comply with AES48-2005 for audio system grounding

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 Submit shop drawings for products specified in this Section.

1.02 SYSTEM SUPPLIER QUALIFICATIONS

- .1 The system supplier (or system integrator) to be system manufacturer's designated approved Canadian regional authorized distributor for the product proposed with full manufacturer's warranty privileges.
- .2 The system supplier to be an established communications and electronics contractor that has and currently maintains a locally run and operated business for at least five years. The system supplier to hold applicable provincial and local licenses.
- .3 The system supplier to employ technicians who have attended and successfully completed the manufacturer's technical certification classes for the proposed system.
- .4 The system supplier to show satisfactory evidence, upon request, that system supplier maintains a fully equipped service organization capable of furnishing adequate inspection and service to the system on a 24 hour/7 day basis. The System Supplier to maintain at in this facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.
- .5 Field wiring shall be CAT6 cable, and all voice and data connections shall be by RJ-45 connectors

1.03 WARRANTY AND MAINTENANCE

- .1 The System Supplier to provide manufacturer's standard warranty on the system which is to include necessary labour and equipment to maintain the system(s) in full operation for a period of one year from the date of Substantial Performance of the Work of the entire project. Warranty to include a 24 hours emergency service to provide response within 2 hours of notification of any major failures.
- .2 Manufacturer to provide, free of charge, product firmware/software upgrades throughout the warranty period for any product feature enhancements.
- .3 Installation of system upgrade software to be by the system supplier and to be covered under this warranty.
- .4 System firmware / software upgrades to be downloaded to the system by data connection. Upgrades to be accomplished system-wide from a single point of connection.
- .5 Systems requiring local programming of individual network components / sub-systems at multiple physical locations or which do not allow for remote download of component firmware or which require the exchange of components, will not be accepted.
- .6 The vendor to include for an additional extended software and firmware maintenance agreement for additional 4 years beginning after the expiry of initial year of warranty.

1.04 SOFTWARE NOMENCLATURE REPROGRAMMING

- .1 Include for system manufacturer to make necessary on site final changes to applicable system/equipment software. Make such changes after successful testing and verification of the systems, but prior to turn over to Owner. After successful final verification of the work, confirm and obtain approval of final nomenclature in writing from Owner and Consultant. The software revisions to incorporate final room names/area names/building names and equipment identification.

1.05 MOCK-UPS

- .1 Prior to start of work and submission of shop drawings, provide a working mock-up of the system for full review and demonstration on site. After acceptance of system by Owner, such mock-up (with any changes agreed to with Owner) to be used for onsite training of the end users up to period of turnover of system to Owner. Confirm location for mock-up with Consultant after award of Contract.
- .2 During Bid period, the manufacturers of each system (base specified and alternatives), to provide a working mock-up of the systems proposed, for full review and demonstration on site. Such mock-ups are to be used for final decision making on the selection of the system to be provided and if successful, to be used on site for training of the end users up to period of turnover of system to Owner. Confirm location for mock-up with Consultant.

1.06 SYSTEM WIRING

- .1 System cable shall consist of Category 6 cable to all field devices and IP Controllers
- .2 All wiring shall test free from all grounds and shorts
- .3 All wiring shall terminate with manufacturer approved connectors
- .4 All Category 6 cable to be tested for performance and quality

1.07 SYSTEM DESCRIPTION

- .1 Call-points and all other in-room devices, including patient stations, code blue stations, washroom emergency pull cord stations, and over door lights shall have its own unique embedded address allowing for auto discovery. Each device shall contain two RJ45 connectors enabling the option of sequential cabling of devices within the room or to other rooms
- .2 System components shall include, but not limited to the following:
 - .1 VoIP Master Stations
 - .2 VoIP Patient Station
 - .3 Washroom Emergency Pull Cord Station
 - .4 Code Blue Station

- .5 RGB Dome Light
 - .6 Zone Light
 - .7 Controllers / IPNET Routers
 - .8 Power Supplies
-
- .3 Call activation shall be by means of easy-to-identify, colored and back-illuminated call buttons, washroom emergency pull cords or patient call cords. All touch surfaces on devices shall be antibacterial to aid with infection control
 - .4 Pre-announce tones for intercom calls and Public Address calls, and a green monitor LED to alert patients of an active speech circuit (microphone active)
 - .5 The over door indicator LED lights shall have a minimum four segments with a minimum of 9 programmable flashing and non-flashing colour combinations to indicate call types priority
 - .6 The system shall have all call handling and processing distributed amongst IP-based routers in a peer-to-peer network. The software for the operation of the nurse call sub-system in each unit will be fully embedded and the system will work independent of an attached nurse station on that unit
 - .7 VoIP nurse master and VoIP Workflow station consoles with the ability to respond to calls out of sequence by simply selecting the call to be answered
 - .8 Ability to sequentially display active calls by priority
 - .9 Bright and clear touch screen display for the nurse stations shall indicate call priorities and room numbers in a prioritized list of at least eight (8) simultaneous calls with associated alarm color. All calls will have an elapsed timer indicating time since the call was activated (Duration)
 - .10 Ability to initiate paging announcements to one room or selected rooms by software programming and simple touch panel selection
 - .11 Administration of system servers, including configuration, is web-based and does not require any additional software to be loaded on any device
 - .12 The server and client software shall be agnostic, allowing the use of Windows or Linux as the operating systems
 - .13 Programming of the system is done locally or remotely using a web-based application by any PC with access to the network. Systems requiring proprietary software installed on a PC for system programming will not be considered
 - .14 There shall be rostered shift assignments (i.e. morning, afternoon, night) of patient beds/rooms or unit to staff pagers and or wireless telephones with a selection of shift. Dynamic re-assignment of staff pagers / telephones / mobile devices from the nurse station touch screen will be in site hierarchy (tree) format

- .15 All configuration parameters and data history shall be stored in non-volatile, non-magnetic media such as compact flash. All calls on the system will also be logged and retained for a minimum of two (2) years which can be retrieved as an archival log at any time from any GUI
- .16 The system will include comprehensive activity reporting. All calls on the system will also be logged and retained for a minimum of two (2) years which can be retrieved as an archival log at any time from any GUI on the IP network
- .17 The master and duty / workflow stations, routers and servers shall be directly connected to the IP network via manufacturer approved Ethernet switches
- .18 Connection to the Hospital LAN and Telephony LAN shall all be via the IP Connect Server. Integrations shall be achieved without the use of third-party vendors or middleware running on other servers
- .19 System shall operate during power failure for a minimum of 30 minutes utilizing battery backed UL-1069 power supplies (depending on volume of the alarms received during the backup battery power)
- .20 System shall be supervised for wiring shorts and opens between all devices (controllers, dome lights, patient stations, washrooms stations, etc.) at all times
- .21 The nurse call equipment shall conform to the relevant standards below:
 - .1 CUL-C22.2 NO. 205-12 Signal Equipment – Edition 2 issue date 2012/11/01
 - .2 UL-1069 Hospital Signaling and Nurse Call Equipment
 - .3 UL-2560 compliant

2 PRODUCTS

2.01 NURSE CALL SYSTEM (BASIC HARD WIRED)

- .1 The system is be based on the Austco Nurse Call System.CSA approved and UL 1069 listed system components. The system to include, but not be limited to the following:
 - .1 area control units, floor control stations, remote monitor and remote annunciators;
 - .2 software programming;
 - .3 washroom stations;
 - .4 staff stations and duty stations;
 - .5 emergency stations;
 - .6 bed stations;
 - .7 centralized code blue (cardiac arrest) stations;
 - .8 corridor dome lights;

- .9 Zone lights
- .10 call cords;
- .11 wiring and required ancillary devices, as recommended by system manufacturer.
- .2 Components and the system as a whole to meet or exceed the minimal standards issued by CSA, EEMAC and ULC. Work in conjunction with this installation to meet the provisions of the local governing electrical code, edition of CSA Z32 enforced by local governing authority and any applicable local codes.
- .3 Each major component to bear the manufacturer's name, catalogue number, place of manufacture and CSA/ULC label.
- .4 The system head end equipment and software to be capable of handling an additional minimum 20% future expansion. Include for sufficient cabinet/panel spaces, sufficient power supplies, and sufficient space for future zone/device connection modules and include in system software programming to easily accommodate future expansion requirements.
- .5 The system to be at least be provided with the following features:
 - .1 Bedside Patient Station Operation
 - .1 A patient call shall be activated following a momentary press of the button on a patient call-point or call pendant. On activation of a patient call, the system shall:
 - .1 Sound a reassurance tone on the call-point for the duration of the patient pressing the call button
 - .2 Indicate to the patient that the call has been placed by means of a red reassurance light at the bedside call-point
 - .3 Illuminate an over door light above the entrance way to the patient's room
 - .4 Display customized call priority text such as "Patient Call", bed/room number and time the call has been active on the touch screen of the designated nurse station for that room, and sound a slowly repeating patient call chime tone at the nurse station until the call is answered or cancelled
 - .5 Send customized call priority text such as "Patient Call" and the bed/room number to assigned master stations
 - .6 Record the call and duration in the in-built call log
 - .2 The patient call can be cancelled by a staff member entering the room and cancelling the call at the point of origin, by another device within the room or by answering the call at the nurse station. On cancellation of a patient call, the system shall:
 - .1 Cancel the patient call from the Nurse Master Station

- .2 Cancel the call-point reassurance light
- .3 Cancel the patient call indication from the over-door light of that room
- .4 Record the cancellation in the in-built call log
- .2 Answering Active Calls at the Nurse Station
 - .1 To answer active calls on the nurse call system, staff shall pick up the handset and select the incoming call to connect to the room intercom and speak with the patient. This will have the following effect:
 - .1 Chime at the patient's room and nurse station to indicate call connected
 - .2 Connect the microphone on the patient station to the speech circuit
 - .2 If programmed for call cancel, picking up the handset from the cradle will have the following effect:
 - .1 Cancel that patient call information from nurse station.
 - .2 Cancel the red reassurance lights on the bed head panel
- .3 *Washroom Call Operation*
 - .1 A washroom call shall be activated following a momentary pull of the cord on the pull-cord call-point. On activation of a washroom call, the system shall:
 - .1 Indicate to the patient that the call has been placed by means of a red reassurance light and a reassurance tone on the washroom pull-cord station
 - .2 Illuminate an over door light above the entrance way to the patient's room or washroom
 - .3 Display customized call priority text such as "Washroom Call", room number and time the call has been active with optional patient details via a patient database interface on the touch screen of the designated nurse station for that room and sound a slowly repeating patient call chime tone at the nurse station until the call is answered or cancelled
 - .4 Send customized call priority text such as "Washroom Call" and the bed/room number to assigned master station
 - .5 Record the call and duration in the in-built call log
 - .2 The washroom call can be cancelled by a staff member entering the room and cancelling the call at the point of origin, by another device within the room, by answering the call at the nurse station. On cancellation of a washroom call, the system shall:
 - .1 Cancel the washroom call from the nurse station
 - .2 Cancel the call-point reassurance light

- .3 Cancel the patient call indication from the over-door light of that room
- .4 Record the cancellation in the in-built call log
- .4 Code Blue Operation
 - .1 A code blue call shall be activated following a momentary press of the button on a code blue call-point. On activation of a code blue call, the system shall:
 - .1 Indicate to staff that the call has been placed by means of a red reassurance light and a reassurance tone on the code blue station
 - .2 Illuminate an over door light above the entrance way to the room
 - .3 Display customized call priority text such as “Code Blue Call”, room number and time the call has been active on the touch screen of the designated nurse station for that room, and sound a slowly repeating patient call chime tone at the nurse station until the call is answered or cancelled
 - .4 Send customized call priority text such as “Code Blue” and the bed/room number to assigned master stations
 - .5 Record the call and duration in the in-built call log
 - .2 The code blue call can be cancelled by a staff member entering the room and cancelling the call at the point of origin, by another device within the room or by answering the call at the nurse station. This will be dependent on programming. On cancellation of a code blue call, the system shall:
 - .1 Cancel the code blue call from the nurse station, duty stations, pagers and wireless phones
 - .2 Cancel the call-point reassurance light
 - .3 Cancel the code blue call indication from the over-door light of that room
 - .4 Record the cancellation in the in-built call log
- .5 Nurse Station Operation
 - .1 Active Calls
 - .1 The touch screen display for the nurse stations shall indicate call priorities and room numbers in a prioritized list of at least twelve (12) simultaneous calls. All calls will have an elapsed timer indicating time since the call was activated (Duration)
 - .2 Active call displays shall be accompanied by programmable, volume adjustable single, double and triple chime tones or pulsing buzzer sounds from the nurse station to indicate call priorities

- .2 Staff to Patient Intercom Operation
 - .1 To answer active calls on the nurse call system, staff shall pick up the handset and select the incoming call to connect to the room intercom and speak with the patient. This will have the following effect
 - .1 Chime at the patient's room and nurse station to indicate call connected
 - .2 Connect the microphone on the patient station to the speech circuit
 - .3 If programmed for call cancel, picking up the handset from the cradle will have the following effect
 - .1 Cancel that patient call information from nurse stations
 - .2 Cancel the red reassurance lights on the bed head panel
- .6 2-way signalling and networked communications between control station and remote stations with choice of handset or speaker/microphone communications;
- .7 multiple simultaneous intercom channels;
- .8 digital display of incoming calls at control station with arrangement of calls by priority and/or time of call;
- .9 waterproof/disinfectant proof membrane touch pad on control station;
- .10 non-volatile memory of user programmable functions for room priority call status, control station zone capture, room station zone swing, duty station zone swing, exemption of any room station from voice paging, console identification numbers and overtime duration;
- .11 staff follow mode operation;
- .12 paging of announcements to various zones or "all call" with visual indication of paged zones;
- .13 automatic overtime display of calls;
- .14 ability to set a single level of service requirement;
- .15 direct communications between control stations with ability to operate up to 36 control stations in parallel or selected zone capture;
- .16 full operation for up to 10 minutes during power failure with battery backup;
- .17 supervision of all annunciate point wiring;

- .18 power monitor and chassis fault monitor;
 - .19 capability for linking to local systems;
 - .20 printer/computer interface to record system activity;
 - .21 diagnostic LED indications of system status and display of error messages;
 - .22 "Code Blue" network wide supervised calling;
 - .23 provisions for future interface to telephone system access, pocket page access, wandering patient monitoring/locating and personnel locating and wireless telephones;
 - .24 provisions for automatic connection to a remote monitor service by the local police station;
 - .25 local call provisions through localized audio devices and/or indication, for door entry and staff assist;
 - .26 full system programming functions through main nurse call console; sequence of operation to be approved by Owner/Consultant prior to start of work; make demonstration to Owner/Consultant prior to start of work;
 - .27 other standard manufacturer's features.
- .6 The system controller to be microprocessor controlled, modular construction, complete with microcomputer board, audio interface module, power supply battery backup and system software programming. Enclosure to be enamel painted steel, wall mounting backbox with lockable hinged front door. System to include data interface module, network management software and interface cards to other systems as required.
- .7 Flush mounting terminal cabinets to be provided to house head end equipment.
- .8 The type NC floor control station to be No. IP-TSNS microcomputer controlled solid state station with LCD screen display with keypad, digital display, 2-way communication handset and speaker, controls, firmware operating system software and all housed in enamel painted steel cabinet suitable for placement on desk top. Station to be complete with flush mounted interface receptacle station. A remote colour monitor to be mounted for video displays.
- .9 No. IP-TSNS call stations include the following features:
- .1 simple, easy plug-on connection;
 - .2 3-levels of priority;
 - .3 integral speaker microphone;
 - .4 "Call placed/service required" indicator;
 - .5 "Cancel" buttons;
 - .6 universal call cord receptacles with call cord;

- .7 automatic emergency call placed in event of call cord disconnection.
- .10 Staff stations to be flush wall, single gang back box mounting, solid state units complete with momentary action "reset" button, bi-colour LED indicating, integral speaker-microphone high impact moulded plastic faceplate and call place pushbutton. The stations to provide two-way voice communications with the control stations. Stations located at exterior doors to be weatherproof types, provided with stainless steel gasketed faceplates.
- .11 Duty stations provide remote annunciation of assigned bedside control stations and substations via 4-LEDS and six (6) call tones and includes similar features to staff stations.
- .12 No. IP-PST2 Patient stations to be water resistant, gasketed, two touch point membrane, flush wall mounted station. One touch point to have ability for a user defined customized call label and associated LED. The other touch point to be used for resetting station.
- .13 No. IP=PST2 code blue station to be water resistant, gasketed, touch point membrane with blue colour finish and flush wall mounted station.
- .14 No. IP-CPG-PC/X and IP-CPG-PC/R/BS washroom stations and to be gasketed, waterproof, flush wall single gang box mounting solid state units complete with touch pad "reset", call placed LED and 1.8 m (6') long pull cord activation.
- .15 Dome lights to be four (4) LED type lamp units complete with one (1) piece moulded acrylic thermoplastic lens and mounting plates assembly. Include auxiliary contacts as required. Lamp indications to comply with Owner's colour schedule and generally be as follows:
 - .1 white - normal patient call (steady) and emergency patient call (flashing);
 - .2 red - washroom emergency call (steady);
 - .3 blue - cardiac arrest (flashing);
 - .4 amber - patient room smoke detectors.
- .16 Call cords to be 1.8 m (6') length PVC construction, with momentary pushbuttons mounted in high impact moulded plastic housings and stainless steel security clips. Supply minimum one (1) call cord for each receptacle of each station.
- .17 System wiring to be copper conductors as per manufacturer's requirements. Video cables to be minimum RG-6U co-axial cables.
- .18 Wall mounting, remote annunciators to be provided in areas as shown and in telephone operator's room, identifying the system calls. Remote annunciator to be digital display panel located where shown. The display to provide the following features and functions:
 - .1 indication to be by LED alphanumeric display with two (2) lines of minimum twenty (20) standard width characters, for display of each call of room number, bed number, and call priority;
 - .2 calls scroll in order of highest priority (or longest pending) call and with a configurable pause between scrolling calls;

- .3 networked to be programmed by nurse call system;
- .4 the time of day to display when the panel is idle;
- .5 complete with mounting bracket for wall mounting.
- .19 Flush wall mounting, fire alarm system remote annunciators to be provided as part of the fire alarm system work at nurses station as shown, identifying the patient room smoke detector in alarm. Coordinate work with fire alarm system supplier/installer.
- .20 Equipment panels and enclosures to be CSA approved for application and in climate controlled areas, be rated NEMA 2 drip proof construction with sprinkler proof provisions including gasketing of doors and openings and ventilation louvers designed to prevent egress of water from activated sprinklers from contacting live components. Equip surface mounted panels with drip shield manufactured by system manufacturer.
- .21 Manufacturer's representative to provide following on site work:
 - .1 assist Contractor on required installation requirements;
 - .2 programme system head end;
 - .3 inspect installation and perform required final equipment connections;
 - .4 adjust, test, start-up and certify system;
 - .5 demonstration and instructions to Owner.
- .22 Acceptable manufacturers are:
 - .1 Austco;
 - .2 Approved alternates

3 EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- .1 Coordinate work of all trades for scheduling, demolition, rough-in, power, and conduit requirements, installation and testing. Refer to Section entitled Basic Materials and Methods for additional general installation requirements.
- .2 Provide specified various nurse call systems components in areas as shown and as required. Programme system on servers/terminals. Obtain Owner's approval of room nomenclature prior to start of programming. Customize software to suit Owner's specific applications. Program sequence of operation and user information as required. Include for system manufacturers authorized representative to program systems. Programme exact programming requirements as confirmed with Consultant and/or Owner in writing prior to start of Work. Utilize manufacturer's recommended configuration chart during installation and record respective device names, serial number, room name and number and comments, as outlined on sheets. Submits sheets with test reports.

- .3 Locate head end equipment, terminal cabinets, racks, patch panels, UPS, and central computer terminal in locations as shown and/as directed by Consultant. Locate equipment in electrical or telecom closets or as noted. Provide terminal cabinets/panels as required, and locate in electrical or telecom closets as approved by Consultant. Do not locate in ceiling spaces or public/patient areas, corridors, stairways or offices. Ventilate areas as required for proper equipment performance. Confirm cabling standards with system manufacturer and perform installation to suit standards. Clearly label each cable run and port. Install devices in strict accordance with system manufacturer's instructions and recommendations.
- .4 Provide central computer station/terminal for activity reporting software in specified locations or as directed by Consultant. Locate equipment on racks as typically specified for network cabling systems of Section. Provide power receptacles, feeders, data jack/drop as required. Exact locations to be confirmed with Consultant prior to roughing-in. Coordinate work of all trades.
- .5 Provide dedicated conduit feeder(s) into the equipment cabinets and UPS units. Generally, required sizing of breakers, feeders and conduits to be as noted on drawings, but in absence of directions, size distribution to local governing electrical code requirements to suit applications and general requirements herein this Specification. Coordinate exact power requirements with suppliers/manufacturers of equipment. Dedicated circuit breakers to be used for each supply. This power feed to not have any other devices connected directly to it. Provide circuit breakers located in electrical panels and label breakers "Nurse Call System". These electrical circuits to be connected to the facility's essential power circuits of panels serving the area of work. Connect all network system power supplies and equipment cabinets to a common earth ground utilizing copper conductors as required. Comply with local governing electrical code requirements. Provide required data drops.
- .6 Provide control units and stations and install into locations. Install components at the mounting heights as noted on drawings and as required and confirmed with Consultant. Generally, wall mounted devices onto recessed boxes. Provide suitable conduits and backboxes to accommodate device installations. Confirm back box requirements with system vendor prior to roughing-in.
- .7 Generally, install dome lights located between door frame and underside of suspended ceiling. Interconnect patient room smoke detectors to dome lights and remote communicators. Coordinate work with fire alarm system technicians of fire alarm system vendor. Install zone lights to ceilings on recessed boxes in locations confirmed with Consultant and coordinated with other systems and equipment. Confirm colours for dome lights with Consultant prior to ordering.
- .8 Provide system wiring. Wiring to be copper conductor, colour coded, and in accordance with the system manufacturer's recommendations and instructions. Connect equipment in accordance with the system manufacturer's certified wiring diagrams and instructions and under direct supervision of the manufacturer. Provide and arrange for authorized system manufacturer's representative to make final equipment connections. Run conductors in conduit or where identified on drawings, in cable tray.
- .9 Obtain required training from manufacturer's representative on any special installation procedures. Install devices and perform work in accordance with the manufacturer's instructions and requirements and in accordance to applicable codes of the governing authorities having jurisdiction.

- .10 Confirm locations of devices with Consultant prior to roughing-in.
- .11 Perform system integration connections to various systems as required. Include costs for systems service vendors to perform required integration and programming requirements.
- .12 Ground and bond system as required by local governing electrical code and authority and system manufacturer.
- .13 Provide a lamacoid identification nameplate for each enclosure. Confirm wording of identification nameplates and colour finishes of devices with Owner prior to ordering.
- .14 When work is complete, arrange for attendance at the site of the system manufacturer's authorized representative to make final equipment connections and provide testing and verification requirements.
- .15 Additionally, refer to testing, coordination and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.
- .16 Provide signed documented test report verifying that system components have been tested successfully and that the system is in proper working order. Testing and verification of system to be witnessed by the Consultant and Owner at times approved by Consultant.
- .17 Turn over to Consultant/Owner, specified loose accessories.

3.02 SYSTEM TRAINING, INSTRUCTIONS AND TRAINING UNIT

- .1 Provide to Owner's designated staff, onsite training sessions to Owner's designated personnel on the operation and maintenance procedures with regards to the system. Each session may be held on different days and locations, at Owner's discretion. Exact times and dates to be coordinated with and approved by Owner.
- .2 The following are required from Nurse Call System supplier, one week before each training session:
 - .1 an easy to read manual describing the features, providing trouble-shooting guidelines;
 - .2 one mobile training unit to be able to be transported to sites for training purposes.
- .3 Schedule
 - .1 Training on the operation of the Nurse Call System for Maintenance staff:
 - .1 Two sessions, 1 hour duration for up to ten (10) people each session.
 - .2 There should be enough copies of printout regarding repair of parts, for each participant.
 - .2 Training on the operation and managing software for Nurse Managers, Program Service Managers, Program Director, Operations Directors, VP Programs, Director of Organizational effectiveness and Risk Management and designate, Program Assistant:
 - .1 Two sessions, 1 hour duration for up to ten (10) people each session.

- .2 There should be enough copies of handouts on summary of training, for each participant.
- .3 Training for Nurses will be for the operation only. Allow for four (4) training days. At each training day, the training schedule to include:
 - .1 minimum four (4) 1 hour sessions spread out over the day at times directed by Owner;
 - .2 the number of nurses to be accommodated to be as later directed.
- .4 Provide training/coordination on access and networking issues for Owner's computer network for one session, one hour duration for up to 8 people. There should be enough copies of handouts for technical information for networking and edit access.
- .4 Include for professional recording of and copying onto CD/ DVD digital video disk of operation and maintenance procedures.
- .5 For the duration of the Work, provide mobile training unit of the nurse call system, including typical consoles, bed stations, staff stations, and wireless telephones. The unit will be set up to allow the users to train and familiarize themselves with the system, outside of the designated times for the training sessions. The unit to be easily transportable to designated areas for training purposes. System supplier to be responsible for transporting and set-up as required by Owner's schedule.

END OF SECTION

PART 1 – GENERAL

1.1 Reference

- .1 Section 26 00 10 applies to and is a part of this Section of the Specification.
- .2 Section 26 05 00 forms a part of this Section and contains requirements, products and methods for execution that apply to this Section.

1.2 Inspection, Testing, Start-Up and Verification

- .1 In addition to requirements specified in this Section, refer to requirements of Section 26 05 70.

1.3 Shop Drawings

- .1 Submit shop drawings for equipment and accessories specified in this Section. Shop drawings shall include connection wiring schematic drawings for each system, system design drawings including dimensions and layouts, system riser drawings and copies of manufacturer's component literature sheets.

PART 2 PRODUCTS

2.1 Existing Clock System

- .1 The existing Primex master clock system shall be extended to serve the additional areas. Include for providing the Hospital's existing system Contractor, to provide work which shall include the following:
 - .1 Inspection of existing system to determine exact system requirements of the Global Positioning System (GPS) type equipment; provide additional components accordingly;
 - .2 inspection of existing master transmitter and provision of required additions/modifications to accommodate additional satellite transmitters;
 - .3 additional satellite transmitters with receiver switches;
 - .4 provide required system reprogramming;
 - .5 provide additional clocks, provided to match existing complete with required connector/receptacle and hanging provisions to existing standards; clock faces shall include Owner's logo to match existing and which shall be confirmed and coordinated with Owner;
 - .6 wiring in conduit and required backboxes and ancillary devices;
 - .7 inspection, testing and adjustments after installation are complete.
- .2 Confirm clock power requirements (battery, or PoE). Ensure that power requirements match existing clocks and provide necessary power feeds to components. Review exact type of devices with Owner and Consultant prior to ordering.

PART 3EXECUTION

3.1 Installation of Clock System

- .1 Review onsite, existing clock system and provide necessary additional components matching and 100% compatible to existing system, to extend existing system to serve the additional and renovated areas.
- .2 Provide additional receiver/transmitter to transmit GPS signal from existing main antennae to additional clocks service project areas. Connect with required power wiring and locate in position coordinated with Consultant and as recommended by system manufacturer to suit required coverage area.
- .3 Install clocks and controllers as coordinated with Consultant. Any system power wiring shall be installed in conduit recessed in walls and within accessible ceiling spaces.
- .4 Install devices in accordance with manufacturer's instructions. Cabling and devices shall be installed in accordance with manufacturer's instructions and system vendor directions.
- .5 Ground and bond system to code and manufacturer's requirements.
- .6 Confirm the exact requirements and locations of the equipment with the Consultant and the system installers prior to roughing-in.
- .7 Refer to the system riser diagram on the drawings.
- .8 Quantities for outlets shall be as per the floor plan drawing and not the riser diagram.
- .9 When work is complete, arrange for attendance at the site of the system manufacturer's authorized representative to make final equipment connections and provide requirements as specified in the article entitled "Inspection, Testing, Start-Up And Verification" found in Part 1 of this Section.

END OF SECTION

1 GENERAL

1.1 REFERENCES

- .1 International, national and local codes and standards:
 - .1 National Fire Code (NFC)
 - .2 CAN/ULC-S319-05 Electronic Access Control Systems
 - .3 CAN/ULC-S3-1-M88 Standard for Central and Monitoring Station Burglar Alarm systems
 - .4 ASTM F476-84(2002) Standard Test Methods for Security of Swinging Door Assemblies
 - .5 ASTM F571-87(2001) Standard Practice for Installation of Exit Devices in Security Areas
 - .6 Local Building Department
 - .7 Local Fire Department
 - .8 Electrical Safety Authority
 - .9 Other Municipality Bylaws
 - .10 CENELEC EN 50173 Information Technology: Generic Cabling Systems
 - .11 FIPS PUB 174 Commercial Building Telecommunications Wiring Standard
 - .12 ISO/IEC IS 11801A Generic Cabling for Customer Premises
 - .13 NEMA WC 63 Performance Standard for Field Testing of Unshielded Twisted-Pair Cabling System
 - .14 UL 294-1999, Standard for Safety for Access Control System Units.
 - .15 UL 1076-1995, Standard for Safety for Proprietary Burglar Alarm Units and Systems.
 - .16 ULC-S317-1996, Installation and Classification of Closed-Circuit Video Equipment (CCVC) Systems for Institutional and Commercial Integrated Security Management Systems.
 - .17 UL 60950 Standard for Safety of Information Technology Equipment
 - .18 ULC-S318-96 Power Supplies for Burglar Alarm Systems
 - .19 CIP-002-3 through CIP-009-3 – Critical Infrastructure Protection
- .2 American Society for Industrial Security (ASIS)

- .1 ASIS/SHRM WVP.1-2011 Workplace Violence Prevention and Intervention ANSI Standard
- .2 ANSI/ASIS/RIMS RA.1-2015 Risk Assessment
- .3 ANSI/ASIS PAP.1-2012 Security Management Standard: Physical Asset Protection
- .4 ANSI/ASIS CSO.1-2013 Chief Security Officer (CSO) Organizational Model
- .5 ASIS FPSM GDL (2009) Facilities Physical Security Measures Guideline

1.2 SCOPE OF WORK

- .1 Provide a complete Security System(s) turnkey installation as detailed in this and other sections of these specifications. The Security System(s) shall comprise of the following systems:
 - .2 An IP-based Physical Access Control System (PACS) throughout the facility as detailed on the Security System(s) drawings and specifications. PACS shall be connected to and utilize the property's converged network for communication. PACS shall be an extension of TWH's existing SoftwareHouse Access Control system.
 - .3 Provide full point and click mapping of entire property where PACS devices are located. Maps shall report status of PACS components and provide control of devices using a point and click interface.
 - .4 IP-based Video Management System (VMS) cameras throughout the facility as detailed in the Security System(s) drawings and specifications. Cameras shall be connected to and utilize the property's converged network for communication. VMS shall be an expansion of TWH's existing system.
 - .5 Supporting networking, network cabling, signal conversion/transmission devices, servers, workstations, and associated peripherals as detailed on the Security System(s) drawings and specifications.
 - .6 For all systems, provide spare materials as detailed in the Execution section of the respective specification(s).
 - .7 Provide the following for all components of the Security System(s):
 - .1 Warranty on all components furnished, and maintenance/repair/replacement during the warranty period.
 - .2 Submittals, samples and record documentation.
 - .3 Comprehensive commissioning and testing with the Owner or Consultant during substantial completion.
 - .4 Training services for the Owner and Operators.
 - .5 Coordination with other site subcontractors.

- .6 Reporting to the Owner, the Architect and Consultant for the coordinated and timely execution of the Work.
- .7 All power supplies and conditioners, interlocking and control relays, equipment enclosures, conduit and cable trays, junction and mounting boxes, cabling, access doors, sleeves, fire stopping and other components, software, materials and services required for a completed and fully operational turnkey Security System(s) installation meeting these specifications.

1.3 GENERAL CRITERIA

- .1 The Security System(s) shall meet the following general criteria:
 - .1 All Security System(s) control equipment, including but not limited to system control panels, networked devices, servers, workstations, interface devices, storage devices shall be fully IP networked, microprocessor based, and feature real time distributed processing. All networked devices shall reside on a converged facility network, provided as detailed in the Security System(s) drawings and these specifications.
 - .2 The Security System(s) shall be configured to ensure reliability of systems operation and control of critical functions/systems. The following describes, in very general terms, a relationship between the various components of the Security System(s) that would be acceptable. Other Security System(s) topologies shall be acceptable if they meet the intent and performance requirements defined in these specifications.
 - .3 Any Intelligent Control Panels (ICP's) shall be network based, communicate natively via TCP/IP, and connect to the Security System(s) LAN for communication to the PACS server. The network connection shall be via a direct on-board RJ-45 connection on the ICP. The use of code or protocol converters is not permitted.
 - .4 Any Remote Modules (RM's) (specific system required control or monitoring panels if required) that are subcomponents of ICP's shall be directly connected to their corresponding ICP via dedicated cabling referred to as panel cabling. If physically possible, the RM's shall be located within the same room as the ICP, otherwise in approved locations as agreed upon by the owner and consultant.
 - .5 Field devices connected to RM's or ICP's shall be directly connected via dedicated cabling. This cabling shall be compliant to the device's functional requirements, manufacturer's recommendations, and these specifications.

1.4 WARRANTY AND SERVICES DURING THE WARRANTY PERIOD

- .1 The Warranty Period for all components of the new Security System(s) and their installation shall be a minimum of one (1) year from the date of Substantial Performance. The date of Substantial Performance shall be the date when all components have been certified by the Consultant and accepted by the Owner to be complete in accordance with the definition of Substantial Performance.

- .2 All components and their installations shall be free from defects. Any defective material or workmanship and any resulting damage to work of other trades shall be replaced or repaired as directed during the Warranty Period. Comply with General Conditions, agreeing to repair or replace any components of the Security System(s) that have failed within the warranty period.
- .3 Schedule repair work with the Owner's representative to prevent interference with normal building activities.
- .4 The Security System(s) Contractor shall maintain an inventory of commonly replaced components in the local office for the replacement of failed components. Larger components shall be readily available within the North America for overnight courier shipping response.
- .5 The Base Tender price shall include the cost of all replacement parts during the warranty period and all of the associated installation costs and all of the costs associated with the repair of components during the warranty period but shall not include the cost of labour for routine maintenance during the warranty period. The cost of labour for routine maintenance during the warranty period shall be provided separately as an Alternate Price as detailed below.
- .6 Replace or repair all supplied defective installations. Respond and be on site within four hours of the Owner placing a system trouble call for items of a critical, urgent or immediate nature (e.g. failed head end component, non-functioning controller, etc.). Response to Warranty call out by the Owner shall be within 24 hours for items not requiring immediate attention. Work to trouble shoot and identify the cause of the Security System(s) or component failure shall begin immediately and shall continue until repaired to the satisfaction of the Owner.
- .7 Any software modifications or upgrades that become standard product offerings from the Security System(s) Contractor and/or Security System(s) equipment vendors during the warranty period shall be brought to the attention of the Owner and, at the discretion of the Owner, may be requested and, if so, shall be provided at no additional cost to the Owner.
- .8 Provide replacement components within the specified time periods for the following components. The Contractor shall guarantee to the Owner that the delivery of replacement components will be provided within the specified time periods.
 - .1 Security System(s) Component Delivery-Time (business days)
 - .2 Computer Equipment (server/central computer components, workstations and components, primary communication components (network switches, fiber optic switches, NIC cards, etc.) Five days
 - .3 Head End Equipment (ICP's, RFP's, remote modules, secondary LAN components including any concentrators, protocol convertors, etc.) Ten days
 - .4 Field Equipment (card readers, detection sensors and devices, cameras, intercom stations, etc.) Five days

1.5 CODES, PERMITS AND APPROVALS

- .1 Obtain all required permits, such as Magnetic Lock Installation Permits, and any other security –related inspection certificates. All permits and certificates shall be made available to the Owner.
- .2 The latest requirements of all national, provincial, county, municipal and other authorities having jurisdiction shall be met.
- .3 Work that is not clearly defined by local ordinance or amendment shall be governed by the local Building Code, and by the Authorities Having Jurisdiction (AHJ).
- .4 The requirements of The Occupational Health and Safety Act (OHSA), Environmental Protection Act (EPA), Americans with Disabilities Act (ADA), Accessibility for Ontarians with Disabilities Act (AODA) and CSA Barrier Free Design Standards shall be followed for all job-site procedures and installation methods.
- .5 Work shall be performed in compliance with Owner's insurance underwriters' requirements which will be provided to the successful Security System(s) proponent following project award.
- .6 All equipment and materials furnished under this subcontract shall be new and shall meet all applicable UL/ULC standards and all requirements of these specifications.

1.6 SCHEDULE

- .1 Complete all requirements of the Security System(s) subcontract prior to the scheduled Substantial Performance date for each portion of the work.
- .2 Provide to the General Contractor a schedule indicating the sequence of work, durations of individual tasks, delivery dates for all material, devices and equipment and detail any interface that must be coordinated with any other subcontractors.
- .3 Attend all project meetings as requested by the Owner and the General Contractor.
- .4 Provide written status reports at required intervals and in a format acceptable to the Owner. An updated schedule of work shall be included in each status report.
- .5 Comply with the Project Construction Schedule. Provide additional staff and work overtime as required to comply with the Project Schedule and so as not to interfere with other on-site subcontractors in their effort to comply with the Project Schedule.
- .6 Provide written Request for Information notices to the Owner when specific information or clarification of the specifications is required. Request for Information notices shall be provided at least two weeks prior to the need for the information.

1.7 CONTRACTOR QUALIFICATIONS

- .1 The Contractor shall:
 - .1 Be certified by the manufacturer to procure, install, program, maintain, and service the acceptable Security System(s) components.
 - .2 The Contractor must have permanent full-time certified staff available in the project area to perform all necessary project cycle installation functions, including service and maintenance work following system acceptance.

- .3 Have staff and be able to supply information to support that their current installation and service technicians are competent factory trained and certified personnel capable of maintaining and servicing the proposed system.
- .4 Have a proven record of experience with similar in the supply and installation of equivalent systems over a minimum period of five years. Document at least three and no more than six projects, of equal or greater size and complexity, on the acceptable Security System(s) components. Indicate quantities of card readers, VMS cameras, and SIS units included in the scope of the projects along with a description of the property secured.
- .5 Have been a factory certified representative for the Security System(s) products indicated, for a minimum of three years entailing design, installation, configuration, and maintenance.
- .6 Have comprehensive local service and support facilities in the project area for the total Security System(s) as provided.
- .7 Maintain local supplies or have access to a factory authorized organization that shall carry a complete stock of essential and expendable parts.

1.8 INFORMATION TO ACCOMPANY TENDER

- .1 The information to be submitted for the Security System(s) tender shall include, at minimum, the following:
 - .1 Schematic diagrams of the Security System(s) configurations indicating all primary system elements and their locations.
 - .2 Specifications (data sheets) for all equipment to be provided.

1.9 SYSTEM COMPLIANCE AND PERFORMANCE CERTIFICATION

- .1 The Security System(s) Contractor shall thoroughly review all aspects of the Security System(s) Design Documents and certify that their bid submission and proposed Security System(s) facilities are in compliance with the Contract Documents. The Contractor shall provide a Compliance Review of all Specifications and Addenda as part of the Contractor's proposal. The Compliance Review will be an item-by-item list and review of the Specifications. The Security System(s) Tender Respondents shall clearly identify any areas where the proposed Security System(s) facilities are not in full compliance with the Security System(s) design. An accompanying performance statement and technical supporting documentation must be supplied for consideration.
- .2 In lieu of a full Compliance Review, one or more general Letter of Compliance may be supplied if the proposed system(s) are in full compliance with the issued drawings and specifications. A Letter of Compliance from the bidder, subcontractors, and manufacturers are acceptable.
- .3 Unless an exception is specifically noted in the Compliance Review, it is assumed that the Contractor is in complete compliance with the Contract Documents. Exceptions taken in cover letters, subsidiary documents, by omission, or by contradiction do not release the Contractor from being in complete compliance unless the exception has been specifically noted (explicitly, not by implication) in the Compliance Review.

1.10 DOCUMENTATION - GENERAL

- .1 The primary purpose of the shop drawing and equipment documentation submittals is to give instruction and information to those responsible for providing a turnkey Security System(s) which is compliant with the Security System(s) specifications in all respects. The Consultant shall review the shop drawings and equipment documentation submittals with the intent of identifying as many potential areas of non-compliance as possible, but the review of shop drawings and equipment documentation submittals by the Architect, Engineer and Consultant, shall not relieve the Contractor of the responsibility for complete compliance with the specifications. Identification of some errors by the Architect, Engineer and Consultant but overlooking others does not relieve the Contractor of his responsibilities nor does it allow him to proceed based on erroneous shop drawings and equipment documentation submittals.
- .2 Approval of shop drawings or submittal data by the Architect, Engineer or Consultant shall not constitute an order to fabricate, purchase, ship to the site or undertake any other action. The sole responsibility for the timely purchase and/or fabrication of components, obtaining approval on shop drawings and equipment documentation submittals, and delivery of components to the project to comply with the requirements of the project schedule is that of the Contractor.
- .3 The intent of the record documentation is to provide the Owner with complete information on the Security System(s) provided such that a person familiar with installations of this nature shall be able to perform any operating, maintenance or engineering functions with respect to this Security System(s) without having to contact the Security System(s) Contractor or obtain any additional documentation.

1.11 SHOP DRAWING AND EQUIPMENT DOCUMENTATION

- .1 Prepare all shop drawings, diagrams, equipment and device schedules, equipment technical data sheets and software information necessary for the Consultant to determine compliance with the specifications. Submit all shop drawings and equipment documentation data together as one submittal within four (4) weeks after notice to proceed.
- .2 The following information shall be included on the cover page for each shop drawing and equipment documentation sheets:
 - .1 Project name.
 - .2 Date.
 - .3 Submittal number and re-submittal number as appropriate.
 - .4 Name and address of Consultant.
 - .5 Name and address of General Contractor.
 - .6 Name and address of Security System(s) Contractor.
 - .7 Name and address of supplier or vendor if appropriate.
 - .8 Name of manufacturer.

- .9 Reference to the applicable Specification Section by name and number.
- .3 Shop drawings shall be CAD generated and be clearly referenced to each other and shall include diagrams, mounting instructions, installation procedures, equipment details and software descriptions for all components of the system. AutoCAD floor plan drawings shall be provided to the Contractor. Shop drawings shall be in this order and at a minimum include:
 - .4 Cover page with required information identified above.
 - .5 Floor plan drawings in same order and format as architectural drawings. Floor plans shall indicate each Security System(s) field device location. Uniquely identify each cable type for each field device. Identify desired cable routing from each device to termination location. Update these drawings to reflect actual routing location on as-built submittals. Provide a chart-based schedule on each floor plan drawing or on a separate drawing sheet prior to the floor plans with, at minimum, the following columns for:
 - .1 PACS:
 - .1 Point reference.
 - .2 Device type (card reader, door contact, local alarm, etc. with manufacturer/model number).
 - .3 Lock/control type (manufacturer/model number) if appropriate.
 - .4 Request to exit device type (manufacturer/model number) if appropriate.
 - .5 Special accessories.
 - .6 Cable type (manufacturer/model number).
 - .7 Cable colour and labelling scheme.
 - .2 VMS:
 - .1 Point reference.
 - .2 Camera type (manufacturer/model number).
 - .3 Fixed or PTZ.
 - .4 Lens size and type (manufacturer/model number).
 - .5 Housing type (manufacturer/model number).
 - .6 Mount type (manufacturer/model number).
 - .7 Special accessories.
 - .8 Cable type (manufacturer/model number).
 - .9 Cable colour and labelling scheme.

- .6 Separate wiring schematic diagram for each system. Include all types of controllers, panels, interfaces, and interconnection locations to head-end equipment.
- .7 Separate Riser diagrams for each system including general layout and configuration of each system indicating major component locations and relationships.
- .8 Detail installation diagrams of all monitoring and control equipment for each monitoring and control equipment location. Include routing of wiring.
- .9 Wiring diagrams and installation drawings for each component.
- .10 Security System(s) data communications network architecture diagram indicating all NDS's, OIW's, SAN devices, ICP's, video encoder/decoder units, CIS's, other network connected devices, network switch and network interface connection points.
- .11 Equipment documentation submittals shall include design, performance and installation details for all aspects of the system to be installed. At minimum, the submittals shall include:
 - .1 Bill of Quantities with name and address of supplier or vendor for each device.
 - .2 Equipment technical data sheets.
 - .3 Central monitoring and control equipment.
 - .4 Operator workstation specifications and data sheets.
 - .5 Software specifications and descriptions.
 - .6 Training outline.
- .12 Literature pertaining to a particular item, piece of equipment or installation shall be submitted at one time and shall be specifically prepared for this project. Each submittal shall be properly marked with service or function, any options available that are not to be provided shall be crossed out or options that will be provided shall be highlighted.
- .13 Comply with the requirements of the Contract Documents. Any deviations from the Contract Documents will not be allowed. Submittals not in accordance with the Contract Document requirements shall be rejected. Before equipment, devices and materials are installed; they shall have submittals that are stamped "No Comment" or "Make Revisions Noted". "No Comment" or "Make Revisions Noted" submittals containing errors and/or omissions shall not relieve the Contractor from the requirements to comply with the complete requirements of the specifications. Corrections or modifications to the work because of errors and/or omissions shall be at the Contractors expense.
- .14 Each submittal shall be reviewed, and electronically stamped and certified by all applicable parent contractors prior to submission to the Consultant. The stamp shall certify that the equipment submitted complies in all respects with the requirements of the Contract Documents for this Project.
- .15 Submit electronic copies of all shop-drawing submittals to the Architect, Owner, Consultant, General Contractor, General Contractor Project Manager, and Electrical Sub-Contractor.

- .16 Shop drawings or equipment documentation submittals returned that are noted " No Comment " on " Make Revisions Noted ", do not require additional review.
- .17 Shop drawings or equipment documentation submittal data that are noted "Revise and Resubmit", will require additional review. Resubmit all shop drawings and equipment documentation submittals noted "Revise and Resubmit". If more than two reviews are required for any shop drawing or equipment documentation submittals, the Contractor shall reimburse the Owner for any additional fees and expenses required from the Architect, Engineer or Consultant in performing the additional reviews.

1.12 RECORD DOCUMENTATION

- .1 At minimum, the record documentation shall include all submittals (shop drawings and equipment documentation) made at the shop drawing stage updated to reflect the actual installation and the manuals outlined below.
- .2 A draft version of the record documentation shall be submitted to the Consultant at the time of the request for acceptance testing. Following the acceptance testing and, if necessary, the subsequent rechecking of deficiencies, the Security System(s) Contractor shall re-submit the record documentation incorporating all changes resulting from the acceptance testing and any other changes requested by the Consultant as a result of the consultant's review of the draft version of the record documentation. The Certificate of Substantial Performance shall not be granted until the final approved record documentation has been received.
- .3 Update all documentation to indicate any changes made during the Warranty Period.
- .4 Provide record documentation in manuals. Manuals shall be placed in hard cover binders with index page and indexing tabs along with two electronic PDF file format copies on a USB flash drive. Provide record document types and quantities as indicated below:
 - .1 Operators' Manuals (three (3) copies).
 - .2 Managers' Manuals (which includes the Operators' Manuals – three (3) copies).
 - .3 Hardware Manuals (three (3) copies).
 - .4 Security shop drawings in binders (11" x 17" tabloid size colour printed – two sided – three (3) binder copies)
- .5 Provide Operators' and Managers' Manuals with, at minimum, the following information:
 - .1 Details of all features and functions available to the Operators and Managers.
 - .2 Details of all alarm, diagnostic, error and other messages. Detail the Operator action to be taken for each instance.
 - .3 Detail special programs provided and provide a complete programming instruction manual. Detail operations of all software applications.
 - .4 Detailed listing of the database for all installed devices.
 - .5 Details of all data base management functions and features.

- .6 All details and descriptions shall be in a step-by-step format such that an Operator or Manager shall be able to respond to and undertake the respective actions on the basis of information provided in the manuals and drawings.
- .6 Provide hardware manuals that shall include, at minimum, the following:
 - .1 Details of all specifications including maintenance and installation requirements for all computers, field panels, equipment, devices, interfaces and facilities provided.
 - .2 Record drawings and schedules of the completed installation including location of devices, mounting details, and wiring details.
 - .3 Operating sequences and interlocks.
 - .4 Names and addresses of spare parts suppliers.
- .7 Record drawings shall be CAD generated, pdf printed, based on the latest version of AutoCAD and shall include, at minimum, the following:
 - .1 Details required by the shop drawings.
 - .2 Final locations and point ID for each monitored and controlled device.

1.13 TRAINING

- .1 Four weeks prior to the commencement of training, submit an email outline of the training materials and curriculum to the Owner and Consultant for review and approval. This outline shall include a schedule of the training sessions, topics to be covered in each session and any prerequisite requirements that should be met prior to attendance, including pre-class study materials, indicated as such. Training shall not commence unless a training outline and schedule has been approved by the Owner and subsequently reviewed and approved by the Consultant.
- .2 Provide details of a training course for system administrators and client operators. The training program shall include two (2) sessions of four (4) hours each for system administrators, up to a class size of 8, and two (2) sessions of four (4) hours each for client system operators, up to a class size of 12. The first session of each shall take place at or near substantial completion, and the second session shall take place at an agreed date after substantial completion to address further training needs. Training should be on-site on the newly commissioned systems that form part of this integrated security project.
- .3 Provide all required pre-study and training materials (hand-outs, textbooks, workbooks etc.) and provide any computer, audiovisual, notebook, writing materials, and other equipment required to execute the training.
- .4 Training sessions shall be formatted to maximize the usage of time of the attendees and prevent redundant coverage of materials for advanced students. Training sessions shall be designed toward the specific requirements of each session based on the attendees scheduled to participate. The training shall be specific to this project and shall cover, at minimum, the following:

- .5 Set up and implementation of all security monitoring and control software for database administrators (DBA), with demonstration of system capabilities common to DBA tasks, including but not limited to operating sequence programming, interface features, partitioning VMS events, printing and burning event logs, and VMS incidents.
- .6 Login, and navigation of Security System(s) PACS, SIS and VMS systems, for system users/operators. Acknowledging incidents, writing response narratives, opening, dispatching, and closing events. Establishing door by-passes, shunting alarm points, selecting VMS cameras for pop-up display, searching VMS activities, re-playing VMS events, saving VMS files to HDD, receiving and placing communications calls, issuing SIS commands, and any other common-user activities as defined by the Owner's representative during the training précis development.
- .7 Other subjects necessary to ensure that the operators and DBA managers will be able to operate the Security System(s) without any on-going assistance from any outside party.

END OF SECTION

PART 1 – GENERAL**1.1 Reference**

- .1 Section 26 00 10 applies to and is a part of this Section of the Specification.
- .2 Section 26 05 00 forms a part of this Section and contains requirements, products and methods for execution that apply to this Section.

1.2 Inspection, Testing, Start-Up and Verification

- .1 In addition to requirements specified in this Section, refer to requirements of Section 26 05 70.

1.3 Shop Drawings

- .1 Submit shop drawings for equipment and accessories specified in this Section. Shop drawings shall include connection wiring schematic drawings for each system, system design drawings including dimensions and layouts, system riser drawings and copies of manufacturer's component literature sheets.

1.4 General Scope of Work

- .1 The UHN security specialist integrator/company shall provide required work and components needed for the provision of an IP based integrated security system to provide following:
 - .1 Access Control System (ACS) to perform security monitoring and control of access devices serving the whole building;
 - .2 Closed Circuit Television (CCTV) system to provide the building with a central integrated security system;
 - .3 Intercom system.
- .2 This Section specifies the integrated ACS for facility utilizing centrally controlled distributed processing system and contact-less smart card technology card readers.
- .3 Include but not be limited to providing the following work:
 - .1 perform detailed system design requirements and installation drawings for construction of system infrastructure to meet specified requirements;
 - .2 determine configuration of system and sequence of operation to integrate with CCTV system and other integrated building systems and provide operations to meet Owner's requirements;
 - .3 determine locations for remote terminals/panels/controls to meet voltage drop limitations and signal level requirements and which such locations shall meet Owner's approval;

- .4 provide system components to best meet specific applications on site as per manufacturer's recommendations;
- .5 configure system such that control modules/panels, power supplies and other such common components are located in secured telecom rooms with connections out to ACS door components; do not locate any components up into ceiling spaces; panels located in telecom closets to include a common key lock; main equipment enclosures to include tamper switches fully wired and connected to alarm at main system terminal.
- .6 security Data Gathering Panels (DGPs) in telecom rooms require network connection to the main IT room.
- .4 Connectivity from the panels to the system front end will be based on Ethernet IP based protocols over the Owner supplied network.
- .5 Backbone of the system to be IP based Ethernet LAN network structured cabling infrastructure based on requirements as specified in Section 27 10 00. System network to include use of fibre optic cabling, UTP copper horizontal network cabling and components, and network switches. System integrator to coordinate with the telecommunications system integrator responsible for the IT network structured cabling system, and provide a dedicated network cabling structure to serve the ACS/CCTV system, consisting of but not limited to providing the following:
 - .1 system components to match requirements of Section 27 10 00;
 - .2 dedicated enclosed equipment racks for mounting of required network switches, patch panels and UPS unit;
 - .3 dedicated system of fibre optic cabling and horizontal UTP copper cabling and jacks;
 - .4 dedicated labelling system.

1.5 Software Nomenclature Reprogramming

- .1 Include additional costs for system manufacturer to make necessary on site final changes to applicable system/equipment software. Make such changes after successful testing and verification of the systems, but prior to turn over to Owner. After successful final verification of the work, confirm and obtain approval of final nomenclature in writing from Owner and Consultant. The software revisions to incorporate final room names/area names/building names and equipment identification.

PART 2 PRODUCTS

2.1 General

- .1 Existing ACS head end to be connected to additional system. Include for Owner's existing security integrator to provide following at existing head end:

- .1 Provision of additional hardware as required to accommodate integrated connection of additional system;
- .2 Provision of additional servers, associated hardware, system and equipment licenses and ancillary devices for expansion of existing system to accommodate work of this project;
- .3 Reprogramming of existing system software to accommodate work of this project;
- .4 Modifications to annunciators as required.

2.2 System Configuration

- .1 The ACS to be comprised of components identified on drawings, specified and as required to provide a fully operational and functioning system meeting Owner's requirements.
- .2 Supply and install necessary field devices as shown and as required including, but not limited to:
 - .1 head end equipment;
 - .2 online card readers;
 - .3 keypads/pin pads;
 - .4 access cards;
 - .5 request to Exit Motion Detectors (REX);
 - .6 local audio/ visual alarms;
 - .7 motion detectors;
 - .8 door control units and/or power supplies;
 - .9 door operator pushbutton;
 - .10 door release pushbutton.
- .3 The following field devices are to be supplied and installed by the hardware contractor:
 - .1 door locking devices (electric strikes, and/or electronic mortise locks);
 - .2 "offline card" readers.
- .4 Connect at the System Integration Point (SIP) to field devices supplied and installed by the hardware contractor as shown on drawings and where required, including, but not limited to:
 - .1 electric strike;
 - .2 magnetic lock;
 - .3 door control unit outputs & inputs.

2.3 Performance Requirements

- .1 ACS to generally operate and provide functionality and sequence of operation as per existing system serving complex and typically include for requirements specified herein. Confirm with Owner and Consultant of any required functionality or sequence of operation software changes.
- .2 ACS shall consist of devices integrated to the door hardware, electronic locking devices necessary to provide a fully automated system to control authorized pedestrian traffic in and out of controlled areas of the facility.
- .3 ACS will be designed on a distributed processing architecture employing remote DPU (Distributed Processing Unit) and operator workstations connected to a redundant central server solution.
- .4 ACS shall use multi-user, multi-tasking standard operating software and be capable of interfacing with an imaging system.
- .5 Central server will be used to maintain the user database and store activity logs. The system shall be capable of operating even in the event that the central server is unavailable.
- .6 Following a power failure and the restoration of main or backup power, the ACS shall revert automatically to normal service status without the need for operator intervention. The system shall restart in the same state as existed before the power interruption.
- .7 ACS shall provide continuous unattended access control and alarm monitoring at specified locations while meeting the technical, operational and feature requirements of this specification.
- .8 ACS shall grant or deny access within one (1) second of an access attempt. Alarms shall be fully displayed on the visual display unit (VDU) within 3 seconds of origination.
- .9 ACS shall allow no more than one (1) "miss" per 1000 read attempts. A "miss" is an incorrect read of an otherwise valid card.

2.4 Integration to Other Systems

- .1 Fire Alarm – Several door types will require release when the local fire alarm zone is activated. The fire alarm system will send signals to the door controller or directly to the lock power supply as appropriate. The door will unlock, and a remote alarm will be activated. Re-set of the fire alarm will require an Access Control indication to reset the (closed) door to locked status.
- .2 CCTV system –ACS shall be integrated to the CCTV monitoring and recording system such that upon an alarm initiation, the appropriate CCTV image(s) live and/or recorded are displayed on the operator monitoring workstation(s) automatically or by selection of the camera icon.

- .3 Intercom - The ACS shall be integrated to the intercom system such that upon an alarm initiation or Operator interaction, the appropriate intercom voice channel is established automatically or by selection of the intercom icon. The integration shall include the monitor of multiple intercom states and monitor and control of intercom functions both manually and through configured events based on system activity.

2.5 Technical Requirements - Field Devices

.1 Controller:

.1 TemaServer2 – TS2 controllers with features as follows:

- .1 Management of up to 16 doors;
- .2 Up to 250,000 cards memory;
- .3 10/100MB direct LAN/WAN connection;
- .4 Based on Linux Operating System;
- .5 Built-in Barracuda Web server;
- .6 WEB pages;
- .7 IPSEC with 3DES encryption on LAN communication;
- .8 Command authentication on LON devices;
- .9 Card number encryption.

.2 Electric Locks:

- .1 Sargent Assa Abloy Profile Series v.S1 intelligent PoE locks with and without keypads depending on application; final finishes to be confirmed with Consultant.

.3 Card Readers:

- .1 Card readers shall consist of contact-less readers employing RFID (Radio Frequency Identification) Smart Card technology credentials. The products chosen shall be equivalent to HID iClass 13.56 MHz reader and card technology.
- .2 Card readers shall read the encoded data from the credential and transmit the data to the host panel. The card reader shall also present audio and visual feedback to the user that a card read operation is either "valid" or "invalid".
- .3 Card readers shall be capable of being flush or surface mounted, and will typically be wall mounted. Slim line mullion mounted types are required for applications where locations consist of windows and insufficient wall space. Coordinate exact requirements with Consultant prior to roughing-in.
- .4 Card readers where required to include key pads.

.4 Access Cards:

- .1 Badging System:

- .2 Existing system to be used.
- .5 Tamper Alarms:
 - .1 Equipment cabinets shall be equipped with sensors, which detect and remotely annunciate their opening.
 - .2 Communication and alarm device cabling at the door and between the DPU 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.
- .6 Motion Detector:
 - .1 Motion detectors to be dual technology passive infra-red (PIR) and microwave technology devices immune to RFI, vibration, static electricity, stray light, rapid temperature changes and other false alarm sources. These devices shall be of type to suit specific applications as recommended by security system integrator.
- .7 Door Position Switches:
 - .1 Sentrol 1078/78C series, steel type contacts, recessed and surface mounted types to suit specific applications and door types, as recommended by system integrator and approved by Consultant.
 - .2 Sentrol 2315/2335 series overhead door magnetic contacts of types to suit specific applications and door types, as recommended by system integrator and approved by Consultant.
 - .3 Coordinate exact types to suit door constructions, with General Trades Contractor and trade supplying doors and frames.
- .8 Request to Exit Motion Detector:
 - .1 Request to Exit Motion detectors shall be PIR type exit detector for access control applications suitable for mounting in a single gang box above doorways. Features depending on application, include:
 - .1 Tamper shutters;
 - .2 Audible sounder with volume control;
 - .3 Cover tamper switch;
 - .4 Reader/keypad/keystroke inputs;
 - .5 Remote arming and sounder inputs.
- .9 Alarm Pushbuttons:

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- .1 At point of sale, cashier and designated public locations, provide concealed pushbutton operators in under counter locations to suit specific installations. Pushbutton shall include provisions that will prevent inadvertent operations but still allow users quick and easy operation during emergencies. Buttons shall interconnect to main ACS system as distinct alarm addresses and annunciate at main security room.
 - .2 Wall mounted alarm stations consisting of minimum 20mm dia. pushbuttons mounted on single gang stainless steel faceplates and be complete with tamper flip cover, shall be provided where required. Buttons shall interconnect to main ACS system as distinct alarm addresses and annunciate at main security room.
 - .3 Alarm pushbuttons shall be resettable with the alarm disabled locally, unless otherwise directed by Owner.
 - .10 Exit Pushbuttons:
 - .1 Rutherford Controls 918/918 N series, vandal and tamper resistant mushroom head (1-5/8" dia) of colour and required operational models as confirmed with Consultant; with stainless steel faceplate and engraved wording to suit application.
 - .11 Door Release Buttons:
 - .1 Rutherford Controls 909 series.
 - .12 Auxiliary Keypads:
 - .1 Linear 212 series.
 - .2 Provided at locations noted to provide door override functions.
 - .13 Door Switching Network Interface Relay:
 - .1 Where doors include auxiliary operators supplied under work of others (typically by door hardware vendor) and require interface to ACS provisions at door, coordinate with door hardware vendor to confirm exact requirements and where necessary provide door interface relay – Camden No. CX-12.
 - .14 Miscellaneous Components:
 - .1 System licenses and manuals;
 - .2 CSA approved power supplies of types and capacities to suit applications and loads, to recommendation of system manufacturers.
 - .3 Sufficient battery backup to provide continuous on line back-up power supply to head end and field equipment as required to maintain system operation for minimum 4 hours when no emergency power is connected. Battery back-up system to be supervised and be monitored for faults. Batteries to be typically gel cell type. Include required system charger.
 - .4 Wall mounting hardware, back-boxes, conduits, cabling, etc. as required.
 - .5 Identification labelling as required.

PART 3 EXECUTION

3.1 Installation of Security Devices

- .1 Install power supplies with equipment enclosures in accordance with the manufacturer's specifications ensuring that proper installation techniques are observed. The exact enclosure type must suit the installation location, and such location must be confirmed with the Consultant prior to roughing-in. Enclosures shall be permanently tagged with identification properly noted and cross-referenced on the "As Built" drawings.
- .2 Provide controllers, card readers, key pads and associated devices at locations as required. Refer to drawings and details.
- .3 In locations of electromagnetic door locks, provide pull station interconnected to fire alarm system as required by local governing authorities and codes. Provide suitable signage. Coordinate work with fire alarm system vendor.
- .4 Install devices in accordance with manufacturer's instructions and recommendations to suit specific applications.
- .5 Power supplies shall be installed in a neat and professional manner in accordance with applicable building and electrical codes. Power supplies and transformers shall be permanently tagged with identification properly noted and cross referenced on the "As-Built" drawings.
- .6 Inputs and outputs shall be properly identified, recorded, and cross referenced on the "As-Built" drawings.
- .7 Refer to Division 08 Sections and include for coordination of required electrical work to accommodate door hardware and door frame construction. Provide required conduit and boxes to suit hardware and wiring. Coordinate with respective trades. Where instructed by General Trades Contractor, supply boxes to frame vendor for installation to frames.
- .8 Ground system to code and manufacturer's requirements.
- .9 Program system to accommodate connected devices and to perform system sequence of operations as per manufacturer's specifications and customized to Owner's requirements. Confirm exact sequence of operation with Consultant and Owner prior to programming. Refer to drawing notes, schedules, and details. Submit detailed proposed sequence of operation with shop drawing submission. Only the manufacturer's authorized technician shall perform required programming work or any central control panel work.
- .10 Installation work shall be performed in a neat and professional manner and in accordance with applicable building and electrical codes. The installation shall be in accordance with manufacturer's specifications ensuring proper installation techniques are observed.
- .11 Materials and equipment proposed and installed shall be new and unused.

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- .12 Installed cabling, connectors, and equipment must meet or exceed minimum manufacturer specifications. Any cabling, connectors or equipment failing to meet those specifications shall be promptly replaced at no additional cost to the Contract. Conductors must be run concealed.
 - .13 Cable and equipment installation shall be permanently tagged with identification properly noted and cross-referenced on the "As Built" drawings to be provided to the Consultant, upon completion, verification, and acceptance of the installed systems.
 - .14 Provide engraved lamacoid nameplates on equipment enclosures. Verify exact nomenclature in writing with the Consultant.
 - .15 Include for manufacturer's authorized installer/supplier to perform the following services:
 - .1 final connections from the devices to the control unit;
 - .2 system programming, inspection, testing, start-up and verification;
 - .3 verify the sequence of operation and provide written confirmation that the system is functioning properly;
 - .4 provide schedule of connected devices and zones;
 - .5 Instructions to Owner's authorized representatives;
 - .6 certified re-verification of entire system one (1) year after completion of the Work.

END OF SECTION

1 GENERAL

1.1 WORK OF THIS SECTION

- .1 This section of the specifications details the work and components to be provided by the Security System(s) Contractor relating to the Surveillance Cameras.

1.2 RELATED REQUIREMENTS

- .1 The requirements of the Project Manual are related to and shall be read in conjunction with this section.
- .2 This section is related to and shall be read in conjunction with all other Division 28 sections.
- .3 The section is related to and shall be read in conjunction with all other Division 27 sections.
- .4 This section is related to and shall be read in conjunction with the Security System(s) drawings.

1.3 REQUIREMENTS

.1 GENERAL

- .1 Supply and install a fully functional IP technology-based indoor surveillance cameras and power supply equipment.
- .2 Surveillance cameras shall be connected to the converged LAN for video signal transmission.
- .3 Provide all equipment, bezels, mounting brackets, interconnections, power supplies, termination boots, controls and other services as required to integrate cameras into Video surveillance System (VSS) as contained in the security drawings and performance specifications.
- .4 Surveillance cameras shall be provided complete with protective housings, mounts, fasteners, arms, cableways, heaters/fans, and all required hardware for proper installation and performance.
- .5 All interior ceiling dome cameras, where possible, shall be recess mounted in finished areas. Where indicated by the Architect, provide wall mount brackets with concealed wiring. Surface mounted dome cameras are acceptable in unfinished areas provided they are mounted on a finished back-box, suitable for the installation. Obtain written approval from Owner and Architect prior to finalizing design of the camera mounts in all finished spaces.
- .6 For high finish interiors, coordinate with Architect and Consultant to provide cameras with trim rings, bezels, mounts, etc. to match the surrounding finish. Submit all proposed finishes and configurations to the Architect and Consultant for approval.
- .7 Surveillance cameras that are required to be mounted on non-structural walls or ceilings shall be provided complete with suitable mounting plates or supporting materials on the reverse side of the wall or ceiling to ensure the devices are securely fastened.

- .8 Surveillance cameras shall be mounted at heights necessary to maximize the camera field of view. Housings and mounts shall be properly supported from building structure as appropriate. If required, custom mounts and housings shall be provided to allow for maximum use of the cameras. Provide any required miscellaneous materials for bracing and mounting. Conduit shall extend to the housing such that cables are not exposed.
- .9 Provide video loss detection on all cameras.
- .10 Internet Protocol (IP) technology-based cameras connected to the converged LAN for video signal transmission.
- .11 For IP based elevator cameras, power supplies, Power over Ethernet (POE) injectors, and media converters as indicated on the drawings and within these specifications, and in order to comply with code and prevent damage to transmission cables, coordinate with elevator contractor.
- .12 The Security System(s) Contractor shall ensure proper equipment selection for each application. Consideration shall be given to such criteria as area of coverage, light conditions, etc., consistent with the generally accepted practices for VSS surveillance and to the approval of the Architect, Owner and Consultant.
- .13 The Security System(s) Contractor shall coordinate 120 VAC power sources for auxiliary VSS devices such as power injectors, encoders, module boxes, and media converters as required.
- .14 The Security System(s) contractor shall provide cable, transformers, POE network switches, POE power supply equipment (PSE), mid-span power injection devices, media converters, module boxes, dedicated 24 VAC transformer power supply units, connection of power supplies to 120 VAC sources and power all Surveillance cameras and devices.
- .15 Interior mounted fixed cameras shall be powered by POE. Provide VSS equipment which is compliant with IEEE Standard 802.3af POE.
- .16 Refer to the electrical design drawings for details of electrical power supply circuit facilities to be provided by the Electrical Contractor for the Security System(s) Contractor. Coordinate electrical requirements (where required) with the Electrical Contractor.
- .17 The Security System(s) Contractor shall provide the Owner and Consultant with space requirements for all surveillance cameras related equipment (such as power supplies, injectors, media converters, and auxiliary devices) to be mounted within the detailed locations. The Security System(s) Contractor shall also refer to the security drawings, electrical drawings and architectural drawings for equipment layouts. Coordinate equipment mounting in the locations with other trades.
- .18 All equipment must bear the CE mark, or be tested for immunity against EN 55024 or CISPR 24 and for emissions against EN 55032 or CISPR 32.

2 PRODUCTS

2.1 SURVEILLANCE CAMERAS

- .1 Provide cameras at the locations as indicated on the Security Drawings.
- .2 Provide solid state imaging with Charge Coupled Device (CCD) or CMOS, 1/3 " format, color cameras meeting the following minimum requirements:
 - .1 Provide a minimum of 2 (two) separate video streams, capable of 30fps for both a recording and live viewing stream.
 - .2 50 db signal to noise ratio.
 - .3 60 dB minimum dynamic range.
 - .4 True Color Rendition circuitry or color temperature settings.
 - .5 Back-light (BLC) compensation circuitry.
 - .6 10/100 Base T Ethernet, auto-sensing, half/full duplex video signal data communications with integrated RJ-45 connection.
 - .7 Selectable video resolution at minimum: 720P, 1080P or higher.
 - .8 VSS cameras shall be a minimum of 720P or 1.3MP resolution for parking general surveillance, corridors, and lobbies.
 - .9 VSS cameras for the parking garage, building exterior, overhead doors (inside and outside) and the ground floor primary / public corridor cameras shall be 1080P or 2.1MP resolutions or higher.
 - .10 Output video utilizing H.264 video compression (MPEG-4 Part 10) and M-JPEG motion video compression.
 - .11 Video motion detection.
 - .12 Video signal loss detection.
 - .13 POE IEEE 802.3af compliant devices wherever possible or 12 VDC or 24 VAC if required to meet camera power requirements. Where required provide all power supplies cabling, transformers, enclosures to power cameras from the 120 VAC circuit locations.
 - .14 Discreet with easy flexible installation on wall or ceiling, recessed, flush, or pendant mounting to avoid obstructions.
 - .15 Three years warranty minimum.
 - .16 Subject to meeting these specifications, acceptable manufacturers of the cameras shall be:
 - .1 Axis Communications;
 - .2 Bosch;
 - .3 Hanwha Techwin;

- .4 No accepted alternates.

3 EXECUTION

3.1 INSTALLATIONS

- .1 Provide all required programming and complete calibration and set-up of all cameras, for integration into VSS System and fully functional system.
- .2 Adjust all camera varifocal lenses to meet the Consultant/Owners requirements.
- .3 Provide a video image snapshot showing the maximum field of view (FOV) of all installed fixed cameras complete with camera software port description. All images shall be provided to the Owner/Consultant on electronic format. The snapshot will be utilized by the Owner/Consultant to select the final desired FOV of the camera.
- .4 Coordinate IP addresses and all network configuration details with IT Services. Comply with building project IT Services requirements for IP addressing, device naming and documentation.

END OF SECTION

PART 1 – GENERAL

1.1 Reference

- .1 Section 26 00 10 applies to and is a part of this Section of the Specification.
- .2 Section 26 05 00 forms a part of this Section and contains requirements, products and methods for execution that apply to this Section.

1.2 Related Work Specified in Other Sections

- .1 The following work which is related to the fire alarm system work is specified in other Sections of the Specification:
 - .1 Provision of fire alarm system supervised valve contacts, alarm valve contacts and piping pressure switches;
 - .2 Provision of pre-action sprinkler system;
 - .3 Provision of fire detection air sampling smoke detection system.

1.3 Inspection, Testing, Start-Up and Verification

- .1 In addition to requirements specified in this Section, refer to requirements of Section 26 05 70.

1.4 Shop Drawings

- .1 Submit shop drawings for equipment and accessories specified in this Section. Shop drawings shall include connection wiring schematic drawings for each system, system design drawings including dimensions and layouts, system riser drawings and copies of manufacturer's component literature sheets.

1.5 Software Nomenclature Reprogramming

- .1 Include additional costs for system manufacturer to make necessary on site final changes to applicable system/equipment software. Make such changes after successful testing and verification of systems, but prior to turn over to Owner. After successful final verification of work, confirm and obtain approval of final nomenclature in writing from Owner and Consultant. Software revisions to incorporate final room names/area names/building names and equipment identification.

PART 2 – PRODUCTS

2.1 Existing Fire Alarm System Work - General

- .1 The existing fire alarm system serving complex requires that additional system to be provided to serve the additional and renovated areas must be 100% compatible with and of same manufacture as per existing NOTIFIER NFS3030 system. Engage Owner's existing system manufacturer's authorized technicians to provide and perform required system work. Original equipment onsite is of various generations of equipment. Work required to be provided on existing system to include but not be limited to:
 - .1 necessary control panel and annunciator work of existing system to accommodate

- additional annunciators, transponders, additional devices and zones, replacement of devices, reworking of existing zones and circuits, and integration of additional system serving additional areas of Project;
- .2 provision of transponder/control panel at existing CACF, to provide smoke control, EVAC controls, fire-fighter's communications, magnetic lock controls and other system controls and monitoring of additional system;
- .3 Re-program system to suit renovations work.
- .2 Typically, additional devices to be added to existing NFS system to include but not be limited to provision of following:
 - .1 Annunciators
 - .2 Remote Annunciators at nurse stations
 - .3 Transponders;
 - .4 MHW1 strobes, horns and combination horns/strobe units;
 - .5 MHR, MHR1 speakers and combination speaker/strobe units;
 - .6 FSP intelligent multi-sensor detectors;
 - .7 NBG-12LX intelligent pull stations with key switches;
 - .8 remote fire fighters telephones complete with back box and door;
 - .9 FST intelligent thermal detectors;
 - .10 Ancillary devices as required.

2.2 Manual Control Station for Building Services

- .1 Provide manual control station for control and monitoring of various building services related to fire alarm system and smoke control system for Hospital. Provide components as specified, detailed and as required to provide smoke control, smoke venting, stairwell pressurization, magnetic door lock release, and other interrelated functions as per detail, schedule and notes on drawings. Sequence of operation to be as noted. Interconnect related systems. Panel to be manufactured by fire alarm system manufacturer and is to be a part of main fire alarm system and be fully integrated to system.
- .2 Provide supervised control wiring in conduit for following:
 - .1 from fire alarm system to fan shut-down contacts as specified and/or as required;
 - .2 from fire alarm system to automatic temperature controls of air handling equipment contacts as specified and/or as required;
 - .3 from selector switches to relays as shown and/or as required;
 - .4 to BAS system contacts as shown and/or as required;
 - .5 to centralized door lock controls as required;
 - .6 to system equipment as scheduled;
 - .7 to auxiliary equipment as required.
- .3 Wall mounting control station to include following:

- .1 enclosure with front hinged lockable panel and flush trim (where installed in finished areas; confirm with Consultant); standards and quality of materials to be as typically for fire alarm panels;
 - .2 red and green high illuminating, long life LED type indicators;
 - .3 "START/STOP/NORMAL", three position selector switch complete with keys;
 - .4 colour graphic displays of building outline and zones as per drawing detail; submit sample display with shop drawing submission; standard and quality of displays to be as per fire alarm system graphics; size of graphic to be minimum 4'x4' (1200 mm x 1200 mm);
 - .5 engraved lamacoid identification nameplates with mounting screws and suitable nomenclature to suit; confirm exact nomenclature with Consultant;
 - .6 power supply as required;
 - .7 wiring as required.
- .4 Manual control station and integrated systems to be inspected, tested, and verified as part of fire alarm system testing and verification.
 - .5 Co-ordinate work with work provided by Mechanical Divisions.

2.3 Addressable Device Network

- .1 System provides communication with addressable initiating devices and these devices are annunciated on control panel/transponder main LCD display. Annunciation includes following conditions for each point:
 - .1 zone/device location;
 - .2 type of device;
 - .3 detector status (normal/alarm/trouble);
 - .4 device missing/failed.
- .2 A minimum of 100 addressable devices may be multi-dropped from a single pair of wires. Systems that require factory reprogramming to add or delete devices are unacceptable.
- .3 Each addressable device to be uniquely identified by an address code entered on each device at time of installation. Use of jumpers to set address will not be acceptable due to potential of vibration and poor contact.
- .4 A 100% digital loop controller within control panel/transponder to interface with intelligent microprocessor-based detectors and modules.
- .5 Loop controller connected to detectors and modules using any wiring material or method complying with local governing electrical code, without need for special shielded or twisted wire.
- .6 Loop controller to be capable of supporting Class A (Style 7) or Class B (Style 4) circuits without need for additional hardware modules. Multiple branch circuits can be T-Tapped from Data Communications Link (DCL).
- .7 Loop controller to be capable of automatically addressing devices connected to it electronically, without need to set switches at any of individual device locations.

- .8 Loop controller to determine electrical location of each connected detector and module. Location and type of each connected device to be mapped and stored in memory in loop controller. Map can be accessed and displayed.
- .9 Mapping report of devices connected to loop controller for confirmation of "as-built" wiring can be obtained. Mapping report shows electrical relationship of connected devices, including T-Taps, device types, and address of each device on circuit. Loop controller to be capable of reporting any additional device addresses, which may have been added to circuit, and/or changes that, may have been made to wiring. A specific trouble to latch on system until changes are verified and accepted in program by authorized personnel.

2.4 Power Requirements

- .1 Control panels, transponders and annunciators to receive power via a dedicated fused disconnect emergency circuit. Incoming power to system to be supervised so that any power failure must be audibly and visually indicated at transponder and remote annunciator. A green 'Power On' LED to be displayed continuously while incoming power is present.
- .2 Power supplies to have following operating characteristics:
 - .1 rated for five (5) amps continuous duty;
 - .2 24 VDC filtered and regulated;
 - .3 power limited with a range of 20.4 VDC to 32 VDC;
 - .4 automatic "Brownout" transfers to standby batteries when supply voltage falls to below set limit.
- .3 System to be provided with sufficient standby capacity to operate entire system upon loss of normal power in a normal supervisory mode for a period of minimum 24 hours, and immediately following, full load power (defined as power required for full signalling activation of devices both visual and audible for full alarm conditions) for not less than 15 minutes. These requirements to be confirmed with local fire authority and be amended to suit local fire authority requirements but such amendments to not lessen requirements herein specified. These requirements must be tested and demonstrated. Refer to Part 3 of this Section. System to automatically transfer to standby batteries upon power failure. Battery charging and recharging operations to be automatic.
- .4 Standby power for system to be produced by maintenance free, sealed lead acid or gelled cell batteries. System batteries to be supervised so that a low battery condition or disconnection of batteries to be audibly and visually annunciated at control panel. Battery chargers to have following operating characteristics:
 - .1 ability to charge batteries to 70% of their capacity within 12 hours;
 - .2 compatible with either lead acid or nicad batteries;
 - .3 circuits requiring system operating power to be individually fused.
- .5 System to be provided with transient voltage surge protection device (SPD) to protect system electronics from surges and spikes on power lines. SPD units to be as recommended by fire alarm system manufacturer.
- .6 System to be provided with transformers as required to power ancillary devices and hardware.

2.5 Addressable Modules

- .1 Addressable modules to be used for monitoring of water flow, valve tamper, non-addressable detectors, air sampling smoke detectors, and for control of fans or dampers that require shutdown or manual control in an alarm condition.
- .2 Addressable modules to monitor any N/O contact device and be capable of powering
- .3 2-wire smoke detectors. Addressable modules to communicate zone's status (normal, alarm, trouble) to transponder. Addressable modules zone address to be set at time of installation via a dip switch package.
- .4 Addressable modules to be able to provide supervised or non-supervised control of any control function. Addressable modules to communicate zone's status (normal, trouble) to transponder. Each addressable modules to provide a double pole double throw relay for switching loads of up to 120 VAC. Each common leg of relay to be equipped with a replaceable fuse sized as required.

2.6 Pull Stations

- .1 Series NBG-12LX, pull stations to be addressable, single action, non-coded, 2-stage, semi-flush mounted type. Pull stations to be key locked and have 2-sets of sealed N/O contacts. One (1) contact is to activate when handle is pulled down, activating a first stage alarm. Second contact is operated by means of a key switch, which activates second stage alarm. Stations to be complete with auxiliary contacts to connect to other building systems, such as to release doors upon 2nd stage alarm activation. Confirm exact sequence of operation with Consultant prior to programming. Set station's address at time of installation.
- .2 Stations located in areas of high abuse or where designated to be complete with guard, to be equipped with STI type, ULC listed and labelled, hinged clear Lexan cover and which to include an integral battery operated alarm if required by code or local fire authority. Include for provision of a quantity of 5 covers to be installed in locations defined by Owner at site.

2.7 Detectors and Bases

- .1 Addressable smoke and heat detector heads as specified below to lock onto their bases. Same base to be compatible for both smoke and thermal detectors. Upon removal of head, a trouble signal to be transmitted to transponder. Detector's address to be set at time of installation.
- .2 Where required provide an additional alarm relay (Form C, SPDT), normally open contact, for auxiliary functions.
- .3 Each detector to contain a LED that flashes each time it is scanned by transponder. When transponder determines that a detector is in alarm or a trouble condition, transponder to command LED on that 'detector' to turn on steady indicating abnormal condition.
- .4 Each detector to be scanned by transponder for its type identification to prevent inadvertent substitution of another detector type. Transponder to operate with installed device but to initiate a 'Wrong Device' trouble condition until proper type is installed or programmed detector type is changed.
- .5 Detector bases include wiring terminals that are accessible to "room side" after mounting

to a standard 4" (100 mm) octagon box.

- .6 Various types of bases to be provided to suit each respective application, which is to be confirmed with system manufacturer. Types include:
 - .1 standard type equipped with wiring terminals, for mounting to a standard 4" (100 mm) octagon box and complete with tamper-resistant mechanism to prevent unauthorized removal of unit head from base;
 - .2 relay type that is same as standard type but complete with auxiliary relay;
 - .3 audible type includes an audible alarm sounder;
 - .4 isolator type with line fault isolator.

2.8 Photoelectric Smoke Detectors

- .1 Model FSP multi-sensor smoke detector to be addressable photo-electric and thermal technology types.
- .2 Detector's microprocessor measures and analyses signals and filters out signal patterns not typical for fires, thus limiting false alarms. microprocessor also performs:
 - .1 self-diagnostics and history logging, with results stored in non-volatile memory;
 - .2 automatic device mapping with supervision of each device location;
 - .3 identification of dirty or defective detectors;
 - .4 stand-alone operation if communications fail between it and main system CPU;
 - .5 on board intelligence which limits information required to be sent to main CPU.
 - .6 Sensitivity range of each detector set in transponder to be from
 - .7 0.67-3.7% smoke obscuration. Each detector to have minimum five different programmable sensitivity levels within this range - 1.0, 2.0, 2.5, 3.0, and 3.5%.
- .3 Detectors feature:
 - .1 a low profile design and ULC Listed for both ceiling and wall mount applications;
 - .2 tamper resistant features;
 - .3 electronic addressing;
 - .4 electronics immune from false alarms caused by EMI and RFI;
 - .5 insect screen;
 - .6 environmental compensation;
 - .7 automatic day/night sensitivity adjustment;
 - .8 RED/GREEN status LED indicators.
- .4 Detectors to be equipped with a dust-bag, which is removed at time of verification, to prevent dust and dirt entering smoke chamber during construction.
- .5 Detector in-patient rooms to be complete with auxiliary contacts for connection to amber lamps of nurse call dome lights.

2.9 Duct Smoke Detectors

- .1 Duct type smoke detector units with features as follows:
 - .1 addressable photoelectric detector features;
 - .2 duct air sampling tube of suitable required length;
 - .3 magnetic activated test switch;
 - .4 status LEDs;
 - .5 form C auxiliary alarm relays;
 - .6 remote alarm indicator assembly with LED type lamp and single gang stainless steel faceplate;
 - .7 remote test station for detectors in locations not easily accessible to test.
- .2 Duct housing assembly to consist of air tight housing mounted on side of duct. This housing to contain detector base into which photoelectric detector head is inserted.
- .3 For units located within ductwork as shown on drawings and for units within air intake ductwork provide ULC listed and labelled weatherproof housing complete with integral heater and thermostat control with alarm contacts for monitoring and annunciation of low temperature. Provide wiring in conduit back to transponder/control panel.

2.10 Audible/Visual Devices

- .1 Series MHR, MHR1 devices include horns/speakers, strobes and combination units. Devices to mount on wall back boxes. Back boxes to be supplied by system manufacturer to suit specific devices and type of installation. Finish colours to be confirmed with Consultant or Owner prior to ordering.
- .2 For finished areas: 7.3" (180 mm) round baffled cone-type speaker suitable for ceiling mount applications. Speaker assembly to consist of following:
 - .1 fire retardant and moisture proof cone rated 15 watts;
 - .2 25/70 volt matching transformer complete with 1/4, 1/2, 1 and 2 watt taps;
 - .3 400 HZ to 4,000 HZ frequency response;
 - .4 89 db at 10' (3 m), with a 1 watt input;
 - .5 moisture repellent treated steel enclosures;
 - .6 pre-tap speakers at 1/2 watt tap.
- .3 For integrated speaker strobe units include integral synchronized strobe to be complete with Lexan lens, field changeable "FIRE" markings and candela output intensity as approved by local fire authority (range from 15 cd to 110 cd).
- .4 Stand alone strobes to be similar to features of combination units specified above but only with strobe features.
- .5 In finished areas, devices to mount to a 4" (100 mm) square, 2-1/8" (60 mm) deep, back box. Where devices are to be surface mounted, provide a red finished surface back box with no knockouts.
- .6 Devices mounted exterior to be complete with "weatherproof" box.

2.11 Remote Lamp Units

- .1 Single gang stainless steel faceplate with LED indicating lamp, suitable for mounting on standard wall box; unit to be remotely connected to any smoke detector located in position where detector activated LED cannot be seen, such as under raised floors, in drop ceilings, above or in ductwork, etc.; smoke detectors to include auxiliary connections to suit connection requirements as per system manufacturer's recommendations; provide suitable identification labelling on faceplate.

2.12 Remote Fireman's Telephones

- .1 Series FB-300/FTS-C/FC-300C remote firemen's telephones to be housed in a flush mounted steel cabinet with a lockable door assembly. Cabinet to be finished in red with inscription "LOCAL FIRE EMERGENCY PHONE." telephone to be constructed of red cyclac Type "T" thermal ABS material and have a 5' (1.5 m) coiled line cord.

2.13 End-Of-Line Resistors

- .1 End-of-line resistors for standard alarm and signalling circuits to be sized to ensure correct supervisory current flows in each circuit.
- .2 End-of-line resistors to be mounted on a stainless steel plate for mounting on a standard single gang box and bear ULC label.

2.14 Isolators

- .1 Isolators to be provided in accordance with code requirements and installed as per system manufacturer's requirements to isolate/monitor zones, loops, group of devices within building and between buildings.

2.15 Wiring

- .1 CSA approved and ULC listed wire and cable, approved for fire alarm circuits; with colour coded, insulated solid copper conductors; of type as per local governing electrical code and local governing fire authority requirements; sized and installed in accordance with system manufacturer's instructions.
- .2 Provide Pentair "Pyrotenax" type "MI" ULC listed and labelled and 2 hour fire rated, mineral insulated, copper sheathed, copper conductors for power wiring to and between each transponder/control panel.

2.16 Warranty

- .1 Warranty to include following:
 - .1 length of warranty as specified in Section 26 0010 and Division 01;
 - .2 repair or replacement warranty on components;
 - .3 warranty to begin upon substantial acceptance of project, or where applicable, phase of project; provide extended warranty for system if used during construction stages and which to cover period of construction before turn over to Owner;
 - .4 support of an operational remote maintenance capability;
 - .5 repair response times for problems defined as routine to be addressed and corrected within 24 hours, excepting statutory holidays and weekends;
 - .6 repair response times for problems defined as major to be addressed and

- corrected within 4 hours, excepting statutory holidays and weekends;
- .7 manufacturers of major components to provide written confirmation of full warranty, extended warranty and service back-up in case of failure to perform or insolvency of successful supplier;
- .8 maintain maintenance records for each system supplied, and must submit a monthly report containing a time and date record of reported or detected problems, detail of corrective action taken and cause of problem.

2.17 Acceptable Manufacturers

- .1 Acceptable manufacturer of main building fire alarm system (products and work to be provided directly from manufacturer, unless otherwise noted) is to be NOTIFIER,

PART 3 – EXECUTION

3.1 Monitoring of Systems

- .1 In area that remain occupied and used by Owner during the Work, the monitoring and supervision of the existing fire alarm system serving the renovated areas, must be daily monitored to ensure that system is left in proper operating condition at the end of each working day. Include for but not be limited to performing the following:
 - .1 under the presence of the Owner's representative, check each morning and evening (start and end of work) of each day, the system to ensure that it is in proper working condition;
 - .2 if portions of the system are not in proper working order, provide temporary bypass wiring (if fire alarm system, must be subject to approval of local fire authority), and/or provide supervisory personnel to monitor systems for the area affected;
 - .3 document and sign off with Owner's representative signing off also, each respective daily check condition;
 - .4 ensure that the work to system does not affect the portion of the system serving the areas outside of the renovation/working areas.

3.2 Installation Work to Existing Fire Alarm System

- .1 Provide relocation work and additional components as required. The sequence of operation of the system shall be retained. Program system to accommodate renovations works, to satisfaction of local fire authority and Consultant.
- .2 All work in conjunction with this installation shall meet the requirements of the latest editions of the OBC, OESC, Ontario Fire Code (OFC), ULC Installation Standard CAN/ULC-S524 and any applicable local codes.
- .3 All work performed on the existing fire alarm system shall be performed by qualified persons as defined in Sub-Section 1.1.5.3 of the OFC. If any requirements of these specifications are different, omitted or contrary to the ULC-S524 Standard, then the ULC Standard governs and overrides these specifications, but in no instance will the standards established by the drawings and specifications be reduced by any of the Codes referred to previously. Control units and annunciators shall be in accordance to the latest requirements of ULC Standard CAN/ULC-S527 "Control Units For Fire Alarm Systems.

- .4 During work to the existing fire alarm system, the time and duration of interruption shall be approved by the Owner. At any time due to emergency situations, Owner may request bypassed zone(s) to be re-instated immediately. In all areas where the renovation work requires shutdown of any part of the fire alarm protection system, provide manual fire alarm protection (Fire Warden) by means of supervising the area as approved by Governing Authorities. At no time shall the fire alarm system or any one (1) zone be left inoperative overnight. Provide all required bypass wiring and temporary wiring as may be required to maintain all parts of the fire alarm system operative during construction and alterations.
- .5 Verify with existing fire alarm system manufacturer during Bid period, the exact requirements needed to provide renovation work. If necessary, visit site with manufacturer to review existing conditions. Items of clarification or proposed revisions to Bid Documents must be reviewed with Consultant during Bid Period.
- .6 Provide for the existing building fire alarm system manufacturers to perform control panel/annunciator work. System DGP to be programmed with sequence of operation matching existing system.
- .7 Ensure that connections to existing systems serving the campus are provided such that activation of circuitry to transmit an alarm signal to Owner's monitoring company to send alarm signal to Fire Department or to an outside private protection company are maintained to existing standards as per requirements of CAN/ULC-S561.
- .8 Provide proposed drawing and sample of graphic display to Consultant for approval before manufacturing. Provide graphic annunciator in location as directed by Consultant.
- .9 Properly ground and bond control panels, transponders and remote annunciator cabinets to building ground. Conduit ground will not be acceptable. Provide green coloured grounding loop, a minimum #10 AWG. insulated copper run in conduit. Connect ground loop to main building ground system source. Do not run ground wire in same conduit as fire alarm and communication wiring.
- .10 Provide required devices. Circuit device's to existing standards and in compliance with local governing codes and authorities.
- .11 Installation of devices to be typically as per additional system devices specified later in this Section.

3.3 Installation of Additional Fire Alarm System – General

- .1 Prior to start of Work as part of shop drawing submission process, review with system manufacturer following:
 - .1 device types to ensure that selected type is suitable for intended application on project;
 - .2 locations of devices to ensure proper operation and coverage are in compliance with requirements of local fire authorities;
 - .3 device mounting heights to ensure proper operation and coverage are in compliance with requirements of local fire authorities;
 - .4 device back box requirements to ensure size and depth suit system manufacturer's recommendations for specific devices;

- .5 proposed system sequence of operation.
- .2 Immediately advise Consultant of any requirements of above that may necessitate revisions to design documents.
- .3 Install fire alarm system components and connect complete.
- .4 Work in conjunction with this installation to meet requirements of latest editions of local governing building code, local governing electrical code, ULC Standards including Installation Standard CAN/ULC-S524, and any applicable local governing codes. If any requirements of these specifications are different, omitted or contrary to ULC-S524 Standard, then ULC Standard governs and overrides these specifications, but in no instance will standards established by drawings and specifications be reduced by any of Codes referred to previously. Control units and annunciators to be in accordance to latest requirements of ULC Standard CAN/ULC-S527 "Control Units for Fire Alarm Systems.
- .5 Perform Work in phases as specified in Divisions 00 and/or 01 and/or as noted on drawings.
- .6 Fire alarm system manufacturer's authorized technician to supervise control panel, transponder, and annunciator work.
- .7 Provide sequence of operation for fire alarm system as approved by local fire authority and Consultant. Owner's fire Consultant to also be contacted with regards to requirements of sequence of operation. sequence of operation and proposed graphic displays to be submitted to local fire authority and Consultant for review during shop drawing submissions. Refer to additional requirements on drawings.
- .8 Demonstrate system to local Fire Department and obtain their approval for complete system.

3.4 Sequence of Operation

- .1 For pricing purposes and which must be confirmed and approved by local authority having jurisdiction and Consultant, fire alarm sequence of operation to include but not be limited to description in following paragraphs. Submit to Consultant for review, proposed sequence of operation based on specification requirements, Consultant comments and input from local governing authorities.
- .2 System to be flexible to easily program any sequence of operation. Control panel to be able to be programmed to initiate a series of pre-defined control actions. Confirm exact sequence of operation with Consultant and local fire authority prior to programming. Review fire plan prepared by Fire Consultant. Sequence herein is provided as an outline with exact requirements to be confirmed and programmed to requirements of fire plan, authority having jurisdiction and Consultant. Include for programming and software re-burning within 30 days of initial burning or within duration as directed by local authority having jurisdiction, and also for additional software reprogramming periods as previously specified. Generally, activation of any alarm initiating device including sprinkler system alarm valves in areas to cause:
 - .1 fire alarm signal tone to sound a first stage fire alert signal as approved by local fire authority, throughout zones as scheduled on drawings or as required by local authority, for 5 minutes after which time they are to be manually silenced;
 - .2 address and zone of fire alarm initiation to register on annunciators;

- .3 activation of circuitry to transmit an alarm signal to device(s) provided by others (Owner's arranged monitoring company) to send alarm signal to Fire Department or to an outside private protection company; this work to comply with CAN/ULC-S561;
 - .4 smoke and fire doors as scheduled, in building which are normally held open by electric door holders to be released and closed, locked doors controlled by electric door locks and/or magnetic door locks to be opened and remain opened until fire alarm system is reset;
 - .5 a signal sent to automatic temperature controls of air handling systems to initiate sequence of operation of air handling equipment to operate;
 - .6 a signal to be sent to smoke control equipment such as designated fans as scheduled to operate or shut down or dampers to open or close and pressurization fans as scheduled to automatically start;
 - .7 alarm condition to be displayed on alphanumeric display on CPU and on remote annunciators;
 - .8 activation of assigned control points through control-by-event;
 - .9 assigned message and activated control-by-event functions, with time and date, for monitored point in alarm to be printed on CPU printer;
 - .10 colour graphic to show on screen layout of floor and zone area in alarm;
 - .11 homing elevator to 1st level or designated level automatically; elevators to operate in emergency sequence of operation;
 - .12 indicate alarm details in remote annunciators;
 - .13 log alarm/trouble events in historical event log;
 - .14 illuminated fire signs to be operated at fire alarm zones where they occur;
 - .15 visual notification appliances (strobe lights) to activate in applicable zones;
 - .16 associated integrated low voltage systems to be signalled, as required; exact systems to be integrated to be as confirmed with Consultant; emergency sequencing of other system to be initiated;
 - .17 send signal to integrated clean agent fire suppression controller and/or tanks release mechanism to initiate sequence of release of clean agent; include time delay; refer to sequence of operation later in this Section;
 - .18 send signal to integrated pre-action sprinkler system controllers to initiate sequence of sprinkler activation;
 - .19 integrated main fire alarm control units of other buildings of complex to be signalled, as applicable.
- .3 This alarm condition to be cleared and system reset only after activated alarm initiating device or devices on both stages of alarm have been restored to normal and building control panel is reset.
- .4 If investigation of alarm zone by key personnel indicates need to evacuate zone, insertion of a special key and subsequent operation of a key switch if any of manual fire alarm pull stations or operation of control panel evacuation switch to sound a "general evacuation"

alarm of temporal pattern in zones as scheduled on drawings. Exact tone pattern of signal to be confirmed with and approved by local governing fire authority.

- .5 Upon activation of fire alarm system, a signal to be sent to elevator controllers to implement emergency sequencing of cars. Generally, elevators to "home" to designated floor, unless alarm zone is on designated floor, in which case, elevators to stop at floor above. Exact emergency sequencing requirements to be as directed by Consultant.
- .6 Voice communication system to include provision for silencing alert signal and alarm signal when voice messages are being transmitted, but only after alert signal has sounded for at least 30 seconds.
- .7 Unauthorized closure of a fire protection system piping supervised valve to cause location of closed valve to be indicated at annunciators, trouble signals (audible and visual) to sound and illuminate, and a trouble signal to be transmitted to Owner's fire alarm monitoring company. This work to comply with CAN/ULC-S561.
- .8 Low pressure in fire protection piping mains (wet and dry), fire protection system pump (fire pump-standpipe system excess pressure pump-sprinkler pump and sprinkler system excess pressure pump) loss of power, sprinkler air compressor loss of power, generator fail to start, generator starting batteries low voltage or operation of fire pump to also activate audible and visual trouble alarm as specified above for supervised valves.
- .9 Refer to drawing notes for additional requirements.

3.5 Installation of Devices

- .1 Install required devices. Do not install devices in locations that may hamper proper operation of devices including adjacent devices.
- .2 Confirm device finishes with Consultant prior to ordering.
- .3 Install manual pull stations in boxes as required, recessed outlet boxes with plaster rings, except in unfinished areas where pull stations are surface mounted, in which case, install stations in surface mounted boxes. Comply with mounting height requirements for local governing building code barrier free access.
- .4 Install mounting plate of thermal detectors to ceiling mounted boxes as required. Secure detectors to plates. Refer to floor plans and drawing symbol list to determine rating of detectors in any given area. Generally, do not install rate-of-rise type detectors in areas subject to sudden changes in temperatures, such as entrance vestibules. Confirm application requirements with system manufacturer and ensure that devices are ULC listed for such applications and are approved by local fire authority for such use.
- .5 Secure base of each ceiling mounted products of combustion detectors to boxes as required, either flush or surface mounted as required. Secure detector heads to bases.
- .6 Interconnect patient room smoke detectors with annunciator at local nurse station and to room nurse call dome lights, as required. Coordinate work and requirements with nurse call system vendor.
- .7 Install cross zoned connection of detectors and remote indicating devices for areas of raised floors or within accessible ceiling spaces or for applications detailed on drawings.
- .8 Mount each duct mounted products of combustion detector on duct in question and connect with smoke sampling tubes which extend into duct air stream. Install a remote

alarm lamp assembly for each duct mounted detector. Wall mount each lamp assembly on a standard 4" (100 mm) outlet box as close as possible or practicable to detector. Do not locate duct detectors within 3' (900 mm) of duct size increaser or decreaser fittings or any duct elbow. Provide wiring in conduit and extend to connect back to system control unit.

- .9 In application with hold open devices on doors, ensure compliance with NFPA regarding smoke detectors tied to hold open devices such that a signal received directly from smoke detector to cause release of door. Where electromagnetic locks are used on doors of egress, provide required automatic release of locks upon activation of fire alarm (i.e. via connection to auxiliary contact of adjacent pullstation). Provide required connections to fire alarm system and to electromagnetic locks.
- .10 Provide required speakers. Speakers shall be flush and surface wall mounted cone type and surface mounted horn type as indicated to suit architectural wall/ceiling types, each complete with a proper backbox. Ensure that exterior speakers are weatherproof and mounted with a weather sealed gland nut connection at the proper dispersion angle. Install speakers in accordance with manufacturer's instructions for specific applications.
- .11 Provide corridor speakers with dedicated dual zone speaker circuits. Provide patient room speakers with dedicated dual zone speaker circuits. Extend both zone A and zone B wiring to each speaker but connect speakers to designated A or B zones of paging as approved by local fire authority and Consultant.
- .12 Mount speakers in stairwells and wire vertically connected to specific zone as approved by local fire authority and Consultant. Refer to drawing riser and annunciator schedule.
- .13 Generally, audible device locations are indicated on drawings, however, exact audible device quantities and locations to be in accordance with results of audibility device coverage site tests. Provide suitable sound detection metering and personnel to make necessary tests. Relocate audible devices and/or provide additional audible devices as required.
- .14 Support flush ceiling mounted speaker backboxes from structure and not suspended ceiling grid or tiles. Connect speakers to specified taps and ensure that sound levels are in accordance with local authority and sound level requirements. Adjust as required and certify that levels are in compliance with Code level requirements. Audible devices to be synchronized.
- .15 Install amplifiers sized as required to power additional speakers and include spare capacity as specified.
- .16 Install specified telephone handsets and mount in recessed wall mounting boxes. Connect complete with wiring in conduit to local transponder.
- .17 Provide double voltage relays, with multiple contacts as required, to shut down fans as noted on drawings. Arrange relays to be energized at all times from fire alarm system to ensure that they are fail safe.
- .18 Install visual notification appliances 8' (2400 mm) above floor or 12" (300 mm) below finished ceiling line. Provide visual notification devices in areas subject to high ambient noise levels, such as mechanical equipment rooms, computer equipment rooms, parking garage, etc., and areas designated for hearing impaired as per local building code requirements. Provide minimum two (2) circuits per floor and connect devices in alternating scheme.

- .19 Install a paging microphone within CACF room and in other locations as required. Confirm locations with Consultant.
- .20 Install fire signs in locations as confirmed with Consultant and connect such that activation of fire alarm system illuminates sign and when system is reset and alarm has been silenced, sign is de-energized.
- .21 Devices in non-climate controlled areas to be weatherproof, corrosion resistant, ULC listed for operation in below freezing temperatures, and as recommended by system manufacturer for use for each specific application. Where electronics are not recommended for cold temperature applications, include for manufacturer's recommendations and directions in remotely locating addressable modules in closest heated areas and connecting to respective device in non-climate controlled areas.
- .22 In areas of high abuse such as public parking areas and publically accessible areas, devices to include vandal resistant, tamperproof and vermin proof features such as guards, fasteners requiring use of special tools and fasteners not exposed.
- .23 Install integrated air sampling smoke detection system and clean agent fire suppression system devices to suit specific applications and respective codes and standards.

3.6 Additional Requirements

- .1 Install wiring in conduit unless otherwise approved by Consultant. Perform wiring connections associated with fire alarm system on terminal strips in junction boxes and colour coded. Ensure that wiring colour coding is consistent for entire length of each run. When pulling wires into conduit, use lubricant and ensure that wires are kept straight and are not twisted or abraded. Neatly secure exposed wires in apparatus enclosures with approved supports or ties. Clearly identify wiring at each termination point. In addition, number wiring with Brady Ltd. or Electrovert Ltd. Z-type markers. Colour conductors for each part of system in accordance with system equipment manufacturer's recommendations. Paint conduit couplings red of paint type suitable for application to standards of Division 09.
- .2 Install wiring in accordance to requirements latest edition of applicable governing electrical code and to requirements of local governing authorities.
- .3 Run alarm indicating circuits (speakers) and alarm receiving circuits (pull stations, detectors) in separate conduits from each other.
- .4 Arrange sprinkler system alarm valve alarm zones to be separate from manual station, thermal detector and products-of-combustion detector device zones, which may be connected together into zones.
- .5 Provide liquid-tight flexible conduit for the final connections at gas flow switch and cylinder solenoid valve. Coordinate connections and requirement with Mechanical Divisions clean agent fire suppression system vendor.
- .6 Provide engraved Lamacoid identification nameplates for each equipment or wiring housing and secure to front of housing. Exact wording designations and sizes to be reviewed and confirmed with Consultant prior to manufacture.
- .7 Verify nomenclature of annunciator identification with Consultant and obtain necessary approvals prior to ordering.
- .8 Install end-of-line resistors to electrically supervise wiring. Generally, locate end-of-line

resistors at ceiling lines above a pull station location. Provide isolators and install in accordance with ULC standards. Properly label and identify. Do not locate end-of-line resistors and isolators in concealed locations. Generally install in equipment rooms.

- .9 Refer to drawing riser diagram and connection schedules. Quantities of components to be as per floor plans and not riser diagram.
- .10 Confirm exact location of components prior to roughing-in.
- .11 Ground and bond system as required by local governing electrical code and authority and system manufacturer.

3.7 Testing, Verification and Certification

- .1 Submit to Consultant for approval, proposed schedule for testing and verification of system. Obtain such approvals prior to start of testing. Refer to Division 00 and 01 for phasing requirements. Where areas of Work are to be phased construction and Owner requires to take occupancy, include for testing, verification and certification at each phase completion of Work, as required by local governing authorities. After completion of Work of last phase, include for total overall system testing, verification and certification of system.
- .2 Consultant and/or other Owner's representatives to have option to witness all or part of testing and verification work. Notify Consultant and Owner minimum seven (7) working days in advance of testing.
- .3 Include for fire alarm system manufacturer to inspect, test, verify and certify system components and wiring, individually and as a complete system, in accordance with requirements of latest edition of CAN/ULC S537. Work to include but not be limited to following:
 - .1 to ensure that type of equipment installed is that designated by Contract Documents;
 - .2 to ensure that wiring connections to equipment components show that installer observed ULC and CSA requirements;
 - .3 to ensure that equipment was installed in accordance manufacturer's recommendations, and that signalling devices of whatever manufacture were operated or tested to verify their operation;
 - .4 to ensure that supervisory wiring of those items of equipment connected to a supervised circuit is operating and that governmental regulations, if any, concerning such supervisory wiring, have been met to satisfaction of inspecting officials;
 - .5 to ensure that sequence of operation is in accordance with specified building sequence of operation and any modifications identified on documents and are approved by local fire authority;
 - .6 to ensure that devices are commissioned and operable.
- .4 System manufacturer to also be responsible for but not be limited to following:
 - .1 confirm that connections to security system and third party monitoring party are in accordance with CAN/ULC-S561;

- .2 coordinate with local fire authority inspector and Electrical Division Contractor, required testing and verification work to obtain certification and meet local fire code and local fire authority requirements;
 - .3 verify fire alarm system on a zone by zone basis, and verify entire system in whole, at completion of installation;
 - .4 test system battery power supplies and demonstrate compliance with local governing building code and local fire authority requirements that battery supplies are capable of providing required 24 hours of supervisory power followed by local governing building code required time (or time directed by local fire authority) of full load power; exact method of testing to be approved by local fire authority, Consultant and Owner; confirm exact procedures with previously named parties prior to testing; include for sufficient sound measurement devices and personnel in order to successfully comply with this requirement;
 - .5 full review, testing, and verification of operation of building ventilation and smoke exhaust system and its integrated operation with fire alarm system and various pieces of air handling equipment;
 - .6 full review, testing and verification of operation of integrated systems such as elevators and their emergency sequence of operation, supervisory annunciation of sprinkler/standpipe monitor switches, pressure switches and flow switches, diesel genset alarms, security alarms, BAS alarms, release of door holders and electromagnetic locks, air smoke sampling detectors, clean agent fire suppression tanks and release mechanism; pre-action sprinkler system; and any other integrated components; coordinate requirements with trades responsible for integrated components and systems who will be present at time of testing and verification work;
 - .7 test that system audible devices provide alarm sound levels in areas as per local governing building code and local fire authority requirements; site adjust tap settings of audible devices as required to achieve required audibility levels; also test that emergency voice communication system meets or exceeds intelligibility requirements of local governing building code and is approved by local fire authority;
 - .8 assist in Testing and Verification of electromagnetic door locks to meet requirements of authorities having jurisdiction and to obtain overall approval of installation;
 - .9 coordination with Electrical Divisions and local fire authority to provide requirements needed to obtain certificates of approvals from local fire authority;
 - .10 provide full detailed test sheets of tested components and provide certification that system has been fully tested, that devices have passed testing and that system is in proper work order in compliance to code requirements and project documents; test documents to be additionally provided in electronic format as confirmed with Owner and Consultant.
- .5 Include for manufacturers' authorized technicians of fire detection air sampling smoke detectors and clean agent fire suppression system products to provide onsite inspection, testing, verification and certification of respective products and coordinate such work with overall system inspection, testing, verification and certifications.

- .6 Contact local fire authority inspector and coordinate and arrange for Fire Inspector to perform required inspections. Integrate local fire authority inspection requirements with testing and verification work to extent as per Fire Inspector's directions. Obtain full approval and certification by local fire authority.
- .7 Local fire authority inspector, Consultant and Commissioning Agent to at their discretion test system or parts of system in their review of test reports. Correct/repair any failures or deficiencies found in system, whether or not identified in test reports of manufacturer. Re-test and re-verify until successfully passed, at no extra cost to Owner.
- .8 Obtain from local fire authority required certificate of approval of system and forward to Consultant.
- .9 Arrange for manufacturers to supply reasonable amounts of technical assistance with respect to any changes required to conform to paragraphs above. During period of inspection, testing and verification, make Electricians available to do any required correction work and to assist during this Work. Include for trades responsible for integrated components (i.e. exhaust fans, sprinklers, elevators, gensets, etc.) and systems to be present at time of testing and verification work.
- .10 On completion of verification, inspection and testing of system, obtain from manufacturer and forward to Consultant, a verification certificate together with detailed inspection reports listing each and every system component, its location in building and its acceptability. Verification certificate and inspection reports to be prepared and signed by certified testing technicians of manufacturer. Signed test reports to confirm that systems are installed and perform in accordance with requirements specified above.
- .11 Obtain from system manufacturer and testing agency and forward to Consultant a certificate of liability insurance of minimum amount of Two Million Dollars (\$2,000,000.00) that is to be registered for this project to show satisfactory proof of manufacturer's liability coverage for both their product and personnel.
- .12 Unless approved in writing by Consultant and Owner, do not use open flame and/or smoke for testing.
- .13 Testing technician to be certified and approved for fire alarm system testing by Canadian Fire Alarm Association (CFAA) and local Fire Marshall as applicable.

END OF SECTION