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## **PART 1 - GENERAL**

### **1.1 References**

- .1 Division 00 and 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 00 or 01, conditions of Division 00 or 01 to take precedence, as confirmed with Owner and reviewed with Consultant prior to Bid submission.
- .2 Advise product vendors of requirements of this Section.

### **1.3 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 Owner and reviewed with Consultant.
- .8 "barrier-free" - means when applied to a building and its facilities, that building and its facilities can be approached, entered and used by persons with physical or sensory disabilities in accordance with requirements of local governing building code.
- .9 "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.
- .10 "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.

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- .11 "OSHA" and "OHSA" – stands for Occupational Safety and Health Administration and Occupational Health and Safety Act, and wherever either one is used, they are to be read to mean local governing occupational health and safety regulations that apply to and govern work and to which work must adhere, regardless if Project falls within either authority's jurisdiction.
- .12 "Mechanical Divisions" - typically, 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.
- .13 "Electrical Divisions" – typically, 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.
- .14 "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.
- .15 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.
- .16 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.

#### **1.4 Documents**

- .1 Documents for bidding include but are not limited to issued Drawings, Specifications and Addenda.
- .2 Specification is typically generally arranged in coordination with guidelines of Construction Specifications Institute/Canadian Specifications Canada (CSI/CSC) 50 Division MasterFormat.
- .3 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 drawings but not mentioned in Specification, or vice-versa, as though fully covered by both.
- .4 Review Drawings and Specification in conjunction with documents of other Divisions and, where applicable, Code Consultant's report.
- .5 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.
- .6 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.

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- .7 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.
- .8 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, all at no additional cost to Contract.
- .9 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.
- .10 Starter/motor control centre (MCC)/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, MCC, VFD, and motor specification requirements of Mechanical Divisions specifications and drawings, prior to Bid submission. Confirm and coordinate exact scope of work and responsibility of work between Mechanical Divisions and Electrical Divisions.
- .11 If there is conflict or discrepancy between, among or within any provisions of Contract Documents, provisions establishing higher quality, manner or method of performing the Work, using more stringent standards, prevails, with intent that provisions which produce higher quality with higher levels of safety, reliability, durability, performance and service prevails.
- .12 Generally, documents govern in following order:
  - .1 Specification.
  - .2 Drawings of larger scale.
  - .3 Drawings of smaller scale.
  - .4 Drawings of later date when scale of drawings is same.
- .13 Upon finding discrepancies in, or omissions from Documents, or having doubt as to their meaning or intent, notify Consultant.
- .14 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.

## **1.5 Metric and Imperial 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 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 Bid Documents and Site**

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- .1 Carefully examine Documents and visit site to determine and review existing site conditions that will or may affect work and include for such conditions in Bid Price.
- .2 Report to Consultant, prior to Bid Submittal, any existing site condition that will or may affect performance of work as per Documents. Failure to do so will not be grounds for additional costs.
- .3 Upon finding discrepancies in, or omissions from Documents, or having doubt as to their meaning or intent, immediately notify Consultant, in writing.

#### **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 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.
- .2 Where regulatory codes, standards and regulations are at variance with Drawings and Specification, more stringent requirement will apply unless otherwise directed by Owner and reviewed with Consultant.
- .3 Supplementary mandatory Specifications and requirements to be used in conjunction with project include but are not limited to following:
  - .1 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., (ASHRAE);
  - .2 American National Standards Institute (ANSI);
  - .3 ANSI/ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings;
  - .4 Building Industry Consulting Services, International (BICSI);
  - .5 Canadian Standards Association (CSA);
  - .6 CSA C282, "Emergency Electrical Power Supply for Buildings";
  - .7 CSA Z432, "Safeguarding of Machinery";
  - .8 CSA Z462, "Workplace Electrical Safety";
  - .9 Electrical and Electronic Manufacturers Association of Canada (EEMAC);
  - .10 Electrical Safety Authority (ESA);
  - .11 Electronic Industries Association (EIA);
  - .12 Illuminating Engineering Society (IES);
  - .13 Institute of Electrical and Electronic Engineers (IEEE);
  - .14 Intertek's Electrical Testing Labs (ETL);
  - .15 National Building Code of Canada (NBC);
  - .16 National Electrical Manufacturers Association (NEMA);
  - .17 National Fire Protection Association (NFPA);
  - .18 Occupational Health and Safety Act (OHSA);

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- .19 Occupational Health and Safety Act - Ontario Regulation 632, "Confined Spaces";
  - .20 Ontario Building Code (OBC);
  - .21 Ontario Electrical Safety Code (OESC);
  - .22 Technical Standards and Safety Authority (TSSA);
  - .23 Telecommunications Industry Association (TIA);
  - .24 Underwriters' Laboratories of Canada (ULC);
  - .25 Material Safety Data Sheets by product manufacturers;
  - .26 local utility inspection permits;
  - .27 codes, standards, and regulations of local governing authorities having jurisdiction;
  - .28 additional codes and standards listed in Trade Sections;
  - .29 Owner's standards.
- .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. Notify Consultant in writing of conflicts between Contract Documents and manufacturer's instructions.
  - .7 Work is to be performed by journeyperson who perform only work that their certificates permit, or by apprentices under direct on site supervision of experienced journeyperson. Journeyperson to apprentice ratio is not to exceed ratio in accordance with requirements of Bill 47, Making Ontario Open for Business Act - 2018.
  - .8 Journeyperson are to have copy of valid trade certificates available at site for review by Consultant at any time.
  - .9 Maintain experienced and qualified superintendent on-site at times when work is being performed.
  - .10 Protect existing areas above, below and adjacent areas of Work from any debris, noise, or interruptions to existing services to satisfaction of Owner and reviewed with Consultant. Maintain in operation 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, in coordination with Owner and review with Consultant. Include for required premium time work to meet these requirements.

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- .11 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 Owner on a 24 hours basis or over various hours, coordinate hours of work with Owner on a regular basis to suit Owner's schedule. Execute work at times confirmed with and agreed to by Owner and reviewed with Consultant, so as not to inconvenience Owner's occupation or in any way hinder Owner's use of building. Include for required premium timework to meet these requirements.
- .12 Coordinate work inspection reviews and approvals with governing inspection department to ensure construction schedule is not delayed. Be responsible for prompt notification of deficiencies to Consultant and submission of reports and certificates to Consultant.
- .13 Properly protect equipment and materials on site from damage and defacement due to elements and work of trades, to satisfaction of Owner and reviewed with Consultant. Equipment and materials are to be in new condition upon Substantial Performance of the Work.

## **1.8 Healthcare Facility Standards**

- .1 Comply with following standards:
  - .1 CSA Z32, Electrical Safety and Essential Systems in Health Care Facilities.
  - .2 CSA Z317.5, Illumination Design in Health Care Facilities.
  - .3 CSA Z317.10, Handling of Health Care Waste Materials.
  - .4 CAN/CSA Z317.13, Infection Control During Construction, Renovation, and Maintenance of Health Care Facilities.
  - .5 CSA Z8000, Canadian Health Care Facilities.
  - .6 CAN/CSA Z8001, Commissioning of Health Care Facilities.
- .2 Prepare list of areas of work where infection control procedures are to be in force and review list and procedures with healthcare facility's Infection Control Officer or a designated healthcare facility representative prior to commencing work in aforementioned areas. As work proceeds, ensure infection control procedures are being maintained.
- .3 Comply with healthcare facility's latest policies and procedures regarding infection prevention and decontamination measures during work of project. Refer to additional requirements of Division 01.

## **1.9 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 Provide ample notification to authorities having jurisdiction to perform required on-site inspection of work, allowing sufficient lead time to correct deficiencies in a manner that will not impede schedule of completion of Work. If any defect, deficiency or non-compliance is found in work by inspection, be responsible for costs of such inspection, including any related expenses, making good and return to site, until work is passed by governing authorities.

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- .4 Obtain, pay for and 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 by such authorities.
- .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.

#### **1.10 Requirements for Contractor Retained Engineers**

- .1 Professional engineers retained to perform consulting services with regard to Project work, i.e. seismic engineer, fire protection engineer or, structural engineer, are to be legally qualified to practice professional engineering in the Place of the Work, 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 regard to the Work of this Contract.
- .3 Unless otherwise specified in Division 00 and 01, 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 form and limits specified above;
  - .5 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 aforementioned consultant's services.

#### **1.11 Workplace Safety**

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials. Submit WHMIS SDS (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.



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- .3 If at any time during course of existing building work, hazardous materials other than those identified in 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 Owner and review with Consultant.

## **1.12 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, as confirmed prior to start of Work with each trade and with Owner and reviewed with Consultant, to suit specific project requirements, 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 reviewed with Consultant, Mechanical Contractor is to generally 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.

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- .6 Prepare plan and interference drawings (at a minimum drawing scale of 1:50 or ¼"=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 Locate control products, products requiring maintenance, junction boxes, and similar products, particularly such products located above suspended ceilings, for easy access for servicing and/or removal. Relocate products which do not meet this location requirement to 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 structural 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.

### **1.13 Phasing**

- .1 Include for scheduling, co-ordination, and construction phasing to suit project as specified in Division 01 and on drawings. Review exact phasing requirements with Consultant prior to start of Work.
- .2 Phasing and scheduling of Work is required to maintain existing building operations. Include costs (including costs for "off hours" work) for scheduling, co-ordination, and construction phasing to suit this project as specified in Division 01 and on drawings. Review exact phasing requirements with Consultant prior to start of Work.
- .3 Project partial occupancy permits to be required throughout project. Provide for each partial permit, local governing authority certificate and any other testing/verification certificates for systems.

### **1.14 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;

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- .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 with Owner and reviewed with Consultant 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. In coordination with Owner and review with Consultant, relocate 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.

#### **1.15 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 later, 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.

#### **1.16 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;

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- .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 to and review with 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 (i.e. for BAS points, elevator requirements, electrical devices in millwork or prefabricated service consoles, 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 various trades and equipment vendors and review with Consultant with regards to ensuring that systems coordinate and integrate properly to meet intent of design and Owner requirements;
- .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.

### **1.17 Products**

- .1 Order products (equipment and materials) in a timely manner 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 use of 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.

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- .3 Products are to comply with applicable respective Canadian standards, and typically with Canadian Standards Association (CSA) approvals and/or Underwriters Laboratories of Canada (ULC) listings markings. References to UL listings of products to include requirements that products are to be also Underwriters Laboratories of Canada ULC / cUL listed for use in Canada. Other certification organizations accredited by Standards Council of Canada to approve electrical equipment may be acceptable subject to approval from local governing electrical authority and review with Consultant. Applicable products are to meet or exceed latest ANSI/ASHRAE/IES 90.1 standards enforced by local governing authorities.
- .4 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 extended period 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.
- .5 Products scheduled and/or specified have been selected to establish a performance and quality standard, and, in some instances, a dimensional standard. In many cases acceptable product manufacturers are specified for products with manufacturer name, series name and/or and model number. Bid Price may be based on products supplied by any of manufacturers base specified or named as acceptable for product. If acceptable manufacturers are not stated for a product, base Bid Price on product supplied by base specified manufacturer.
- .6 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 base specifications, notify Consultant immediately. Be responsible for obtaining other manufacturers product that complies with base specified performance and criteria and meets project timelines. Proposed products are subject to review and consideration by Consultant and are considered as substitutions subject to a credit to Contract. In addition, if such products require modifications to room spaces, mechanical systems, electrical systems, etc., include required changes. Such changes are to be submitted in detail to Consultant for review and consideration for acceptance. There will be no increase in Contract Price for revisions. Above conditions supplement and are not to supersede any specification conditions in Division 01 with regards to substitutions or failure to supply product.
- .7 Listing of a product as "acceptable" does not imply automatic acceptance by Consultant and/or Owner. It is responsibility of Contractor to ensure that any price quotations received, and submittals made are for products that meet or exceed specifications included herein.

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- .8 If products supplied by a manufacturer named as acceptable are used in lieu of base specified manufacturer, be responsible for ensuring that they are equivalent in performance and operating characteristics (including energy consumption if applicable) to base specified products. It is understood that any additional costs (i.e. for larger starters, larger feeders, additional spaces, etc.), and changes to associated or adjacent work resulting from provision of product supplied by a manufacturer other than base specified manufacturer, is included in Bid Price. In addition, in equipment spaces where equipment named as acceptable is used in lieu of base specified equipment and dimensions of such equipment differs from base specified equipment, prepare and submit for review accurately dimensioned layouts of rooms affected, identifying architectural and structural elements, systems and equipment to prove that equipment in room will fit properly meeting design intent. There will be no increase in Contract Price for revisions.
- .9 Where products are listed as "or approved equal", certify in writing that product to be used in lieu of base specified product, at least meets space, power, design, energy consumption, and other requirements of base specified product and is equivalent or better than base 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. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of approved equal product. There must be no increase in Contract price due to Consultant's rejection of proposed equivalent product.
- .10 Whenever use of product other than base specified 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 base specified product to be supplied at Consultant's discretion, at no additional cost to Contract.
- .11 In addition to manufacturer's products base specified or named 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. However, base Bid Price on products base specified or named as acceptable. Certify in writing to Consultant that proposed substitution meets space, power, design, energy consumption, and other requirements of base specified or acceptable product. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of proposed substitution. Consultant has sole discretion in accepting any such proposed substitution of product. Do not order such products until they are approved by Owner, and reviewed with and recommended by Consultant.
- .12 Substitutions will not be considered by Consultant during Bid period unless:
  - .1 permitted by Owner;
  - .2 directions and submission areas are provided on Bid Form;
  - .3 or formally requested in writing a minimum of 10 working days prior to Bid closing date.
- .13 When issued with Documents, complete and submit as directed, Appendix - List of Acceptable Manufacturers and Suppliers, or when directed by Consultant submit separate list of proposed manufacturers and suppliers.

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- .14 Any proposed changes to list of manufacturers initiated by Contractor after award of Contract may be considered by Consultant at Consultant's discretion, with any additional costs for such changes if approved by Owner and reviewed with and recommended by Consultant, and costs for review, to be borne by Contractor.
- .15 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.
- .16 Requirements for low voltage systems of this project that are of technology that changes rapidly and are forever evolving and changing, resulting in systems that may be out dated by time of installation, are to include provisions to allow Owner option to select most updated technology. Shop drawings for such systems and equipment are to include provisions for a minimum 6-week review time for Owner to review degree of technology of each system and determine acceptance. Owner will have right to substitute a more advanced technology subject to negotiated pricing.

#### **1.18 Shop Drawings**

- .1 At start-up meeting review 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 Owner or reviewed with Consultant. Review exact requirements with Consultant.
- .3 Submit for review, drawings showing in detail design, construction, and performance of equipment and materials as requested in Specification. Submit shop drawings to Consultant for review prior to ordering and delivery of product to site. 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.

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- .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 "REVISE & RESUBMIT" – 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 reviewed with 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.

### **1.19 Engineered Submittals**

- .1 Submittals for items required to be sealed by a professional engineer (engineered) are to be duly prepared, sealed, and signed under direct control and supervision of a qualified professional engineer licensed in jurisdiction of the work. Professional engineer is to conform to requirements specified in this Section in article entitled Requirements for Contractor Retained Engineers.
- .2 Engineered submittals are to include, but not be limited to, following:
  - .1 complete CAD layout drawings indicating equipment, wiring schematic, conduit routing and sizing, zones, devices, and any other pertinent data;
  - .2 listing of design data used to determine system layout and sizing;
  - .3 complete copies of design calculations and listing of design data used in preparing calculations;



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- .4 list detailing standards, codes, regulations, etc. adhered to when designing system;
- .5 items as noted in other Sections of the Specification.
- .3 Professional engineer responsible for engineered submittals is to perform periodic field reviews, including review of associated mock-ups where applicable, at locations wherever work as described by engineered submittal is in progress, during fabrication and installation of such work, and submit a field review report after each visit. Submit field review reports to Consultant and authorities having jurisdiction as required.
- .4 Field reviews are to be at intervals as necessary and appropriate to progress of work described by engineered submittal to allow engineer to be familiar with progress and quality of such work and to determine if work is proceeding in general conformity with Contract Documents including reviewed shop drawings and design calculations.
- .5 Upon completion of work as described by engineered submittal, professional engineer responsible for preparation of engineered submittal and for performing periodic field reviews is to prepare and submit to Consultant and, if applicable, authorities having jurisdiction, a letter certifying that work has been supplied and installed in accordance with requirements of Contract Documents, authorities having jurisdiction and engineered submittal.

#### **1.20 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. Review locations of equipment with Consultant prior to construction.

#### **1.21 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 from Owner and review with 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 otherwise directed by Owner and reviewed with Consultant, do not leave any openings unprotected and unfinished overnight.

#### **1.22 Scaffolding, Hoisting, and Rigging**

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- .1 Unless otherwise specified or directed, supply, erect and operate scaffolding, rigging, hoisting equipment and associated hardware required for work, and subject to approval from Owner and review with Consultant.
- .2 Use scaffolds in such a manner as to interfere as little as possible with work of other trades.
- .3 Do not place major scaffolding/hoisting equipment loads on any portion of structure without approval from Owner and review with Consultant. No supports, clips, brackets or similar devices are to be welded, bolted or otherwise affixed to any finished member or surface without approval from Owner and review with Consultant.
- .4 Immediately remove from site scaffolding, rigging and hoisting equipment when no longer required.

### **1.23 Request for Information (RFI)**

- .1 Review contract documents for information prior to issuance of RFI during performance of Work. Where it is determined, at discretion of Owner and Consultant, that information requested in RFI was readily identifiable as part of contract documents, respective trades Contractor to be back-charged against their contract amount for time spent by Consultant and/or Owner in preparing response to RFI. Minimum amount of \$150 CDN plus GST to be back charged against contract amount for any response to a readily identifiable RFI.

### **1.24 Changes In the Work**

- .1 Whenever Consultant proposes in writing to make a change or revision to design, arrangement, quantity, or type of any work from that required by Contract Documents, prepare and submit to Consultant for review, a quotation detailing proposed cost for executing change or revision.
- .2 Quotation to be a detailed and itemized estimate of product, labour, and equipment costs associated with change or revision, plus overhead and profit percentages and applicable taxes and duties.
- .3 Unless otherwise specified in Divisions 00 or 01, following additional requirements apply to quotations submitted:
  - .1 when change or revision involves deleted work as well as additional work, cost of deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from cost of additional work before overhead and profit percentages are applied to additional work;
  - .2 material costs are not to exceed those published in local estimating price guides; for mechanical work material costs, refer to additional requirements of Section 20 05 05;
  - .3 electrical labour unit costs are to be in accordance with National Electrical Contractors Association Manual of Labor Units at difficult level, less 25%;
  - .4 mechanical labour unit costs are to be in accordance with Mechanical Contractors Association of America Labor Estimating Manual, less 25%;
  - .5 costs for journeyman and apprentice labour must not exceed prevailing rates at time of execution of Contract and must reflect actual personnel performing work;

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- .6 cost for site superintendent must not exceed 10% of total hours of labour estimated for change or revision, and change or revision must be such that site superintendent's involvement is necessary;
- .7 costs for rental tools and/or equipment are not to exceed local rental costs;
- .8 overhead percentage will be deemed to cover quotation costs other than actual site labour and materials, and rentals;
- .9 quotations, including those for deleted work, to include a figure for any required change to Contract time.
- .4 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation to enable Consultant to expeditiously process quotation and issue a Change Order will not be grounds for any additional change to Contract time.
- .5 Make requests for changes or revisions to work in writing to Consultant and, if accepted by Owner, Notice of Change to be issued.
- .6 Do not execute any change or revision until written authorization for change or revision has been obtained from Owner and reviewed with Consultant.

#### **1.25 Progress Payment Breakdown**

- .1 Prior to submittal of first progress payment draw, submit a detailed breakdown of work cost to assist Consultant in reviewing and approving progress payment claims.
- .2 Payment breakdown is subject to Owner's approval and Consultant's review and recommendations. 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 system testing and verification, and project closeout submittals.
- .3 Indicate equipment, material and labour costs for site services (if applicable) and indicate work of each trade in same manner as they will be indicated on progress draw.

#### **1.26 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 7 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.

#### **1.27 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.

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- .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.

**1.28 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, paint finishes "touched-up", filters cleaned or replaced, etc.

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**1.29 Temporary Services**

- .1 Coordinate with Prime Contractor, requirements for temporary services including but not limited to temporary electrical power, lighting, heating and exit pathways. Locations of exit pathways to be as decided at discretion of Prime Contractor and to be illuminated complete with emergency lighting and provided with exit signage and fire alarm devices. Unless otherwise noted, provide required services in accordance with requirements of local governing building code and local governing inspection authorities.
- .2 Maintain fire protection of areas which may include fire watch during temporary shutdowns of existing systems, in accordance with requirements of local governing code and local governing authorities.

**1.30 Cleaning**

- .1 During construction, keep site reasonably clear of rubbish and waste material resulting from work on a daily basis to the satisfaction of Owner and 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 top of switchboards, panels, cabinets, bus ducts, cable trays and conduits in room, followed by a thorough HEPA vacuuming of floors;
  - .2 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.

**1.31 Record As-Built Drawings**

- .1 Drawings for this project have been prepared on a CAD system using AutoCAD software of release version reviewed with Consultant. For purpose of producing record "as built" drawings, copies of Contract Drawings can be obtained from Consultant, at expense of \$200 CDN initial base plus \$25.00 CDN per drawing up to first 10 drawings, and \$5.00 per any additional drawings thereafter. HST charged additionally. Drawings may also to be used for preparation of layouts and interference drawings.
- .2 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;

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- .3 location and identification of devices in concealed locations such as accessible ceiling spaces and raised floors;
  - .4 location of concealed services terminated for future extension and work concealed within building in inaccessible locations.
  - .5 location of fire alarm devices and include addresses of devices; identify fire alarm zones;
  - .6 identify routing and location of concealed conduits/ducts of diameter 50 mm (2") and greater.
- 
- .3 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.
  - .4 Use final reviewed "as-built" drawing set to provide CAD files of drawings 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. Save drawings as AutoCAD files and in pdf format and such that each drawing is not x-referenced but as complete drawing.
  - .5 Submitted drawings are to be of same quality as original Contract Drawings. CAD drawing files are to be compatible with software release version reviewed with Consultant.
  - .6 Alternatively, arrange for and make payment to Consultant of respective trade of work to produce record CAD drawings of as-built work from Contractor provided as built white prints. Include cost of \$100 plus GST, per drawing.
  - .7 Unless otherwise noted in Divisions 00 or 01, failure to maintain accurate record drawings will incur additional 5% holdback on progress claims until drawings are brought up to date to satisfaction of Owner and reviewed with Consultant.
  - .8 For projects with phased turnover of project (refer to Division 01), review with Consultant completeness of as-built drawings prior to turn over of an area. Copies of hand drawn interim as-built drawings to be made available to Owner's maintenance personnel.
  - .9 Prepare and submit for review with record drawings, a neat, clear, properly identified, "as-built" electrical distribution 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 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.

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- .10 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 ( $\Delta$ ) 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 review exact requirements with Consultant prior to commencing work.
- .11 Replace existing posted single line electrical distribution drawings with revised to reflect renovations and revisions to electrical distribution equipment. Drawings to be of type to match existing as confirmed with Owner. Supply electronic files of format confirmed with Owner and reviewed with Consultant for following:
  - .1 fire alarm system test report devices and addresses;
  - .2 network cabling system test report devices and labelling of each device and cable.

### **1.32 Operating and Maintenance Manuals**

- .1 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. Review 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 as follows:
    - .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 including warnings of any maintenance practice that will damage or disfigure equipment/systems;
    - .4 complete parts lists with numbers.

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- .7 performance data as follows:
  - .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.
- .2 Generally, binders are not to exceed 75 mm (3") thick and not to be more than 2/3 full.
- .3 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.
- .4 Before applying for a Certificate of Substantial Performance of the Work, assemble one draft copy of O & M Manual and submit to Consultant for review prior to assembling remaining copies. Incorporate Consultant's comments into final submission.
- .5 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 reviewed with Consultant and enhanced with bookmarks and internal document links.

### **1.33 Commissioning**

- .1 Commissioning Agent is appointed by Owner to oversee commissioning activities of contract.
- .2 Interface, cooperate and coordinate with Commissioning Agent and attend commissioning meetings. Perform commissioning activities for aspects of work provided in Electrical Divisions and perform corrective work identified by Commissioning Agent.
- .3 After successful start-up and prior to Substantial Performance of the Work, commission electrical work. Demonstrate to Owner and Consultant, for purpose of final acceptance, by means of successful and documented functional performance testing, that equipment, systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of Contract Documents.
- .4 Verify modes and sequences of control and monitoring, interlocks, and responses to emergency conditions. Complete commissioning data sheets to document successful operational performance testing.
- .5 Submit copies of submittals such as O & M manuals, shop drawings, schedules and test reports of systems and equipment to Commissioning Agent, prior to start of commissioning activity or as directed by Commissioning Agent.



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- .6 Commissioning Agent may also be present for any testing/commissioning activities. Notify Commissioning Agent in advance of these activities.
- .7 Refer to Division 01 for additional commissioning requirements. Refer to Section entitled Electrical Work Commissioning for additional requirements.
- .8 Where commissioning specifications are included as part of Division 01, requirements of Section entitled Electrical Work Commissioning are to supplement commissioning requirements of Division 01. Where variances or contradictions exist, more stringent requirement will apply unless otherwise directed by Owner and reviewed with Consultant.

#### **1.34 Warranty**

- .1 Unless otherwise specified in Divisions 00 and 01, warrant work to be in accordance with Contract Documents and free from defects for a period of 1 year from date of issue of a Certificate of Substantial Performance of the Work.
- .2 Where equipment includes extended warranty period, e.g., 5 years, first year of warranty period is to be governed by terms and conditions of warranty in Contract Documents, and remaining years of warranty are to be direct from equipment manufacturer and/or supplier to Owner. Submit signed and dated copies of extended warranties to Consultant.
- .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, and 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 It is understood that warranties are to commence from time of Substantial Performance of the Work, regardless of what is noted within following Sections of Specification. Be responsible for providing whatever "bridging" or additional extended warranty period is required from time that material is purchased until this time.
- .7 Visit building during warranty period with Owner representatives. Owner to organize these visits. At these meetings, Owner representatives are to review performance of systems. If performance is satisfactory, then no further action needs to be taken. If unsatisfactory, then correct deficiencies, as directed by Owner representatives, to satisfaction of Owner representatives. These site visits to occur:
  - .1 once during first month of building operation;
  - .2 once during third month of building operation;
  - .3 once between fourth and tenth month in a season opposite to first and third month visits.

#### **1.35 Project Close Out Submittals**

- .1 Prior to application for Substantial Performance of the Work, submit required items and documentation specified, including following:
  - .1 O&M Manuals;

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- .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;
- .2 Refer to additional requirements in Division 01.

**1.36 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 Unless where specified otherwise in trade Sections, minimum requirements are for manufacturer/suppliers of each system and major equipment, to provide minimum two separate sessions each consisting of minimum 4 hours on site or in factory training (at Owner's choice), of Owner's designated personnel (for up to 6 people each session), on operation and maintenance procedures of system.
- .4 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.
- .5 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.
- .6 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:

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- .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.).
- .7 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.
- .8 Submit to Consultant copy of electronic version of training materials loaded on USB flash drive. Include in operating and maintenance manuals submission.

**1.37 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 with Consultant and accepted by Owner;
  - .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, as confirmed by Owner and reviewed with Consultant;
  - .7 as-built and record drawings have been completed and submitted to and reviewed with Consultant and accepted by Owner;
  - .8 Owner's staff has been instructed in operation and maintenance of systems;
  - .9 commissioning procedures have been completed;
  - .10 fire alarm verification has been 100% completed and Verification Certificate has been submitted to and accepted by Consultant.

**1.38 Allowances**

- .1 Include in Bid amount a prime cost allowance in amount of \_\_\_\_\_.
- .2 Allowance is for \_\_\_\_\_.
- .3 Amount of allowance is to be net and is to include product and material costs (less applicable trade discounts), including delivery to site and applicable taxes.
- .4 Other costs, including unloading and handling at site, installation, overhead and profit and other burdens are to be included in Bid amount, not in allowance.
- .5 Whenever costs are more or less than amount of allowance, Contract amount is to be adjusted accordingly by change order.

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- .6 Materials and products under allowance are to be selected by Owner in sufficient time to avoid delays to work, and Owner reserves right to take entire or any part of allowance out of Contract amount at any time.
- .7 Expenditure from above allowances may be made only upon receipt of order signed by Consultant. Relationship of Contractor and Subcontractors performing work to be paid out of allowances to be strictly between Contractor and Contractor's Subcontractors.

**PART 2 - PRODUCTS**

**2.1 Not Used.**

**PART 3 - EXECUTION**

**3.1 Not used.**

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 Application**

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

### **1.2 Submittals**

- .1 Submit shop drawings for products of this Section.
- .2 Additionally, as part of shop drawing submission process, submit following to Consultant for review:
  - .1 sample of each proposed type of access door if supplied under work of this Division, as well as electronic copies of reflected ceiling plan drawings and wall elevation drawings showing proposed access door locations;
  - .2 dimensioned location drawings indicating required sleeves and formed openings in structural poured concrete or precast concrete construction, and locations of cutting or drilling required for Electrical Divisions work;
  - .3 samples of materials and any other items as specified in succeeding Sections of Electrical Divisions;
  - .4 weight loads of selected equipment (upon request);
  - .5 equipment nameplate and warning sign proposed nomenclature, print type, symbols, sizing and colours;
  - .6 fire stopping installation drawings with ULC certifications;
  - .7 copies of prior to start of construction approvals from local governing authorities having jurisdiction.
- .3 Prior to application for Substantial Performance of the Work, submit following to Consultant for review (note: funds will be withheld until each of following items have been completed and documented to satisfaction of Owner and reviewed with Consultant):
  - .1 fire alarm system testing and verification report of each component of work; devices to be certified working and in proper order;
  - .2 final distribution system testing and arc flash study performed and documented to satisfaction of Consultant;
  - .3 structured network cabling system tested and verified to be operating and performing in accordance with specified standards.

### **1.3 Patient Care Areas**

- .1 Comply with requirements for patient care areas (PCA) included in Work as required by Section 24 of OESC. Patient care areas are identified on drawings or in schedule appended to end of this Section. Review final PCA nomenclature with Consultant prior to start of Work.

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- .2 Note that room and area names/numbers are based on information available at time of preparation of documents and such names/numbers may be revised in later documents or during construction of Work. In no way are patient care area classifications to be reduced due to name/number revisions. Confirm exact classifications as per local governing electrical code requirements to suit final construction and any design changes made by Consultant.
- .3 Provide testing and verification of circuits and devices to confirm compliance with OESC.

#### **1.4 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. Contractor to match base building standards, where noted in the drawings.

#### **1.5 Series Rated Combinations**

- .1 Series rated combinations of over-current protective devices are not permitted.

#### **1.6 Protective Coordination and Equipment Withstand Ratings**

- .1 Obtain results of coordination study and short circuit calculations reports and Consultant comments and incorporate into shop drawings of electrical distribution equipment (high voltage and low voltage equipment as applicable). Do not order equipment until shop drawings submission process has been completed and reviewed with Consultant.
- .2 Provide ratings for electrical equipment, circuit protective devices, bussing, and switches to interrupt and withstand short circuit faults greater than available fault current at its source of supply.

#### **1.7 Hazardous Materials**

- .1 Hazardous materials and infectious materials are known to be present on site in existing buildings, including but not limited to following:
  - .1 aspergillus;
  - .2 mould;
  - .3 asbestos;
  - .4 PCBS;
  - .5 lead;
  - .6 mercury.
- .2 Divisions 01 and 02 may identify specific requirements and if such materials are present, refer to Division 01. Comply with requirements and those of local governing authorities.

- .3 Include for company specializing in removal and disposal of materials containing PCB's to remove and dispose off-site luminaire ballasts containing PCB's. Check luminaires being deleted for ballasts containing PCB's. Disconnect and dispose off-site such ballasts. Only companies that are certified and comply with Ministry of Environment and Ministry of Transport regulations with regards to hazardous waste materials are to be used to perform this Work. Prior to start of Work, submit to Consultant a copy of PCB disposal certificate and identification of Ministry authorized and designated disposal site.

## **PART 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 by local governing codes. Provide raintight type fittings where EMT is exposed to water spray of activated sprinklers.
- .2 Galvanized steel flexible metallic conduit to CSA C22.2 No. 56, complete with proper and suitable squeeze type connectors at terminations.
- .3 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.
- .4 Tyco "True Color" red EMT fire alarm conduit.

### **2.2 Outlet Boxes**

- .1 CSA approved stamped galvanized steel outlet boxes.
- .2 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.
- .3 Electrical boxes exposed exterior of building or in non-climate controlled locations to be weatherproof boxes complete with gasketted 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 Physical size of pullboxes to be as required by local governing electrical code to suit number and size of conduits and conductors.
- .3 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.
- .4 Boxes exposed exterior of building or in non-climate-controlled locations to be weatherproof boxes complete with gasketted 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 Firestopping and Smoke Seal Materials**

- .1 Asbestos-free, elastomeric materials and intumescent materials, tested, listed and labelled by ULC in accordance with CAN/ULC S115, and CAN/ULC S101 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 Firestopping 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 system number for each specific installation.
- .3 Smoke and fire seal materials and manufacturers must be specifically approved for each application of penetrated surfaces, as approved by FM Global and listed in FM Global Approval Guide. Listed companies herein and other manufacturers are only acceptable if compliant with these requirements. As part of shop drawing submission, submit copies of firestopping drawings with FM Global Approval Guide.
- .4 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with firestopping manufacturer's recommendations and ULC tested assembly. Coordinate material requirements with trades supplying abutting areas of materials.
- .5 Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.
- .6 For typical standard indoor applications for conduit and cable installations to seal openings up to 25 mm (1"): Hilti "Cable Disc CFS-D 1", pre-formed firestopping solution with features as follows:
  - .1 Approximate Density 1.6 g/cm<sup>3</sup>;
  - .2 Mold and mildew resistant;
  - .3 Surface burning characteristics (UL 723 (ASTM E84): Flame spread: 0 and Smoke development: 5;
  - .4 Application temperature 0 to 40°C (32-104°F);
  - .5 Percent Fill: up to 100% per tested system;
  - .6 Sound Transmission classification (ASTM E 90): 62 (Relates to specific construction).
- .7 For typical standard indoor applications to seal openings up to 1800 mm x 900 mm (72" x 36"): Hilti "Firestop Block (CFS-BL)", ready-to-use, intumescent flexible block designed for:
  - .1 Sealing single or multiple penetrations of openings;



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- .2 Temporary or permanent sealing of cables and cable tray penetrations;
- .3 Temporary or permanent sealing of conduit penetrations.
- .8 Firestop Block (CFS-BL) features as follows:
  - .1 Tested in accordance with CAN/ULC-S115, UL 1479, ASTM E 814 and ASTM E 84;
  - .2 Halogen, asbestos, solvent free and smoke resistant;
  - .3 Operational immediately after installation;
  - .4 Application temperature 5°C to 40°C (40°F to 104°F);
  - .5 Temperature resistance -15°C to 60°C (5°F to 140°F);
  - .6 Intumescent activation approximately 200°C (392°F);
  - .7 Expansion ratio (unrestricted) Up to 1:3;
  - .8 Surface burning characteristics (ASTM E 84-10b): Flame Spread Index: 10 and Smoke Development Index: 15;
  - .9 Sound transmission classification (ASTM E 90): STC Rating: 52;
  - .10 Suitable for wet areas when applied with additional silicone coating to manufacturer's directions.
- .9 For applications where fire rated firestopping cable pathway system is to be special structurally reinforced, reusable and require no or minimal alterations to firestop component when cables are either added or removed, provide Hilti "Speed Sleeve CP 653" with features as follows:
  - .1 Tested in accordance with CAN/ULC-S115, UL 1479 and ASTM E 814;
  - .2 Re-penetrable cable management device for electrical and telecom cables;
  - .3 Smoke gaskets;
  - .4 50 mm (2") or 100 mm (4") diameter opening models to suit specific applications;
  - .5 Total length: 315 mm (12.4");
  - .6 Temperature resistance -6°C to 100°C (-22° F to 212°F);
  - .7 Intumescent activation approximately 160°C (320°F);
  - .8 Expansion ratio (unrestricted) 1:40;
  - .9 Construction: metal steel with zinc coating, plastic ABS and fabric glass-fibre;
  - .10 Structure to be sturdy enough to stand up to constant modification and use, but maintain its ULC firestopping rating.
- .10 Supply products of a single manufacturer for use on work of this Division.
- .11 Installer to be manufacturer trained and certified on specific product. Submit copy of certificate with shop drawings.
- .12 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.

- .13 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".
- .14 Acceptable manufacturers are:
  - .1 Hilti Canada;
  - .2 Specified Technologies Inc.;
  - .3 3M Canada Inc.;
  - .4 Tremco;
  - .5 A/D Fire Protection Systems;
  - .6 Nelson.

## **2.6 Fastening and Securing Hardware**

- .1 Concrete inserts - Crane Canada Ltd., No. 4-M for concrete work for single or double conduit, cable tray, etc., runs and equipment. Unistrut Ltd. multiple type inserts for runs of three (3) or more conduits etc., or where a grid support system is required.
- .2 Concrete fasteners – "WEJ-IT" anchors, lead cinch anchors and/or "STAR" or "PHILLIPS" self-drilling anchors.
- .3 Masonry inserts – "WEJ-IT" 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 - Crane Canada Ltd., beam clamps.
- .6 Anchors, fasteners and other securing hardware to be of capacity and type to suit application and for which materials to which hardware are being installed. Include manufacturer's product literature with shop drawing submissions detailing that supplied hardware is suitable for respective applications. Arrange for manufacturer's representative to provide onsite installation training for hardware products.
- .7 Metal framing channels – typical 40 mm (1-5/8") width but increased where required to suit application, galvanized steel channels complete with required fittings and ancillary hardware. Acceptable manufacturers of framing channels are:
  - .1 Unistrut;
  - .2 Thomas & Betts;
  - .3 Hilti;
  - .4 Eaton B-Line.
- .8 Acceptable manufacturers of fastening and securing hardware:
  - .1 Crane;
  - .2 Hilti;
  - .3 Thomas & Betts.

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- .9 Pentair Erico metal "J" hooks or Panduit "J-Pro" cable support systems for communications system cabling in accessible ceiling spaces where conduit or cable tray is not being provided. J hooks to be of type and size to maintain cable minimum bending radii of cable being supported and have smooth edges that cannot damage cable. Clearly identify cable manufacturer's bending radii specifications and submit with shop drawings. Use of J-hooks is subject to approval from Owner and review with Consultant.
- .10 Velcro tie wraps for bundling and securing cables.

## **2.7 Access Doors**

- .1 Access doors to be provided under work of Division 08 by General Trades Contractor.
- .2 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 to where possible be accessible from common access door. Coordinate work to ensure that same common location access doors are not supplied by more than one Division.
- .3 Size access door to suit 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 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.
- .5 Identify on reflected ceiling plans and wall elevation drawings, coordinated locations of proposed access door locations and submit to Consultant for review.

## **2.8 Identification Nameplates**

- .1 Laminated plastic (Lamacoid) 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. Various colour configurations to be used to differentiate systems. Confirm exact nomenclature, sizing, print type and colour scheme with Owner and review with Consultant.
- .2 Brother "P-Touch" or approved equal, portable electronic labelling system complete with self-adhesive, permanent printed labels with required nomenclature.
- .3 For non-climate-controlled areas: nameplates to be weather resistant, corrosion resistant and UV resistant to prevent fading. Mounting hardware to be corrosion resistant stainless-steel construction.

## **2.9 System Backboards**

- .1 FSC (Forest Stewardship Council), G1S (good one side) 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.

## **2.10 Breakers**

- .1 Breakers to be NEMA rated types, and for switchboards and distribution panelboards, breakers when frame sized greater than 225 amperes, or where scheduled or where noted on drawings, 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 selective coordination. Unless otherwise noted on drawings, provide ground fault alarm and trip functions at breaker trip unit rating above 600 A, and set as coordinated with results of coordination study and as reviewed 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 local governing electrical code.

## **2.11 Disconnect Switches**

- .1 Heavy duty, CSA certified, disconnect (safety) switches. Features include:
  - .1 front operated with handle suitable for padlocking in "OFF" position and arranged so that enclosure cover cannot be opened while handle is in "ON" position;
  - .2 operating mechanisms: quick-break, positive acting with visible blades and line terminal shield;
  - .3 100% load break / make rated;
  - .4 non-fusible units;
  - .5 fusible units with fuse clips suitable for HRC fuses, unless otherwise noted;
  - .6 ampere rating, number of poles and fuse requirements as indicated on drawings;
  - .7 factory primed and painted switch enclosures.
- .2 Disconnects for variable speed drives to be suitable for use with such drives and include auxiliary switch/contact to de-energize control power circuit, as required and as applicable.
- .3 Acceptable manufacturers are:
  - .1 Eaton;
  - .2 Siemens Electric Ltd.;
  - .3 Schneider Electric (Square D);
  - .4 ABB.

## **2.12 Fuses**

- .1 Unless otherwise indicated, fuses to be Form I, Class "J" HRC fuses for constantly running equipment, and Form II, Class "C" HRC fuses for motorized equipment that cycle "ON" and "OFF".
- .2 Fuses to be of type suitable for applications as required by local governing electrical codes and in coordination with respective equipment manufacturer's recommendations in which fuses are required. Coordinate also with Mechanical Division Contractor for requirements for Mechanical Division equipment.
- .3 Fuses to be of product of one manufacturer.
- .4 Acceptable manufacturers are:

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- .1 Mersen (Ferraz Shawmut);
- .2 English Electric Ltd.;
- .3 Noram;
- .4 Eaton (Cooper Bussmann).

## **2.13 Splitter Trough**

- .1 CSA certified, splitter trough each complete with:
  - .1 formed, factory primed and painted steel box with knockouts;
  - .2 hinged front coverplate;
  - .3 suitable mounting provisions;
  - .4 a nameplate giving its rating.
- .2 Terminal blocks consist of pressure type main lugs and branch lugs approved for copper wiring and mounted on porcelain bases.
- .3 Enclosures for splitters mounted in climate controlled areas to be NEMA 1. For standard non-climate controlled applications, enclosures to be minimum NEMA 3R. Use NEMA 4X for corrosive environment applications.
- .4 Splitter trough ratings are scheduled on drawings.
- .5 Acceptable manufacturers are:
  - .1 Bel Inc.;
  - .2 Hydel;
  - .3 Hammond.

## **2.14 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 reviewed with 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 NEMA / (EEMAC) 1, 2 or 12.
- .6 Obtain CSA approval where required by local governing authorities.

## **PART 3 - EXECUTION**

### **3.1 General 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 Where conduit is proposed to be embedded within structural concrete, obtain Owner's approval and review with Consultant (Structural Engineer). Install such conduit in compliance with requirements of latest edition of CSA Standard CAN3-A23.1, "Concrete Materials, and Methods of Concrete Construction". Confirm and review with Structural Consultant, proper installation practices and methods. In areas where Consultant has directed conduit not to be embedded in concrete, run conduits through beams via sleeved openings pre-coordinated and reviewed with General Contractor and by Consultant (Structural Engineer). Do not embed conduit runs in concrete slab of parking garage areas, unless approved by Owner and reviewed with Consultant.
- .4 So as not to impair required strength of structure, following criteria to be generally followed but which is to be reviewed and coordinated 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;

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- .8 do not run conduit longitudinally in beam without approval of Owner and 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 approval of Owner and 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 approval of Owner and review with Consultant.
- .5 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.
- .6 For isolation type rooms and other rooms as reviewed with Consultant, seal conduits that penetrate through walls, floors or ceilings, and boxes within these surfaces with suitable elastomeric and intumescent materials around penetrating item and within any openings of item to ensure complete isolation of rooms. Such sealing materials are to be suitable for specific applications and maintain fire rating of penetrated surface and not be of a hazardous material. For wiring devices, provide gasketting under faceplates. Submit shop drawings of proposed materials.
- .7 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 approved by Owner and reviewed with Consultant.
- .8 Where receptacle type devices are located in existing floors and/or where feeds are required to furniture systems in open spaces, and where chasing of floor slab to run conduit is not acceptable to Owner, after review with Consultant provide fire rated "poke-thru" assembly installed through floor and feed from conduit runs provided in ceiling space of floor below.
- .9 Mounting heights of devices may be typically identified on drawings, but such dimensions are for general pricing only. Review exact mounting heights with Consultant prior to roughing –in, refer to Architectural drawings and comply with local governing codes and standards including building code barrier free requirements.

### **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:

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- .1 for interior building surface mounted conductors greater than 600 V – rigid galvanized steel;
- .2 for conductors exceeding 600 V for main distribution wiring in Electrical rooms, and for concealed conduit in exterior walls-rigid galvanized steel;
- .3 for branch circuit conductors underground inside building, and underground outside building beneath concrete, asphalt, and similar paving material-rigid PVC;
- .4 for exposed conduit mounted at a height of less than 1200 mm (4') in electrical, mechanical or other service areas – rigid galvanized steel;
- .5 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;
- .6 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;
- .7 at points, where conductors cross building expansion joints – galvanized steel flexible conduit with no less than 600 mm (24") of extra curve;
- .8 for branch circuit conductors in poured concrete slab – rigid PVC;
- .9 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;
- .10 for corrosive environments – epoxy coated rigid steel;
- .11 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.



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- .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 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 and local governing inspection approvals.

### **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.

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- .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 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 Outlet boxes in plastic conduit systems to be rigid PVC plastic outlet boxes, unless otherwise noted.
- .6 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.
- .7 Provide barriered outlet box for switches connected to normal and emergency power and share a common faceplate.
- .8 Provide outlet boxes for special wiring devices, for special equipment and special applications. Refer to requirements specified in other Sections and/or on drawings.
- .9 Size and arrangement of outlet boxes to suit device which they serve.
- .10 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.
- .11 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.
- .12 Properly support exterior mounted boxes for receptacles as noted on drawings. Where location is not adjacent a structure, provide rigid conduit support properly imbedded into ground and secure box at suitable required height. Review exact installation requirements with Consultant prior to start of work.
- .13 Provide blank coverplates on existing obsolete boxes which are to remain in position.
- .14 Provide blank coverplates over boxes left empty for future installation of devices. Clearly identify each box as to its intended use, to Owner'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.

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- .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 (excluding obvious outlet boxes) by painting outside of covers. Spray painting is not permitted unless approved by Owner and reviewed with Consultant. Paint colours to be in accordance with Owner's standards
- .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. Pack and seal sleeves set in exterior walls with governing authority approved materials suitable for application and pack both ends of sleeves watertight with approved permanently flexible and water tight materials. Coordinate exact responsibility of work 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 Owner 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 Firestopping and Smoke Seal Materials**

- .1 Where 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. Openings not in immediate vicinity of working areas are to be firestopped and sealed same day as being opened.
- .2 Install firestopping 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 firestopping materials.
- .3 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".
- .4 Comply with following requirements:
  - .1 Manufacturer's installation instructions for each specific application.
  - .2 Clean areas and surfaces before materials are installed.
  - .3 Examine substrates, openings, voids, adjoining construction and conditions under which firestop and smoke seal system is to be installed. Confirm compatibility of surfaces.
  - .4 Verify penetrating items are securely fixed and properly located with proper space allowance between penetrations and surfaces of openings.
  - .5 Report any unsuitable or unsatisfactory conditions to Consultant in writing, prior to commencement of work. Commencement of work will mean acceptance of conditions and surfaces.
  - .6 Mask where necessary to avoid spillage and over coating onto adjoining surfaces. Remove stains on adjacent surfaces.
  - .7 Prime substrates in accordance with product manufacturer's written instructions.
  - .8 Provide temporary forming as required and remove only after materials have gained sufficient strength and after initial curing.
  - .9 Tool or trowel exposed surfaces to a neat, smooth, and consistent finish.
  - .10 Remove excess compound promptly as work progresses and upon completion.
- .5 Notify Consultant when work is complete and ready for inspection, and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies. Arrange for final inspection of work by local governing authority inspector prior to concealing or enclosing work. Make any corrections required.

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- .6 On completion of firestopping and smoke sealing installation, submit a Letter of Assurance to Consultant certifying the firestopping and smoke sealing installation has been carried out throughout the building to service penetrations and that installation has been performed in strict accordance with requirements of local governing building code, any applicable local municipal codes, ULC requirements, and manufacturer's instructions.
- .7 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.
- .8 Where work requires removal of existing firestopping materials and replacement of firestopping materials after cabling changes have been made, ensure that replacement material is same material and manufacturer of existing if any remains in place, or ensure that all existing material is removed before installation of replacement material.

### **3.8 Installation of Fastening and Securing Hardware**

- .1 Provide fasteners, anchors 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 approved by Owner and reviewed with Consultant, weld hanging and support provisions to structural steel.
- .6 Install devices in accordance with manufacturer's instructions to suit each respective application.
- .7 Explosive powder actuated fasteners are not permitted unless specific approval for their use and type has been obtained from Owner and reviewed with Consultant.
- .8 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.
- .9 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.
- .10 Comply with Consultant's (Structural Engineer's) limitations for maximum penetrations of securing hardware into concrete slabs.

### **3.9 Installation of Identification Nameplates**

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- .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 "ESSENTIAL POWER SYSTEM", where applicable. Comply with CSA Z32 requirements.
- .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 Provide nameplates engraved "Dedicated Circuit" on faceplates for receptacles on dedicated circuits in Critical and Intermediate Patient Care Areas. Provide nameplates engraved "Housekeeping" for Housekeeping receptacles generally located in Corridors with exact extent to be determined on site. In these areas where lamacoid nameplates are employed, engrave source of supply (circuit designation) on these nameplates as well.
- .6 Faceplates for devices not in-patient care areas or not in corridors in vicinity of patient care areas are to be labelled with plastic self-adhesive printed labels with similar information as specified for nameplates. Provide labels on inside and outside face of faceplates. Apply a layer of a clear coat finish over each label.
- .7 Panelboard identification is to be arranged typically as following example: "WING-C-LP-A-1" where:
  - .1 "WING" denotes building wing;
  - .2 "C" denotes floor of wing;
  - .3 "LP" denotes panelboard type;
  - .4 "A" denotes panelboard number;
  - .5 "1" denotes a sub-fed panelboard of same number.
- .8 Building wings for panelboard identifications to be reviewed with Consultant prior to start of work.
- .9 Building floors for panelboard identifications to be indicated as follows:
  - .1 "B" or "C" denotes Basement or Concourse where applicable to match installation;
  - .2 "G" denotes Ground Floor;
  - .3 1 to 10 denotes Floors 1 through 10.
- .10 Panelboard types are to indicate service as follows:
  - .1 "DP" denotes "Distribution Panel" that feeds various branch circuit panels and larger loads;

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- .2 "LP" denotes "Lighting Panel" for lighting and general receptacle loads;
- .3 "PP" denotes "Power Panel" for multiple loads within a specific area such as a shop;
- .4 "VP" denotes "Vital Panel" for designated loads;
- .5 "KP" denotes "Kitchen Panel" for equipment loads within kitchen.
- .11 Where panelboards are supplied from Emergency Power, panelboard type to be preceded by letter "E", i.e. "EDP", "ELP", "EPP", "EKP", etc.
- .12 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;
  - .3 Isolated Power Red with white letters;
  - .4 Vital Power Yellow with white letters;
  - .5 UPS Power Orange with white letters.
- .13 Above identification nameplate and nomenclature requirements are for typical requirements for pricing only.
- .14 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.
- .15 Review print size type and size, colours, sizing and nomenclature of nameplates with Consultant prior to ordering. Submit sample board.

### 3.10 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.

### 3.11 Installation of Disconnect Switches

- .1 Provide disconnects switches and install into locations and connect complete. Ensure adequate clearance is provided as per local code requirements and as required for access for operation and maintenance. Install as follows:
  - .1 wherever shown on drawings and/or specified herein;
  - .2 wherever required by MCC/VFD/starter schedule drawings;

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- .3 for motorized equipment which cannot be seen from motor starter location or is more than 9 m (30') from starter location (in accordance with local governing electrical code requirements);
- .4 for "packaged" equipment fed from a motor starter panel.
- .2 Where double throw switches are required, connect to provide operations as noted.
- .3 Ensure enclosure ratings are suitable for intended applications.
- .4 Provide engraved lamacoid nameplate with nomenclature reviewed with Consultant.

### **3.12 Installation of Fuses**

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Provide a complete set of fuses for each fusible disconnect, motor starter, and similar fusible equipment provided or supplied.
- .5 Supply 3 spare fuses of each size and type used on project, mount fuses in cabinet. Secure cabinet in wall location as reviewed with Consultant.

### **3.13 Installation of Splitter Trough**

- .1 Provide splitter trough and install into locations and connect complete. Install with adequate clearance as per code requirements and as required for access for operation and maintenance.
- .2 Ensure enclosure ratings are suitable for intended applications.
- .3 Secure splitter trough in place independent of connecting conduit, secure into position and connect complete.
- .4 Provide engraved lamacoid nameplate with nomenclature reviewed with Consultant.

### **3.14 Installation of Signage**

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



### **3.15 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 Perform necessary tests to show compliance with above requirement. Make such tests after building is occupied and document into testing report.

### **3.16 Disconnection, Removal and Relocation Work**

- .1 Prior to start of any disconnection, removal or relocation work in any areas of building, prepare schedule of work and notify Consultant and Owner to obtain approval of work to proceed.
- .2 Where indicated on drawings or where required to perform Work of this Project, disconnect and remove items of existing obsolete electrical work. Relocate required devices as required to accommodate work of other Divisions. Where luminaires, switches, receptacles, and other devices and/or equipment is removed, disconnect at point of electrical supply, remove obsolete wiring and conduit up to source, unless otherwise noted, and make system safe to Owner's satisfaction and as reviewed with Consultant. Remove obsolete conduit/raceways in accessible ceiling spaces, exposed locations, etc. Where existing obsolete conduit and similar raceway material cannot be removed, such as embedded in concrete, cut back and cap obsolete conduit and raceways. Refer to specific notes on drawings.
- .3 When respective work is deleted, such deletions are to in no way affect operation of any existing interconnected mechanical or electrical components that remain. When existing circuits are being disconnected, maintain supervision of area to ensure that such circuits do not affect essential existing circuits being retained.
- .4 When relocating luminaires, inspect luminaire for circuit identification and if found, identify circuiting on as-builts, if circuiting is maintained.
- .5 Refer to applicable architectural and electrical drawings which define extent of areas being demolished in existing building. Review drawings and site and include for demolition and/or renovation of services as required to accommodate alterations detailed.
- .6 Except where directed by Owner, remove from site and properly dispose obsolete materials which are removed and are not relocated or reused. Obtain from Owner and review with Consultant, list of existing electrical items for removal and turn over to Owner. Said items remain property of Owner. Package items and provide itemized list.
- .7 Where existing services pass through or are in an area to serve items which are to remain, or pass through areas that are to be deleted, maintain services, but re-route as required. Include for rerouting existing services concealed behind existing finishes and which become exposed during renovation work, so as to be concealed behind new or existing finishes. Confirm with Owner services which are to be kept in service and operational.
- .8 Revise panelboard directories accordingly, if affected by any renovation, disconnection, or removal of work. Provide revised typed directory cards. Use Owner's actual room names/numbers. Ensure service to all equipment being demolished, removed, or relocated has been de-energized prior to disconnecting. Label all breakers no longer being used as "spare" on panelboard directories. Revise all other labels for breakers being reused to suit new loads.

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- .9 Protect existing devices being relocated or deleted to ensure that they are not damaged. Test such devices prior to disconnection and de-energization, to ensure that each device is in proper working condition. Ensure that motors are in proper rotation direction. Examine each device for damage. Report devices not working or with damage to Consultant prior to initiating any work. It will be assumed that devices are in proper working order and good condition if not reported.
- .10 Provide junction boxes, outlet boxes, wiring, plates, etc., as necessary for complete relocation of devices. Clean relocated or temporary removed devices and equipment, and ensure that they are in good operating condition before being reinstalled. Where existing luminaires are relocated, clean luminaires and inspect for damage. Report defects or damages to Consultant. Do not splice conductors unless approved by Owner and reviewed with Consultant. Utilize junction boxes and terminal devices for proper extension of circuits where approved. Otherwise replace circuits with home run continuous run of suitable lengths.
- .11 Provide blank coverplates on existing obsolete boxes which are to remain in position, as designated by Owner.
- .12 Where Work requires opening of ceilings to allow for mechanical equipment installation work or installation of work of other Divisions. Electrical Division devices including luminaires, telecommunications, fire alarm, communications and other such devices with associated conduits and wiring are to be disconnected, temporally relocated/supported and when ceiling is re-installed, devices to be properly re-installed, connected, tested and verified. Re-route wiring and conduit to suit work. Services to temporarily relocated equipment shall be maintained at all times. Life safety equipment to be maintained to satisfaction and approval of local governing authorities. Some existing devices/products as noted on drawings are to be replaced under scope of project work. Coordinate work with Mechanical Divisions Contractor.
- .13 After installation is complete, test parts of re-used or relocated electrical equipment and correct faults and grounds. Include for fire alarm verification company to verify any relocated devices and downstream affected devices, and verify system as required by local fire authority to suit actual relocation work. For other existing systems, engage manufacturers authorized representative or existing system maintenance contractor, as confirmed with Owner, to inspect and verify relocated devices. Review exact requirements with Owner and Consultant. Document testing in test reports, signed by testing technician. Submit copies to Consultant. Confirm vendors with Consultant and Owner.
- .14 Interior, exterior or underground electrical services (including auxiliary services, telephone, fire alarm, P.A. System, etc.) to operating parts of building are not to be hampered under any conditions and to that effect, necessary work may have to be carried out on an overtime basis, at no additional cost to this project. Existing risers are to be maintained in service as required to feed other areas of building(s). Do not interrupt any services without prior written approval by Owner and review with Consultant. Submit formal requests to Consultant outlining in detail requirements of proposal and wait for instructions from Consultant.
- .15 Be present when new doors or openings are being cut into existing walls and ceilings. Should any damage occur to electrical system, restore system to a safe and sound condition.

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- .16 Where references are made on drawings that existing receptacles, etc., be extended and/or relocated to suit new construction, receptacles, etc., are to be tested and if found defective, be replaced with new devices. Cracked or broken cover plates are to be replaced and match Architectural finishes. Contractor may optionally replace existing basic receptacles, switches, and faceplates with devices matching existing devices.
- .17 Be responsible for disconnecting power supply to branch circuits controlling lighting, receptacles, panels, mechanical equipment, etc., for safe removal of equipment, conduit, wiring, boxes, etc., affected by demolition.
- .18 Close openings in boxes, panels, etc., that result from removal of equipment, conduit, wiring, fixtures, etc. Close openings in a proper manner and properly terminate and insulate cables to restore system to a safe operating condition as reviewed with Consultant and to Owner's satisfaction.
- .19 Be present and supervise removal of electrical equipment, P.A. speakers, etc., during demolition of ceilings, walls, floors, etc. Existing equipment which is not to be relocated but interferes with demolition, are to be temporarily relocated until demolition work is completed. Services to temporarily relocated equipment are to be maintained at all times.
- .20 Remove and re-install existing ceiling tiles as required to perform work. Prior to removal, inspect tiles for damage and report any to Owner and Consultant. Any loose cabling is to be secured, and luminaires additionally supported with cables secured to ceiling slab. After work has been completed and successfully inspected, re-install ceiling tiles to existing standards and re-install devices. Be responsible for replacement of tiles and grid members damaged during work of Electrical Division. Comply with applicable governing authority requirements with regards to ceiling work in special areas.
- .21 Where existing surfaces are damaged by Electrical Divisions work and/or where existing devices are removed from wall, ceilings, floors and other surfaces, and such deleted devices are not being replaced in same locations, patch locations of these removed devices and re-finish. Patching and finishing is to be provided by tradesmen skilled in particular trade or application worked on, to Owner's approval and review with Consultant. Where openings are left in existing ceiling tiles, replace ceiling tiles with new matching tiles approved by Owner and reviewed with Consultant. Unless otherwise included for in other Divisions, include for:
  - .1 preparing existing surfaces to be filled and repainted to be cleaned as required to remove dirt, dust, oil, grease, loose paint, rust and any other foreign matter which would prevent proper bonding of new finish; sand glossy surfaces to uniform dull texture;
  - .2 filling in and patching surfaces with same material as existing surfaces; finished surfaces to match and line with existing adjoining surfaces;
  - .3 providing fire stopping materials to maintain fire rating of the existing surfaces; refer to specification article entitled - Firestopping and Smoke Seal Materials;
  - .4 using paint rollers and/or brushes to apply and extend paint finish over full height and/or width of area affected, to a straight line in location reviewed with Consultant;
  - .5 applying sufficient number of coats such that patched area is indistinguishable to surrounding area;
  - .6 materials used to be of equivalent quality to existing finishes standards and be compatible with finishes to which they are applied;
  - .7 finishes to be approved by Owner and reviewed with Consultant.

- .22 Check luminaires to be deleted for PCB ballasts. Disconnect and remove such ballasts. As specified previously, include for company specialized in such hazardous materials to remove and dispose such materials off-site in compliance with Ministry of Environment, Ministry of Transport and any other governing authority regulations.
- .23 If at any time during course of building work, asbestos containing materials are encountered or suspected, cease work in area in question and immediately notify Consultant. Comply with local governing authority regulations. Do not resume work in affected area without approval from Owner and review with Consultant.

### **3.17 Interruptions to and Shut-Downs of Services and Systems**

- .1 Shutdowns and interruptions to existing systems and services are to be coordinated fully with and performed at times acceptable to Owner and reviewed with Consultant. Generally, shutdown may be performed only between hours of 12:00 midnight Sunday until 6:00 a.m. Monday morning. Include for costs of premium time to perform work during nights, weekends or other times outside of normal working hours, which may be necessary to comply with stipulations specified herein this Article. Services for operation of existing non-renovated areas of building are to be maintained.
- .2 Upon award of contract, submit to Consultant for review and approval, a list of anticipated shut-down times and their maximum duration.
- .3 Prior to each shut-down or interruption, inform Consultant and Owner in writing minimum 7 working days in advance of proposed shut-down or interruption and obtain written consent to proceed. Do not shut down or interrupt any system or service without written consent. Note that shutdowns of some essential services may require additional advance notification time.
- .4 Work associated with shut-downs and interruptions are to be carried out as continuous operations to minimize shut-down time and to reinstate systems as soon as possible. Prior to any shut-down, ensure that materials and labour required to complete work for which shut-down is required are available at site.
- .5 Confirm any methods of procedures with Owner and review with Consultant prior to start of work.
- .6 Review with Consultant if any feeder (conductor) is designated for special considerations and if designated as such and is to be interrupted, ensure that at least following preparations are met:
  - .1 provide a schedule of proposed feeders to be interrupted; propose one feeder at a time to be worked on per scheduled shutdown;
  - .2 provide a method of procedure for work;
  - .3 prepare above documentation and submit for approval by Owner and review with Consultant at least 10 working days prior to date of each proposed work;
  - .4 on day/night of proposed feeder work, advise Consultant of which feeder is to be worked on; review with Consultant requirements for witnessing work;
  - .5 de-energize feeders and perform work as per Owner approved and Consultant reviewed schedule;
  - .6 after feeders are re-routed, megger test each feeder.

- .7 Where working in close proximity to "live parts" or inside energized panels or energized cubicles of switchboards/substations, provide protection "boots" over bussing and insulating mats to cover areas of exposed live parts.

### **3.18 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.

### **3.19 Equipment Bases and Supports**

- .1 Provide equipment bases and supports. Coordinate concrete pour for housekeeping pads and luminaire poles bases with Division 03. Ensure that applicable seismic restraint provisions are provided as per local governing building code.
- .2 Secure floor mounted equipment in place on minimum 100 mm (4") high concrete housekeeping pads, minimum 100 mm (4") wider and longer than equipment base dimensions.
- .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 bases for support of large, heavy equipment. Indicate on shop drawings total weight of base, reinforcement, and equipment for which it is required.
- .5 Perform work within formwork contractor's schedule. Failure to meet formwork schedule will result in Electrical Division Contractor being responsible for providing concrete work including formwork and reinforcing steel, to standards of Division 03.
- .6 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.

### **3.20 Concrete Work**

- .1 Provide concrete required for work, including formwork and reinforcing steel.

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- .2 Unless otherwise noted in Division 03, concrete to be minimum 20700 kPa (3000 psi) ready mix concrete provided in accordance with latest editions of CAN/CSA-A23.1 "Concrete Materials and Methods of Concrete Construction" and CAN/CSA-A23.2 "Methods of Tests for Concrete".
- .3 Perform work to standards and general requirements of Division 03.
- .4 Comply with local governing authority and local standard practices in providing concrete to compensate for local frost level of Place of Work.

### **3.21 Excavation and Backfill**

- .1 Unless otherwise noted, excavation and backfill work required for electrical work is to be done as part of work of Division 02, except for final hand grading work and backfill to 450 mm (18") above service which is to be done as part of electrical work. Mark out location and routing of excavation required for work as well as required depth. Ensure that bedding is graded to provide proper drainage for ducts as reviewed with Consultant.
- .2 Inverts and locations of existing site services may have been site surveyed and approximate location may be shown on drawings. Confirm that local utilities have performed locates and marking out. Ensure inverts and locations are correct, prior to commencement of work. Where discrepancies are found, immediately inform Consultant, and await direction.
- .3 Ensure that work is inspected by Consultant before covering and backfilling. Failure to do so prior to backfilling will require re-excavating work and re-backfill at no additional cost to Owner.

### **3.22 Cutting, Patching and Core Drilling**

- .1 Unless otherwise noted, General Trades Contractors are responsible for cutting, patching, and core drilling of existing building required for installation of Work.
- .2 Where added conduits and/or conductors penetrate existing construction, identify, and mark out locations for openings. Size openings to leave 13 mm (1/2") clearance around conduit and/or conductors. Coordinate work with General Trades Contractor.
- .3 Ensure that openings in fire rated construction are sealed as per requirements of article entitled "Firestopping And Smoke Seal Materials" specified herein this Section and as per Division 07, as applicable.
- .4 Fire stop and seal openings as specified, and patch as required before end of workday. No openings are to be left open overnight unless approved by Owner and reviewed with Consultant.

### **3.23 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. Review 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 approved in writing by Owner and reviewed with Consultant.

### **3.24 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.

### **3.25 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.

Basic Electrical Materials and Methods

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- .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 Review 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.

### **3.26 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.
- .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.



Basic Electrical Materials and Methods

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- .8 Submit as part of shop drawing submission, detailed responsibility matrix identifying work and responsibilities of each trade and required interconnections.
- .9 After installation is complete, test and verify operation of components in coordination with General Contractor and door hardware vendor.

**END OF SECTION**

Low Voltage Conductors

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## **PART 1 - GENERAL**

### **1.1 Submittals**

- .1 Submit shop drawings for products and accessories.
- .2 Submit samples of conductors, where requested in Contract Documents or when requested by Consultant.

## **PART 2 - PRODUCTS**

### **2.1 General Power Cables**

- .1 CSA approved, ULC labelled and certified. Unless otherwise noted, conductors to be copper and be suitable for applications as noted in governing local electrical code.
- .2 "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.
- .3 "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.
- .4 "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).
- .5 "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).
- .6 Nexan DriveRX type cable for variable frequency drives: CSA approved to C22.2 no 123; flame, oil and UV resistant cable with copper conductors, corrugated continuous aluminum sheath and 3 bonding conductors; impact and crush resistant; temperature rating is 90°C to -40°C; 1000V 90C rated cross link polyethylene insulation; FT4 PVC jacket;
- .7 Solid conductors to and including No. 10 AWG; stranded conductors in sizes larger than No. 10 AWG; branch circuit conductors constructed of 98% conductive copper; and approved for minimum 600 volts, with minimum 1000 volts where noted.
- .8 Optionally, conductors of amperage rating exceeding 200 A or rating specifically noted on drawings, or for specific conductors as noted on drawings, may be aluminum alloy conductors. Aluminum alloy conductors to be equivalent to ALCAN "NUAL" AA8030 RW90 aluminum alloy conductors. Provide connectors and associated hardware compatible to aluminum alloy conductors as per aluminum wiring manufacturer's recommendations and as required by local governing electrical code. Install aluminum 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.

### **2.2 Connectors**

- .1 General:

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Low Voltage Conductors

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- .1 materials: CSA approved and/or ULC listed and labelled as required by local governing authorities and codes;
- .2 certification: CSA C22.2 No. 65;
- .3 connectors marked with certification, manufacturer, manufacturer catalogue number and approval for conductor size and type.
- .2 Armoured cable connectors of proper squeeze type connectors and plastic anti-short bushings at terminations.
- .3 Connectors for conductors connecting to devices in accordance with local governing electrical requirements, equal to Ideal Industries No. 451, No. 452 and No. 453, "Wing-Nut", CSA certified, 600 volts rated, contoured wing design, fire retardant shell, twist on pressure type connectors.

## **2.3 Fire Rated Cables**

- .1 nVent - Pyrotenax, model "System 1850", 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. Certified to C22.2 No. 124 and ULC Listed 2-hour fire-resistive cable tested to ULC-S139 fire test standards.
- .2 Unistrut type C-channel supports, 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.
- .3 Brass plates for cable openings in ferrous metal enclosures.
- .4 Include for required cable manufacturer's accessories and identification labelling.
- .5 Include for manufacturer's authorized technician to perform initial coordination with and providing training to 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, test cabling and terminations and provide formal report of test results with observations, certification that installation work is complete and cabling with terminations perform as required, to satisfaction of cable manufacturer.
- .6 Acceptable manufacturer of fire rated MI type cables is nVent.

## **2.4 Standard Control and Communications Cables**

- .1 Type LVT 300 V
  - .1 CSA approved, FT4 rated.
  - .2 Solid annealed copper conductors sized as indicated.
  - .3 Insulation: Polyethylene.
  - .4 Overall covering: PVC jackets.
  - .5 Where installed in plenums, cable to be certified to C22.2 No.214 and FT6 rated.
- .2 Type TEW
  - .1 ULC listed and labelled, CSA certified to C22.2 No. 127.

### Low Voltage Conductors

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- .2 Solid copper wire rated for 600 volts, No. 18 AWG.
- .3 Thermoplastic insulated with overall nylon jacket.
- .4 105°C (220°F) conductor temperature.
- .5 Complete with required number of copper conductors and colour coding.
- .3 For interconnection of security system elements, including fire protective signaling devices and two-way emergency communication systems:
  - .1 Nexans, "Securex II", 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 When not run in conduit, include interlock aluminum or galvanized steel armour with overall jacket.

## 2.5 Conductor Pulling Lubricant

- .1 IDI Electric, "Ideal Yellow 77" or "Wire Lube" as required.
- .2 Standard Tracer Wire: solid copper conductor insulated with high molecular weight polyethylene (HMWPE); manufactured according to ULC constructions in both 30 V and 600 V versions suitable for use at maximum continuous operating temperature of 75°C (167°F) in wet and dry locations.

## PART 3 - EXECUTION

### 3.1 Project Conditions

- .1 If identified in documents, verify that field measurements and conditions are as identified.
- .2 Unless specifically noted, cable routing on drawings is schematic and approximate and not reflective of elevations. 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. Provide fire rated conductors for applications as required by local governing codes and standards, and requirements of local governing authorities.

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Low Voltage Conductors

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- .2 In applications where, multiple conductors in conduit are being run, provide trapeze configuration of Unistrut type 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 be permitted in applications approved by Owner and reviewed with 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 luminaries and drops down stud walls to devices and in furniture systems - "AC90" flexible armoured cable ("BX") (maximum 6 m (20') run permitted);
  - .5 branch circuit wiring for patient care areas accessible suspended ceiling spaces consisting of drops down to luminaires - "AC90" flexible armoured cable ("BX"); (maximum 3 m (10') run permitted); flexible armoured cable (i.e. "AC90") is not permitted within walls of patient care areas";
  - .6 branch circuit wiring for non-patient care areas in accessible ceiling spaces and within stud wall construction consisting of drops down to luminaries and drops down stud walls to devices and in furniture systems - "AC90" flexible armoured cable ("BX") (maximum 6 m (20') run permitted);
  - .7 for installation interior of pre-fabricated service consoles – "T90 Nylon" or "RW90" in flexible metallic conduit; or "AC90 ISO-BX" to code requirements; refer also to drawing notes;
  - .8 for isolated power system load side wiring – "RW90";
  - .9 for connections to variable speed drives: Nexan DriveRX type cable for variable frequency drives as recommended by drive manufacturers;
  - .10 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 holes cable straps to "Code" requirements. Run flexible armoured cables in neat manner parallel to building lines. Utilize centralized conduit runs to maintain maximum permitted runs of flexible armoured cables as recommended by cable manufacturer and as required by local governing codes. Provide insulating grommet at cut ends of flexible armoured cable to protect conductor insulation.

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Low Voltage Conductors

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- .5 Splicing of conductors is permitted for replacement of existing conductors and extension as noted on drawings and where approved by Owner and reviewed with Consultant. Splicing of conductors is subject to following conditions:
  - .1 splicing to extend existing conductors;
  - .2 for low voltage control and signal conductors, splicing made within an electrical box with terminal strips;
  - .3 for interior line voltage conductors, splicing made within an electrical box with cold shrink splice kits and mechanical compression connectors; full assembly to suit type and size of conductors and as reviewed with Consultant;
  - .4 for exterior line voltage conductors, splicing made with outdoor weatherproof cold shrink splice kits and mechanical compression connectors; full assembly to suit type and size of conductors and as reviewed with Consultant;
  - .5 splice/splice box properly identified with suitable painting or labelling;
  - .6 splice/splice box clearly identified on "as-built" drawings;
  - .7 use of pressure type twist connectors only for specific applications with prior review with Consultant, but generally not permitted;
  - .8 use of "split bolts" is not permitted.
- .6 Install compression connectors with proper dies and compression tool as per connector manufacturer's instructions. Install cold shrink tubing and associated materials as per manufacturer's instructions.
- .7 Install control wiring as required and as indicated. Confirm exact type of control wiring with manufacturers of equipment/systems being interconnected, and as required by local governing electrical code. Provide required fire alarm cables for fire alarm system applications or security system applications as recommended by fire alarm system manufacturer, complying with requirements of local governing code and local governing authorities. Typically run control wiring in conduit. Conductors not installed in conduit or raceways to be fire insulated rated in accordance with latest governing code flame spread ratings requirements, and suitably mechanically protected by means acceptable to Owner and reviewed with Consultant. Ensure that conductors comply with fire rating - FT6 rating requirements when run in plenums and similar construction.
- .8 Coordinate responsibility for provision of control wiring for Mechanical Division equipment and equipment of other Divisions, with respective Divisions of the Work.
- .9 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 on drawings or obtained from Consultant. Conductors not sized or specified of type, to be sized and of type in accordance with requirements of local governing electrical code.
- .10 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.
- .11 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:

#### Low Voltage Conductors

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- .1 Phase A - red;
  - .2 Phase B - black;
  - .3 Phase C - blue;
  - .4 Ground - green;
  - .5 Neutral - white;
  - .6 Control - orange.
- .12 Colours for isolated power system "load" side power wiring to be as follows:
- .1 Live No. 1 - brown;
  - .2 Live No. 2 - orange;
  - .3 Ground - green.
- .13 Use "French Chalk" or talcum powder for pulling in isolated power centre "load" side wiring.
- .14 When pulling wires into conduit use lubricant and ensure that wires are kept straight and are not twisted or abraided.
- .15 Control conductors, in addition, to be numbered with Brady Ltd. or Electrovert Ltd. Z type markers.
- .16 Colour code conductors for communications systems in accordance with system component manufacturer's recommendations.
- .17 Neatly secure exposed wire in apparatus enclosures with approved supports or ties.
- .18 Install low voltage conductors in conduits, unless otherwise noted within Documents.

### 3.4 Installation of Fire Rated Conductors

- .1 Obtain from local governing electrical authority, approval of proposed fire rated cable to be installed.
- .2 Obtain installation and testing training from cable manufacturer as required for specific cabling type. Installation to be performed by personnel experienced in installation of specific cabling.
- .3 Submit with shop drawings, copy of manufacturer's detailed installation manual and testing procedures. Provide 2-hour fire rated type, CSA approved, ULC listed and labelled, copper conductors for following:
  - .1 emergency conductors from generators to transfer switches;
  - .2 conductors to elevators;
  - .3 conductors to fire pumps and sprinkler pumps;
  - .4 conductors to smoke venting fans;
  - .5 conductors to emergency lighting panel boards;
  - .6 conductors to fire alarm control panels and transponders;
  - .7 fire alarm conductors risers;
  - .8 conductors as required by Code requirements;

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Low Voltage Conductors

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- .9 fire alarm system feeders as shown interconnecting existing fire alarm system and additional system;
- .10 applicable local governing code required applications for control and signalling conductor circuits of and between life safety equipment and systems;
- .11 conductors as noted on drawings.
- .4 Provide fire rated type cabling for specific conductors as noted and as required for specific applications by local governing codes. Install fire rated type 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. Conductors not sized on drawings, to be sized in accordance with requirements of local electrical code.
- .5 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 type C-channel 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.
- .6 Make terminations of conductors with manufacturer's approved components and connectors in accordance with 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. Cable lugs to be temperature rated as per manufacturer's instructions.
- .7 Splicing of cables is not permitted.
- .8 Provide factory splices of cables where noted on drawings as approved by Owner and reviewed with Consultant, and by means as per manufacturer's instructions. Splices to include overall weatherproof heat-shrinkable tubing. Clearly identify splice with proper identification labelling/markers and locate on as-builts. Comply with manufacturer's instructions. Where splices are permitted, locate in area accessible. Review locations of splices with Consultant, prior to start of Work.
- .9 When pulling cable, apply pulling tension to the conductor not in sheath of cable. Limit cable pulling tension to as recommended by cable manufacturer.
- .10 Terminate cable in equipment with termination kits as per cable manufacturer's instructions.
- .11 Terminations to be witnessed by manufacturers authorized technician. Perform terminations in accordance with cable manufacturer's instructions.
- .12 Terminate cables to transformers, motors and other vibrating equipment by use of means to isolate vibration in accordance with cable manufacturer's recommendations.



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Low Voltage Conductors

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- .13 Installation of cable splices and terminations to be witnessed by manufacturer's authorized technician. Perform splicing and terminations in accordance with cable manufacturer's instructions. Ensure that space for splices is sufficient to properly accommodate bundled cables and splice box.
- .14 Ground cabling as per cable manufacturer's instructions and as per local governing electrical code requirements.
- .15 Take necessary precautions when handling cable on reel to ensure that no damage will result in the uncoiling process.
- .16 Where cables penetrate 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.
- .17 Engage with cable manufacturer to test cables and terminations after installation, in strict accordance with cable manufacturer's recommendations. 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 procedures until resistance reaches cable manufacturer's listed acceptable level.
- .18 Include and arrange for cable manufacturer's authorized representative to review installation and associated work and testing of installed cables. Prepare report consisting of test sheets with results of cables tested and a certificate of verification signed by testing engineer/technician. Report to include copy of cable manufacturer's signed inspection letter validating test results and documenting that work was performed to satisfaction of manufacturer. Submit minimum one hard copy and electronic copy to Consultant.

### **3.5 Installation of Corflex Cables**

- .1 Provide type RA90 (Corflex II) type cables for applications as required. Handle, install, and terminate in accordance with manufacturer's recommendations and instructions and as herein specified.
- .2 Coordinate provision of Corflex II cables between genset alternator box and control panel, with genset supplier and controls Contractor.
- .3 Provide system of cable tray and Unistrut Corporation channel support system for overhead suspended Corflex II cable. Support system to consist of non-ferrous cable trays supported by channels, supported by suitable threaded steel rods secured to structure with suitable aluminum clips.
- .4 Tie wraps are not acceptable for securing Corflex II cables. Utilize non-ferrous single screw cable clamps.
- .5 Ground and bond single conductor Corflex II cables at both ends where sheath currents do not affect cable ampacity. For certain areas, where sheath currents will reduce cable ampacity, ground and bond cable at supply end and isolate cable at load end as recommended by cable manufacturer, and provide a No. 3/0 green TW ground conductor for each cable run. Refer to requirements of local governing electrical code.

### **3.6 Installation of Teck Cables**

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Low Voltage Conductors

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- .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 Owner and reviewed with Consultant. Where splices are permitted, locate in area accessible. Review locations of splices with Consultant, prior to start of Work.

### **3.7 Installation of Tracer Wire**

- .1 Install tracer wire in accordance with wire manufacturer's recommendations for specific applications.
- .2 Connect with proper connectors to protect from moisture and corrosion. Do not twist wires together and wrap with electrical tape.
- .3 Place tracer wire in same orientation to installed pipe. Using spacer, tape tracer wire to pipe every 2.4 m to 3 m (8 to 10 feet) in three o'clock position or provide fill between pipe and tracer wire. Install colour coded warning tape minimum 300 mm (1') above pipe.
- .4 Bring tracer wire above ground for ease of terminating signal and terminate in test station.
- .5 Ground ends of wire.
- .6 After installation is complete, perform conductivity test or locate test and demonstrate to Consultant and Owner.

**END OF SECTION**

## Grounding and Bonding

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### **PART 1 - GENERAL**

#### **1.1 Submittals**

- .1 Submit shop drawings for products and accessories.

### **PART 2 - PRODUCTS**

#### **2.1 Basic Materials**

- .1 General:
  - .1 Materials: CSA approved and/or ULC listed and labelled as required by local governing authorities and codes.
  - .2 Certification: CSA C22.2 No. 41.
  - .3 connectors marked with certification, manufacturer, manufacturer catalogue number and approval for conductor size and type.
- .2 Ground Conductors: Solid copper, insulated and bare to suit application and code requirements; and bond conductors.
- .3 Main Electrical Room Ground Busbar: Solid copper busbar, predrilled for two-hole lug connections, of size of 50 mm x 9 mm (2" x 3/8") and of continuous length around perimeter of room, for wall and backboard mounting using standoff insulators.
- .4 Ground Connections:
  - .1 Exothermic connections permitted above grade when approved by Owner and reviewed with Consultant.
  - .2 When making ground and bonding connections, apply corrosion inhibitor to contact surfaces. Use corrosion inhibitor appropriate for protecting connection between metals used.
- .5 Ground Pit: Flush in grade grounding pits with following features:
  - .1 removable cast concrete cover with recessed lifting handle;
  - .2 cast iron or precast concrete pit;
  - .3 ground rod, ground clamps and grounding conductors as required;
  - .4 clay sewer tile for proper drainage.
- .6 Gravel/Stones: Provide gravel and crushed stones as required by local governing authorities to suit application. Layers to be of thickness not less than required by local governing authorities.
- .7 Miscellaneous ancillary components to complete grounding and bonding work to requirements of local governing electrical authority and codes.
- .8 Acceptable Manufacturers:
  - .1 Exothermic Process:
    - .1 Cadweld (nVent - Erico).
    - .2 BURNDYWeld (Hubbell).

## Grounding and Bonding

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- .2 Compression Connectors, Ground Rods, Bus Bars, Fittings and Ancillary Products:
  - .1 Hubbell – Burndy.
  - .2 nVent – Erico.
  - .3 ABB – T&B.
  - .4 ILSCO.

### 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 (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 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.
- .5 Acceptable Manufacturers:
  - .1 Hubbell – Burndy.
  - .2 nVent – Erico.
  - .3 ABB – T&B.
  - .4 ILSCO.

## 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. Comply with requirements of local governing electrical codes.
- .2 Within designated electrical room, provide a ground electrode consisting of minimum four 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.

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Grounding and Bonding

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- .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 independent flexible braided copper ground straps, one bolted to door frame, one bolted to door, each connected to ground bus.
- .4 Connect ground electrode to perimeter ground bus with two 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 minimum No. 3/0 copper conductors.
- .5 Provide 50 mm x 9 mm x 900 mm (2" x 3/8" x 36") electrical grade copper ground bus on perimeter wall of electrical rooms, 300 mm (12") above finished floor level. Secure ground bus on 20 mm (3/4") standoff insulators. Connect electrical rooms ground grid with ground bus with minimum 3/0 copper ground conductor in conduit. Connect each electrical room perimeter ground electrode system back to main electrical room ground electrode with minimum No. 3/0 copper conductors.
- .6 Ground and bond other equipment such as transformers, switchboards, panelboards, and similar metal work to perimeter ground bus. Provide minimum No. 3/0 insulated ground wire from ground bus in electrical rooms to switchboards, transformers, structure, floor, etc.
- .7 Extend conductors to metal piping of main water service and connect ground conductor to street side of water meter. If piping is not metallic, make necessary connections as required by local governing electrical utility.
- .8 Effectively bond metallic pipe services such as, gas mains, water mains, and dry risers, to main grounding terminal at their point of entry. Make connections to services with purpose-made grounding clamps.
- .9 When buses are in place, bolts have been tightened, and lugs have been installed, coat entire installation with two 100% covering coats of suitable shellac to prevent bus from oxidizing.
- .10 Throughout complex, solidly ground systems and make required grounding connections to electrical devices and apparatus. Ground conductors to be insulated copper wire connected with approved fittings in accordance with local governing electrical code.
- .11 Effectively bond building structures to main grounding system (grid).
- .12 Provide separate insulated ground wire for each isolated ground receptacle.
- .13 Extend isolated grounding conductors of computer receptacles to isolated ground bus of computer panel board serving area. From ground bus extend ground conductors to building grounding station.
- .14 In areas of raised floor systems, provide copper ground system as sized and detailed on drawings, and provide in compliance with local governing electrical code requirements. Bond ground system to raised floor supports and floor structure using ground clamps suitable for application, and connect system to building ground system with grounding conductors run in conduit. Bond metallic conduit which penetrates raised floor to raised floor stringer system. Install clamps and other accessories as per manufacturer's recommendations and instructions.

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Grounding and Bonding

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- .15 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.
- .16 Ground metal sheathing and exposed metal vertical structural elements of buildings. Ground metal fences enclosing electrical equipment. Bond metal equipment platforms which support electrical equipment to equipment ground. Bond rooftop equipment.
- .17 Bond metal work associated with pools such as reinforcing steel, piping, ladders and ancillary devices, above ground loops by copper conductors in accordance with local governing electrical code. Clean water pump prior to bond being using approved clamps. As required, make several bonds at various locations or collect wires and make one bond. Ground electrical equipment associated with these piping systems, adequately by installing flexible conduit and ground jumper wire to motors. Ground telephone boxes, speakers, pull stations and other such equipment within pool area with jumper wires within connecting conduit to ensure proper grounding. Include for ground connections to pool reinforcing steel.
- .18 Provide separate ground connection for bathtubs.
- .19 Provide service conductors exceeding 400 amperes with minimum No. 3/0 AWG grounding conductors, unless otherwise noted.
- .20 Ground and bond various telecommunications, audio visual systems, security, life safety and control systems in accordance with respective system manufacturers' recommendations and in accordance with local governing electrical code requirements.
- .21 Do not use conduit systems as ground conductors in patient care areas or in areas as per local governing electrical code requirements.
- .22 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.
- .23 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.
- .24 Isolated Power System Grounding:
  - .1 When grounding is complete, arrange for local governing electrical authority inspection and approval of system and work.
  - .2 Testing as specified in isolated power centre section to be conducted in presence of Owner, Consultant, and local governing electrical authority inspector.
  - .3 Include a program of ground leakage testing using approved leakage detector and recording of results. Ohmmeter or megger tests will not be satisfactory.
  - .4 Submit testing report to Consultant for review.
  - .5 Comply with requirements of CSA Z32.

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Grounding and Bonding

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- .6 Obtain local governing electrical authority's written acceptance of isolated power system ground system and turn over to Consultant. Perform changes as required by local governing electrical authority Inspector.
- .25 Make ground connections in slab or buried underground, or for joining dissimilar metals, using exothermic welding type copper connections. Install in accordance with manufacturer instructions.
- .26 Make exposed ground connections using compression connectors and other grounding fittings suitable for applications. Install in accordance with manufacturer instructions.
- .27 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.
- .28 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.

### **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 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 minimum 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 lock washers.

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Grounding and Bonding

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- .2 Metal Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lock washers, 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 lock washers, and nuts.
- .4 Unistrut Type Metal Channel Supports and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lock washers.
- .7 Building Ground Busbars:
  - .1 Provide busbar hardware at each communications room and connect to pigtail extensions of building grounding ring.
  - .2 Verify that ground ring pigtail is same type and size conductor used for main building grounding ring.
- .8 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 minimum 3/0 AWG).
- .9 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 minimum No. 6-AWG ground wire bonding jumpers.
- .10 Ground metallic conduit at each end using minimum No. 6-AWG bonding jumpers.
- .11 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**



## **PART 1 - GENERAL**

### **1.1 Submittals**

- .1 Submit shop drawings of products specified in this Section.
- .2 Submit copies of documents requested herein, testing reports, certificate of approvals, and commissioning sheets.

## **PART 2 - PRODUCTS**

### **2.1 Vibration Control and Seismic Restraint**

- .1 Electrical equipment installation is to meet local governing authority having jurisdiction and code seismic requirements and additional requirements outlined herein.
- .2 Provide labour, materials, and equipment required and necessary to seismically restrain electrical equipment and equipment bases including concrete pads, and guarantee function of materials and equipment supplied.
- .3 Make electrical connections to vibration-isolated equipment with flexible conduit or other flexible means acceptable to Consultant and local governing authority having jurisdiction so as not to restrict maximum anticipated movement of equipment under seismic excitation movement.
- .4 In event that inadequate isolation is provided by isolation product manufacturer's isolation package, be responsible for improving isolation to an acceptable standard at no additional cost to contract. Isolation product manufacturer's seismic restraint engineer to verify that seismic restraints and combination isolator/restraints intended for use on project are fit for intended purpose. Be responsible for ensuring that manufacturer's seismic restraints are in compliance with applicable local building code requirements for Place of Work.
- .5 Provide additional seismic requirements for suspended electrical raceways, luminaires, and other equipment as per governing local authority requirements and requirements of current codes and by-laws.
- .6 Include for manufacturer of vibration and seismic control products to engage a Professional Engineer registered or licensed in Place of Work and experienced in such Work, to develop/design seismic restraint system and perform seismic calculations in accordance with latest requirements enforced by local governing building code, requirements of local governing authority having jurisdiction, and additional requirements specified in this article. Design of seismic restraints to include provisions to withstand forces of site classification rating and importance category level as per governing building code requirements.
- .7 Submit for Consultant's review, seismic design drawings and product shop drawings with calculations approved and sealed by the Professional Engineer. Shop drawings to identify equipment type, manufacturer's name, model number and weight of equipment to be restrained.

Vibration Isolation and Seismic Restraints

- .8 Shop drawings to additionally include placement drawings for electrical equipment and equipment assemblies including runs of cable trays and conduit/cable racks showing methods of attachment to particular structure for each piece of equipment and assembly and provide anchorage/attachment details. Submit samples of materials required to complete seismic restraint work for review if and when required. Include for Professional Engineer to inspect same on site (note that multiple inspections to be required as work progresses) and to provide typewritten Inspection Reports to Consultant throughout construction and to provide "Letters of Assurance and Conformance" with specified Codes, Standards and Bylaws. Additionally, include copies of documents in Operating and Maintenance Manuals.
- .9 Use of manufacturer's isolation package is acceptable providing it meets requirements of this Specification.
- .10 Provide vibration isolation for equipment or parts connected rigidly to isolated equipment.
- .11 Provide vibration isolation for transformers by means of bridge bearing neoprene isolators or open steel spring isolators. Typical guidelines for static deflection of vibration isolators for electrical transformers are indicated in schedule below. Isolators requiring a static deflection greater than 13 mm (1/2") to be open spring isolators unless otherwise specified. Alternative proposals by vibration isolation manufacturers Engineer may be acceptable subject to supporting shop drawings with calculations supporting use of proposed products.

<b>POWER RANGE (kVA)</b>	<b>ON GRADE (Isolated Slab)</b>	<b>LOCATION ON GRADE (Continuous Slab)</b>	<b>UPPER Floor (Suspended Slab)</b>
Under 10	6 mm	6 mm	18 mm
10 - 100	6 mm	12 mm	25 mm
Over 100	6 mm	25 mm	38 mm

- .12 Standard vibration isolation requirements of equipment such as power transformers and distribution equipment, to comply with following:
  - .1 select equipment isolation mounts on basis of achieving 98% vibration isolation efficiency at lowest operating speed;
  - .2 natural frequency of each vibration isolation system to be at least 1/10 of lowest excitation frequency of rotating machinery, whenever practicable, but in no case less than 1/7;
  - .3 where structural floor deflection exceeds 1/10 of determined static deflection of isolator, increase isolator static deflection to maintain this minimum ratio of floor to isolator deflection;
  - .4 where static deflections are shown on drawings, Specifications, or schedules, they are to be used as a guide only;
  - .5 actual isolators are to achieve required static deflection under load, with at least 50% reserve deflection;
  - .6 submit shop drawings identifying equipment, lowest operating speed, weight, brand, type and location of isolators prior to ordering or fabrication.

Vibration Isolation and Seismic Restraints

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- .13 Following typical electrical equipment require seismic protection (where applicable to Project):
  - .1 transformers;
  - .2 switchboards/switchgear;
  - .3 panelboards;
  - .4 fire alarm system, cabinets and devices;
  - .5 luminaires;
  - .6 conduit and duct banks;
  - .7 other electrical equipment, as required.
- .14 Neoprene Isolators:
  - .1 Neoprene isolators to be bridge bearing rated type manufactured from bridge bearing quality neoprene, CAN/CSA-S6 Section 11.5.8.
  - .2 Where a ribbed pad is used, height of ribs is not to exceed 0.7 times width of rib.
  - .3 Steel layer to be used to distribute load in a multi-layered unit.
  - .4 Select neoprene pads or elements at supplier's optimum recommended loading and do not load beyond limit specified in neoprene manufacturer's literature.
  - .5 Test neoprene isolators to ASTM specifications. Submit to Consultant, following test data to verify performance of neoprene isolators:
    - .1 Data sheet listing all of ASTM test results.
    - .2 Load deflection curves for isolator indicating deflection to full compression for both laterally restrained and unrestrained isolators.
- .15 Open Steel Spring Isolators:
  - .1 Springs to be "Iso-Stiff" (spring coefficient 1.0 to 1.5) with a working deflection between 0.3 and 0.6 of solid deflection.
  - .2 Spring mounts to be complete with levelling devices, minimum 6 mm (1/4") thick neoprene sound pads, and zinc chromate plated hardware.
  - .3 Sound pads to be sized for a minimum deflection of 1.2 mm (0.0472") and meet requirements for neoprene isolators.
- .16 Seismic restraints to restrain equipment in all directions and to be sized to meet appropriate Sp factor defined in Table 4.1.9.D of current National Building Code and Commentary J of Supplement to current Code. Calculations bearing seal of a qualified Professional Engineer to be submitted with shop drawings to justify stated seismic restraint requirements.
- .17 Attachment points and fasteners to be capable of withstanding a load of 3 times sized capacity of restraint. Equipment suppliers to provide proof of conformance with this clause by means of shop drawings certified by a qualified Professional Engineer.
- .18 Seismic Bracing:
  - .1 Typically used for suspended or hanging luminaires and cable tray systems.

Vibration Isolation and Seismic Restraints

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- .2 Braces constructed of assembly of multiple, high strength, zinc coated, steel wires, configured into cable with factory-attached stake eye end that attaches brace to building structure. Various specific cable strengths to suit seismic requirements. Colour coded.
- .3 Pre-stretched bracing.
- .4 Restraint clip connects cable brace to cable tray. Oval sleeve used to secure cable loop through restraint clip.
- .5 Angle bracket end fittings for structure attachments and luminaire attachments.
- .19 Submit test data to Consultant, showing load deflection curves up to 1.5 times rated capacity of restraint, and certifying that neither neoprene elements nor restraint body sustained any deformation after release of load.
- .20 Adjust restraints to have clearances between 3 mm (1/8") and 6 mm (1/4") under normal operating conditions of equipment.
- .21 Acceptable manufacturers of seismic restraints include:
  - .1 Vibro-Acoustics;
  - .2 Mason Industries;
  - .3 Kinetic Noise Control;
  - .4 Eaton B-Line.

## **PART 3 - EXECUTION**

### **3.1 Installation**

- .1 Comply with seismic restraint Engineers and manufacturers design documents, and installation and adjustment recommendations. Refer to detailed shop drawings.
- .2 Obtain required training from manufacturer's representative on any special installation procedures. Install components in accordance with manufacturer's instructions to suit specific installation requirements.
- .3 Refer to Part 2 for additional specific installation requirements.

### **3.2 Inspection and Testing**

- .1 Inspect for removal of breakaway hardware to ensure proper torques of installed systems.
- .2 Test, adjust, and certify installation.
- .3 Comply with local governing authority requirements for testing, certification, documenting and labeling of seismic restraints.
- .4 For non-visually verifiable product, manufacturers to verify proper torque for a minimum 10% of application, unless otherwise directed by local governing authorities. Document torques for applications per manufacturer's instructions.
- .5 Submit copies of test report to Consultant.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 Submittals**

- .1 Submit as part of shop drawing submission, copies of:
  - .1 electrical distribution system protective device coordination study and short circuit calculations;
  - .2 system and equipment testing reports;
  - .3 arc flash analysis report;
  - .4 copies of certificate of approvals from local governing inspection authorities.
- .2 Submit electrical distribution system coordination study and short circuit calculations reports prior to or with proposed shop drawings of major electrical distribution equipment. Allow in shop drawing process, sufficient time for Consultant to review and make comments and for Contractor and equipment vendors to incorporate Consultant comments, necessary revisions and results of reports into equipment shop drawings. Do not order equipment until shop drawings have been reviewed with Consultant and Consultant's comments have been addressed. Time for this shop drawing review process will be at Consultant's discretion, but typically allow for 15 working days for initial review submission with additional 10 working days added to accommodate each resubmission.
- .3 If formal completion of studies and reports may cause delay in equipment manufacture, direction from Consultant may be obtained for preliminary submittal of sufficient data to ensure that selection of device ratings and characteristics will be satisfactory. Subsequently, provide formal studies and reports to verify preliminary findings.
- .4 Submit after completion of factory testing, copies of completed product testing reports.
- .5 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.
- .6 Review 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 preparing and submitting preliminary coordination study and short circuit calculations and recommendations on required relays, sensors and CT's for proper system selective coordination and protection;
  - .2 determining short-circuit current ratings to check that electrical distribution equipment can safely withstand level of fault current;
  - .3 preparing, determining and submitting arc flash study with calculations to ensure required electric shock and arc flash protection are provided;

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Electrical Work Analysis and Testing

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- .4 product manufacturers providing equipment inspection, testing, start-up, adjustments and verification;
- .5 independent 3<sup>rd</sup> party testing of electrical distribution system equipment and associated products;
- .6 independent 3<sup>rd</sup> party testing of systems and equipment as noted;
- .7 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;
- .8 coordination of work with testing company and equipment/system manufacturer's authorized technician in performing adjustments and start-up procedures to equipment/systems;
- .9 preparing testing reports and documentation for submission to Consultant.

### **PART 3 - EXECUTION**

#### **3.1 Distribution System Coordination Study and Short Circuit Calculations**

- .1 Prepare final coordination study and short circuit calculations (available fault currents) of system. Perform work to standards of applicable local governing authorities, local electrical inspection authority and CSA Standards.
- .2 Review and survey existing systems and/or obtain where available, coordination study of existing systems to use in ensuring proper protective device coordination and suitable withstand rating for entire existing, additional and revised distribution equipment/systems. Where existing studies are not available, survey existing systems and prepare additional studies as required to provide full and proper coordination and suitable withstand rating of entire existing, revised and additional distribution equipment/systems.
- .3 Final coordination study and short circuit calculations reports to incorporate results and Consultant reviewed comments, into electrical distribution equipment shop drawings, and updated to reflect final equipment being supplied. Check for selective coordination of devices and confirm withstand ratings of equipment meet results from reports. Prepare studies as required to provide full and proper coordination and suitable withstand rating of entire distribution equipment/systems.
- .4 Protective system devices have been selected such that protection is adequate and good coordination is possible, however, since differences do exist between manufacturers, some changes in trip ratings or relay settings may be necessary and are to be carried out. Obtain local electrical utility information on their protective devices and include requirements as necessary.
- .5 Provide and carry out following:
  - .1 prepare a set of coordination curves on K.E. No. 336E Time Current Characteristic graph paper;
  - .2 this is to be accompanied by supporting symmetrical as well as asymmetrical fault current calculation data with tabulations to verify protection of various elements of systems under maximum and minimum fault conditions at various points in systems.

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Electrical Work Analysis and Testing

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- .3 Plot time-current characteristic curves for following:
  - .1 main and feeder protective devices at voltage levels used in distribution system;
  - .2 protective devices associated with largest motor in each MCC, refrigeration machine compressors and largest device in each distribution panel;
  - .3 motor generator protective devices, damage curves and current decrement curves.
- .6 Cooperate with and obtain from manufacturers, list of equipment requiring protective devices in distribution system and prepare coordination curves. Verify that proper withstand ratings of equipment are provided and proper control and protective devices are selected for coordination with protective devices. Include major mechanical equipment in studies and coordinate requirements with Mechanical Division Contractor. Identify required short circuit current ratings to Mechanical Division Contractor and respective Division manufacturers of major equipment.
- .7 It is responsibility of equipment manufacturers to examine plans and specifications to ensure that relays and protective devices being installed in distribution system provide satisfactory coordination.
- .8 Where automatic transfer switches are provided, submit coordination results and available fault current values at locations of transfer switches, to transfer switch manufacturer to ensure that transfer switches provided are of suitable withstand current ratings.
- .9 Document testing, coordination study and arc flash analysis in a report stamped and signed by a Professional Engineer licensed in the Place of Work and authorized by testing company. Report to include test results with properly plotted curves, identified trouble areas of coordination, extensive comments regarding test results and recommendations on best course of remedial action. Submit copies of report to Consultant.
- .10 Acceptable companies to provide this work include:
  - .1 Eaton Electric Services Division;
  - .2 Schneider Electric Services Division;
  - .3 Siemens Electric Services Division;
  - .4 G.T. Woods;
  - .5 AC Tesla;
  - .6 EnKompass Power and Energy;
  - .7 Eastenghouse.

### **3.2 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;

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Electrical Work Analysis and Testing

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- .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 Rectify deficiencies to satisfaction of Owner.
- .3 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.

### **3.3 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 Integrated Systems Testing:
  - .1 Perform testing of integrated systems and equipment in accordance with CAN/ULC-S1001.
  - .2 Engage respective systems or equipment vendors or trades to be onsite during inspection and testing work to perform adjustments or remedial work to correct issues identified by inspection and testing work.
- .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.
- .5 Provide these requirements after each phase (as applicable) to allow Owner option to use area of phase of work. These requirements are also to be provided prior to applying for Certificate of Substantial Performance of the Work of project.



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Electrical Work Analysis and Testing

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- .6 Include for manufacturers authorized technicians of equipment/systems integrated to equipment/systems being tested to be onsite during full integration testing. Coordinate with each manufacturer.
- .7 Rectify deficiencies to satisfaction of Owner.
- .8 When system inspection, testing, start-up and verification specified above is complete, obtain from supplier/manufacturer (or where specified, independent inspection company) a test report with test sheets, and covering verification letter signed by authorized testing technician, stating that system or equipment has been inspected and tested, performs as specified and is ready for acceptance. Include date and time of testing, testing technician's name and specification section number test fulfilled.
- .9 Bind documents under cover and submit copies to Consultant.

### **3.4 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, local electrical inspection authority and CSA Z32 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 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 and devices such as metering, power factor capacitors, UPS, isolated power centres, transfer switches, inverters, central battery systems, generators sets and load banks;
  - .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;

Electrical Work Analysis and Testing

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- .12 verification and certification work of equipment and systems;
- .13 witness testing of EMI testing and verification (signing of report) of test results.
- .3 In addition to above testing and 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.
- .4 Perform services procedures properly documented, and in accordance with manufacturer's instructions and recommendations.
- .5 When performing hi-potential testing, disconnect surge protection devices as recommended by SPD manufacturers.
- .6 Where relays, breakers, etc., do not perform to Consultant reviewed coordination curves as prepared for in coordination study, revise as part of work.
- .7 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. 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.
- .8 Test high voltage cable installation before placing in regular service. Work includes phase verification, grounding verification, hi-pot test of insulation strength to IPCEA Specifications (Leakage Curves to be obtained), and time domain reflectometer tests to give records of cable impedance profiles to draw attention to cable damage. Reference cable manufacturers testing procedures and do not exceed maximum test voltage levels and durations.
- .9 Testing organization to report high voltage cable defects directly to Consultant as soon as such defects are discovered. Re-test affected cables after proper repair. Also, re-test cables in cases where cable damage after installation is suspected. On completion of satisfactory testing of installation, submit a report by testing organization stating that cables concerned have satisfactorily passed required tests and are suitable for service. Submit copies of report to Consultant. Submit recorded test data (properly bound) with report, in each case.
- .10 Test main power transformers before placing in regular service. Work to include voltage ratio test, phase angle test, insulation resistance, oil sampling (liquid type transformer), start-up and other manufacturer's recommended tests.

Electrical Work Analysis and Testing

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- .11 Provide testing and coordination of emergency power distribution system to ensure that system performs in accordance to latest requirements of CSA Standard C282 and CAN/CSA Z32. Ensure that engine-generator set manufacturer and testing and coordination companies co-operate to ensure compliance with CSA requirements. Provide necessary adjustments and coordination to ensure that emergency power distribution system transfers essential loads to emergency power within required response time of loss of normal power.
- .12 Provide visual and mechanical inspection of ground system and verify that it is in compliance with issued documents and local governing electrical code requirements.
- .13 Perform fall-of-potential test or alternative in accordance with IEEE Standard 81 on main grounding electrode or system to determine current status, possible grounding contamination and proper ground resistance value. Perform point-to-point tests to determine resistance between main grounding system and major electrical equipment frames system neutral, and/or derived neutral points. Resistance between main grounding electrode and ground is not to be typically greater than 5 ohms for commercial or industrial systems and 1 ohm or less for generating or transmission station grounds unless otherwise specified. (Reference: ANSI/IEEE Standard 142). Investigate point-to-point resistance values which exceed 0.5 ohm.
- .14 Perform testing of lighting control systems and devices to ensure conformance with ASHRAE 90.1 requirements.
- .15 Coordinate testing of equipment and systems with respective product vendors as required to ensure alliance with product vendor standards.
- .16 Document testing, coordination study and arc flash analysis in a report stamped and signed by a Professional Engineer licensed in the Place of Work and authorized by testing company. Submit copies of report to Consultant. Report to include test results with properly plotted curves, identified trouble areas of coordination, extensive comments regarding test results and recommendations on best course of remedial action. Report must state that testing was successful and Work complies with project documents, applicable CSA standards, and other applicable governing codes and requirements.
- .17 Any work that failed testing that was responsibility of Contractor to be rectified by Contractor and be re-tested and verified, until successful testing, and be at no additional cost to Owner. Rectify deficiencies to satisfaction of Owner and Consultant.
- .18 Acceptable companies to provide equipment and system testing and verification work are to be independent of successful manufacturers providing distribution system equipment and include (unless otherwise approved by Owner, do not use company supplying electrical distribution equipment on project):
  - .1 G.T. Woods;
  - .2 AC Tesla;
  - .3 EnKompass Power and Energy;
  - .4 Eaton Electric Services Division;
  - .5 Schneider Electric Services Division;
  - .6 Siemens Electric Services Division;
  - .7 Eastenghouse.

Electrical Work Analysis and Testing

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### **3.5 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.
- .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, deficiencies and failed test results in distribution system testing report and submit copies to Consultant.
- .7 Contractor to perform remedial work on deficiencies and failed test results and retest, till successful testing, all at no additional cost to Owner.
- .8 Acceptable testing companies are as those listed for distribution system testing work.

### **3.6 Shock and Arc Flash Analysis**

- .1 General:
  - .1 Provide analysis for electric shock and arc flash protection as specified herein, and as required by local governing codes and local governing authorities.
  - .2 Prepare study to determine severity of potential exposure and selecting personal protective equipment (PPE) under general guidelines of governing edition of CSA Z462.
  - .3 Determine arc flash hazard distance and incident energy that workers may be exposed to from electrical equipment under general guidelines of IEEE 1584.
  - .4 Design safety signs and labels for applications to equipment under general guidelines of CSA Z462 and ANSI Z535.4.
  - .5 Incorporate documentation with short circuit calculations and coordination study report submitted to Consultant.
- .2 Arc Flash Hazard Analysis Study:
  - .1 Perform Arc Flash Hazard analysis by calculating arc flash incident energy and arc flash boundaries as outlined in CSA Z462. Analysis to include locations where work could be performed on energized parts of equipment such as switchboards, switchgear, motor-control centres, panelboards, busway and splitters.
  - .2 Retrieve short circuit calculations and clearing times of phase overcurrent devices from short circuit and coordination study specified previously.
  - .3 Arc-Flash Hazard Analysis to include customer owned service entrance equipment down through equipment rated 208 volts with significant locations in 240 V and 208 V systems fed from transformers equal to or greater than 35 kVA.

Electrical Work Analysis and Testing

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- .4 Specify safe working distances based upon calculated arc flash boundary considering incident energy of  $1.2 \text{ cal/cm}^2$ .
  - .5 Include Arc Flash Hazard analysis calculations for maximum and minimum contributions of fault current magnitude. Minimum calculation to assume that utility contribution is at a minimum and a minimum motor load. Conversely, maximum calculation to assume a maximum contribution from utility and motors to be operating under full-load conditions. Other switching scenarios are to be included as necessitated by power system design and layout.
  - .6 Arc Flash computation to include both line and load side of main breaker, where necessary.
  - .7 Arc Flash calculations to be based on overcurrent protective device clearing time per coordination study.
- .3 Arc Flash Warning Labels:
- .1 Provide minimum 90 mm x 127 mm (3.5" x 5") thermal transfer type label of high adhesion polyester for each work location analysed.
  - .2 Typically, use red header label with "DANGER, ARC FLASH HAZARD" wording. Typically, use orange header label with wording, "WARNING, ARC FLASH HAZARD", and include following information:
    - .1 Location/equipment designation;
    - .2 nominal voltage;
    - .3 arc flash protection boundary;
    - .4 incident energy;
    - .5 working distance;
    - .6 engineering report number, revision number and issue date.
  - .3 Machine print labels with no field markings. Submit as shop drawing submissions, sample labels and proposed nomenclature for Owner approval and Consultant review.
  - .4 Provide Arc Flash labels typically for following equipment (and base labels on recommended overcurrent device settings):
    - .1 panelboards;
    - .2 motor control centres/VFDs;
    - .3 distribution transformers;
    - .4 switchboards;
    - .5 transfer switches;
    - .6 genset control equipment;
    - .7 switchgear;
    - .8 high voltage equipment;
    - .9 other equipment as outlined on drawings, and required by local governing authorities.

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- .5 Document in report, method of calculating and data to support information for labels.
- .4 Acceptable companies to provide this work are to be successful manufacturer of electrical distribution system equipment and include:
  - .1 G.T. Woods;
  - .2 AC Tesla;
  - .3 EnKompass Power and Energy;
  - .4 Eastenghouse.

**END OF SECTION**

Electrical Work Commissioning

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## **PART 1 - GENERAL**

### **1.1 Application**

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

### **1.2 Reference**

- .1 Refer to commissioning requirements specified in Division 01.

### **1.3 Commissioning Agent Involvement Versus Warranty Obligations**

- .1 Involvement of Commissioning Agent performing duties as described in this Section is not in any way to void or alter any Contractual warranty obligations.

### **1.4 Submittals**

- .1 Submit to Commissioning Agent, at same time as submittal to Consultant, one copy of each shop drawing or product data sheet associated with equipment or systems to be commissioned.
- .2 Submit for review, a Commissioning Plan with schedule, commissioning procedures for commissioning events, and a copy of Commissioning Agent's commissioning data sheets for equipment/systems to be commissioned.
- .3 Submit a list of commissioning instruments and for each instrument, indicate purpose of instrument and include a recent calibration certificate.
- .4 Submit equipment and system manufacturer's start-up and test report sheets for review a minimum of one month prior to equipment and system start-up procedures.
- .5 After start-up and successful pre-functional performance testing and submittal of completed forms, submit, for each system or subsystem, a letter to confirm that pre-functional performance testing has been successfully completed and system or subsystem is ready for functional performance testing and commissioning process to commence.

### **1.5 Definitions**

- .1 Commissioning: process of demonstrating to Owner and Consultant, for purpose of final acceptance, by means of successful and documented functional performance testing, that systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of Contract Documents, as further described below.
- .2 Commissioning Agent: commissioning authority who will supervise commissioning process, and who will recommend final acceptance of commissioned electrical work.
- .3 Start-Up and Adjusting: process of equipment manufacturer's/supplier's technical personnel, with Contractor, starting and operating equipment and systems, making any required adjustments, documenting process, and submitting manufacturer's/supplier's start-up reports to confirm that equipment has been properly installed and is operational as intended.

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Electrical Work Commissioning

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- .4 Pre-Functional Performance Testing: testing, adjusting and operating of components, equipment, systems and/or subsystems, by Contractor, after start-up but before functional performance testing, to confirm that components, equipment, systems and/or subsystems operate in accordance with requirements of Contract Documents, including modes and sequences of control and monitoring, interlocks, and responses to emergency conditions, and including submittal of pre-functional performance testing documentation sheets.
- .5 Functional Performance Testing: a repeat of successful pre-functional performance testing by Contractor, in presence of Commissioning Agent and Consultant with completed Commissioning Agent's commissioning documentation sheets to document, validate, and verify that equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance.
- .6 Commissioning documentation sheets: prepared sheets for pre-functional performance testing and for functional performance testing supplied by Commissioning Agent for each piece of equipment/system to be commissioned, each sheet or set of sheets complete with Project name and number, date of commissioning, equipment/system involved, equipment/system name and model number, equipment identification as per drawings, and, for each commissioning procedure listed, a column giving expected data as per Contract Documents, a column to fill in observed data during commissioning, and space for signatures of Contractor and Commissioning Agent.
- .7 Systems Operating Manual: a manual prepared by Commissioning Agent to present an overview of building electrical systems and equipment to be used by building maintenance personnel to assist them in daily operation of systems.
- .8 Validate: to confirm by examination and witnessing tests correctness of equipment and system operation.

## **1.6 Commissioning Agent**

- .1 Retain services of a qualified Commissioning Agent.

## **1.7 Quality Assurance**

- .1 Commissioning work is to be in accordance with requirements of following:
  - .1 Z320, Building Commissioning Standard and check sheets;
  - .2 ASHRAE Guideline 0, The Commissioning Process;
  - .3 Z8001 – Commissioning of Health Care Facilities;
  - .4 Owner designated Commissioning Agent.
- .2 Commissioning Agent is to meet following qualifications:
  - .1 be member of Professional Engineers Association in Province of the Work;
  - .2 be member of Building Commissioning Association, and Certified Commissioning Professional (CCP) as designated by Building Commissioning Association;
  - .3 have minimum of five years of successful documented commissioning experience on projects of similar size and complexity as this Project;
  - .4 supply qualified Professional Engineer and Building Commissioning Association Certified Commissioning Professional (CCP) or ASHRAE Commissioning Project Management Professional (CPMP) on site to supervise commissioning process.



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## **1.8 Commissioning Objectives**

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

## **1.9 Testing Equipment**

- .1 Supply instruments and test equipment required to conduct start-up, testing and commissioning procedures.

## **PART 2 - PRODUCTS**

### **2.1 Not Used**

## **PART 3 - EXECUTION**

### **3.1 Commissioning**

- .1 Commission work in accordance with requirements of this Section and other issued related Sections and as required by Commissioning Agent.
- .2 Prerequisites to successful completion of commissioning are as follows:
  - .1 submittal of signed start-up and test reports;
  - .2 completion of electrical distribution system testing and coordination study;
  - .3 permanent electrical and control connections of equipment;
  - .4 successful completion and documentation of pre-functional performance testing;
  - .5 submittal of letters to Consultant certifying that systems and subsystems have been started, tested, adjusted, successfully pre-functional performance tested, are ready for functional performance testing, and are in accordance with requirements of Contract Documents.

### **3.2 Phasing of Commissioning**

- .1 Project to be constructed in phases as described in Specification. Phase commissioning work to suit progress and phases of work.

### **3.3 Deficiencies Listed During Commissioning**

- .1 Correct deficiencies listed by Consultant and Commissioning Agent during commissioning process within 15 calendar days of notification unless agreed otherwise with Consultant, and when deficiencies have been corrected, notify Consultant and Commissioning Agent.

### **3.4 Systems to be Commissioned**

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Electrical Work Commissioning

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- .1 Electrical systems to be commissioned include systems as specified in Electrical Divisions of Specification. Specific commissioning procedures are to be as directed by Commissioning Agent. General commissioning procedures for typical equipment and systems include but are not limited to:
  - .1 Electrical Distribution Switchgear and Switchboards:
    - .1 Check and record nameplate data.
    - .2 Check and inspect equipment to ensure they are installed in accordance with manufacturer's recommendations and to Code requirements.
    - .3 Check installation is complete and is ready and safe to carry out testing.
    - .4 Check mechanical operation of switches and breakers.
    - .5 Check indication lights and control switches for correct functions.
    - .6 Set protection devices to correct values according to coordination study or as instructed by Consultant; properly set protection devices prior to energization of equipment.
    - .7 Perform tests as required by Commissioning Agent.
  - .2 High Voltage Cables:
    - .1 Visually inspect cable jacket, cable sheath, and insulation in cables for signs of corrosion, abrasion, mechanical damage, and overheating.
    - .2 Check for correct cable installation and termination.
    - .3 Check and record cable sizes, types and method of installation.
    - .4 Perform tests as required by Commissioning Agent.
  - .3 Motor Control Centres (MCC) and Drives:
    - .1 Check and record nameplate data.
    - .2 Check and inspect equipment to ensure it is installed in accordance with manufacturer's recommendations and to Code requirements.
    - .3 Check installation is complete and is ready and safe to carry out testing.
    - .4 Check mechanical operation of switches and breakers.
    - .5 Check connecting bolts are tightened to correct torque values.
    - .6 Check indication lights and control switches for correct functions.
    - .7 Set protection devices to correct values according to coordination study or as instructed by Consultant. Properly set protection devices prior to energization of switchboards.
    - .8 Check and set overload relays provided. Set and record overload relays to correct settings.
    - .9 Check control functions for proper functioning and connection.
    - .10 Check interface contacts for control and indications for proper functioning and connections.
    - .11 Check motor running current; readjust overload relays as necessary.

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- .12 Coordinate testing and commissioning work with Mechanical Divisions, to ensure full testing and commissioning work is completed to satisfaction of Commissioning Agent.
- .13 Perform tests as required by Commissioning Agent.
- .4 Distribution Cables:
  - .1 Check for correct cable installation and termination.
  - .2 Check and record cable sizes, types and method of installation.
  - .3 Check and confirm installed cable sizes are of adequate rating, taking into consideration of type of cable, method of installation, correction factors and any other Code requirements.
  - .4 Grounding test to ensure equipment, conduit and cable armour/sheath, if applicable, are properly grounded.
  - .5 Perform tests as required by Commissioning Agent.
- .5 Transformers:
  - .1 Check and record nameplate data.
  - .2 Check and record sizes and types of primary and secondary protection devices, conductor sizes and types.
  - .3 Test windings on both primary and secondary terminals.
  - .4 Measure primary and secondary winding resistances.
  - .5 Sound level test for different points at 1 m (3.3') away from transformers.
  - .6 Check and record transformer voltage and load current. Check and record transformer on-load temperatures.
  - .7 Perform tests as required by Commissioning Agent.
- .6 Gensets:
  - .1 Check and record alternator, engine, control panel, switchboard, and battery nameplate data.
  - .2 Check and ensure that generator installation, grounding system, associated supply and exhaust air system, fuel system and room are completed prior to carrying out test.
  - .3 Complete generator installation is to be completed prior to carrying out generators site tests. Installations include generators, electrical installation, fuel supply system, ventilation system, exhaust system, automatic control and indication systems, and interface with other systems installations.
  - .4 Test protective devices and circuits on site by actually simulating a fault condition on devices.
  - .5 Test interfaces with transfer switches for correct starting, power transfer, retransfer, and shut down of generators after power is restored.
  - .6 Test interface controls and indications with building management system, fire alarm system, elevator control system and any other systems as specified.

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- .7 Dummy load test at full load operation.
- .8 Test paralleled units, with dummy loading on generators to be shared amongst generators.
- .9 Load test generators in accordance with CSA C282, Z32 (for Healthcare projects) and Z8001.
- .10 Check sound level at various loads.
- .11 Perform tests as required by Commissioning Agent.
- .7 Auto Transfer Switches:
  - .1 Check and record nameplate data.
  - .2 Check and test switch for correct alignment and correct mechanical operation of switch in different positions.
  - .3 Test electrical control, indication and interface signals with generators, fire alarm panel, elevator control panels, building management panel or other interface panels.
  - .4 Test for correct phase sequence and voltage.
  - .5 Perform interface test with generator for starting and stopping, in accordance with CSA 282 and Z32 (Healthcare projects).
  - .6 Perform tests as required by Commissioning Agent.
- .8 Uninterruptible Power Supply Equipment:
  - .1 Check and record nameplate data.
  - .2 Test electrical control, indications and operations as per Specification requirements. Confirm battery back-up capacity.
  - .3 Check condition of back-up batteries and connections.
  - .4 Check and test EPO switch for correct operation.
  - .5 Perform interface test with emergency power system.
  - .6 Perform tests as required by Commissioning Agent.
- .9 Patient Care Areas Power Supply Systems:
  - .1 Check and record nameplate data.
  - .2 Carry out following tests where applicable:
    - .1 conductor insulation resistance test;
    - .2 voltage drop test;
    - .3 circuit breaker mechanical operation test;
    - .4 verification of panelboard directory;
    - .5 receptacle test pin and plug pull out test;
    - .6 polarity test;
    - .7 voltage difference limits test;
    - .8 ground return path voltage rise test;

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- .9 impedance to ground test;
- .10 hazard index monitoring test;
- .11 ground fault circuit interrupter test;
- .12 perform tests as required by Commissioning Agent.
- .10 Distribution Panelboards and Branch Circuit Panelboards:
  - .1 Check and record nameplate data.
  - .2 Check and test to verify panelboard directory is correct.
  - .3 Include directory in test records. Directory to contain size of each breaker, equipment served, cable type and size.
  - .4 Check and test voltage drop is within specified limit from service entrance switchboard to branch panelboards.
  - .5 Test branch circuits voltage drop is within requirements.
  - .6 Megger test branch circuits.
  - .7 Perform tests as required by Commissioning Agent.
- .11 Coordination Study, Arc Fault Calculations Report and On-Site Testing:
  - .1 Testing company to prepare coordination study and arc fault calculations report as specified in Specification.
  - .2 Testing company to carry out on site third party testing.
  - .3 Check and measure and record prospective fault level at service entrance switchboards, motor control centres, transformers, auto transfer switches, generator switchboard and control panels; distribution panels and branch circuit panelboards.
  - .4 Record and set breakers, fuse ratings, and protection devices to ensure discrimination of electrical distribution system.
  - .5 Provide test records for measured prospective fault level and indicate fault ratings of installed equipment such as switchboards, panels, switches, breakers for above systems to confirm adequacy of fault rating of installed equipment.
  - .6 Perform tests as required by Commissioning Agent.
- .12 Lightning Protection System:
  - .1 A certified installer to install and verify lightning protection system in accordance to Lightning Rod Act.
  - .2 Perform a ground resistance test in accordance to CSA Z8001.
  - .3 Issue a certificate of approval upon completion.
- .13 Lighting Systems:
  - .1 Check and verify lighting control systems and dimming systems.
  - .2 Check and verify lighting fixtures are connected and switched properly.
  - .3 Check and verify automatic controls are connected and functioning properly.

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- .4 Check and verify emergency lighting system, including battery lighting system, are connected and functioning properly.
- .5 Carry out lighting level tests as required and directed by Commissioning Agent.
- .6 Check compliance with ASHRAE 90.1.
- .7 Check and record nameplate data.
- .8 Perform tests as required by Commissioning Agent.
- .14 Nurse Call System:
  - .1 Check main panels for proper installation, wiring identification, wire harnessing, and emergency power feed.
  - .2 Test and document each type of alarm from each station, noting station number(s) at which signal has been received.
  - .3 Test specified sequences of system as specified in Specification.
  - .4 Check for integration to other building systems.
  - .5 Record and document operation of system.
  - .6 Check and record nameplate data.
  - .7 Perform tests as required by Commissioning Agent.
- .15 Security Systems (Access Control and CCTV):
  - .1 Check main panels for proper installation, wiring identification, wire harnessing, and emergency power feed.
  - .2 Test and document each type of alarm from each station, noting station number(s) at which signal has been received.
  - .3 Check field devices for proper operation.
  - .4 Test specified sequences of system as specified in Specification.
  - .5 Check for integration to other systems.
  - .6 Check and record nameplate data.
  - .7 Check and report panel enclosure is suitable for environment in which it is installed.
  - .8 Perform tests as required by Commissioning Agent.
- .16 Fire Alarm System:
  - .1 Check panels for proper installation, wiring identification, wire harnessing, and emergency power feed.
  - .2 Test and document each type of alarm from each device, noting device addresses at which signal has been received.
  - .3 Check and record nameplate data.
  - .4 Check and report panel enclosure is suitable for environment in which it is installed.
  - .5 Test specified sequences of system as specified in Specification.

### Electrical Work Commissioning

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- .6 Perform system verifications and tests according to CAN/ULC-S536 and S537.
- .7 Perform tests as required by Commissioning Agent.
- .17 Other Systems:
  - .1 Check and record nameplate data.
  - .2 Check panels for proper installation, wiring identification, wire harnessing, and emergency power feed (as required).
  - .3 Check field devices for proper operation.
  - .4 Test specified sequences of system as specified in Specification.
  - .5 Perform tests as required by Commissioning Agent.
  - .6 Perform tests on following systems, where applicable:
    - .1 public address systems;
    - .2 intercommunication systems;
    - .3 clock systems;
    - .4 audio visual systems;
    - .5 telemetry systems;
    - .6 patient wandering systems;
    - .7 bus duct system;
    - .8 network structured cabling systems;
    - .9 electric heat tracing/snow melting systems;
    - .10 monitoring systems;
    - .11 other systems and equipment supplied under Work of Project.
  - .7 In addition to requirements of Electrical Divisions, test and commission following items:
    - .1 electrical devices supplied in equipment under work of Divisions other than Electrical Divisions;
    - .2 Owner's supplied equipment as noted or directed by Consultant and/or Owner.

### 3.5 Commissioning Process

- .1 Perform commissioning process in stages and include, but not be limited to, following:
  - .1 Stage 1: Commissioning of equipment/systems as listed in this Section, which is a prerequisite to an application for Substantial Performance of the Work and includes supervising and validating results of functional performance testing, and submittal of reviewed Systems Operating Manual.
  - .2 Stage 2: Commissioning work to be performed 12 months after issue of a Certificate of Substantial Performance of the Work and which includes supervision of Contractor's "fine tuning" of equipment/systems through seasonal occupancy, and any other such work to achieve optimal comfort and performance conditions.

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- .3 Stage 3: Successful completion of satisfactory equipment/system operation during first month after issue of a Certificate of Total Performance of the Work.
- .4 Stage 4: Successful completion of satisfactory equipment/system operation during third month after issue of a Certificate of Total Performance of the Work.
- .5

### **3.6 Responsibilities of Commissioning Agent**

- .1 During construction phase Commissioning Agent is to:
  - .1 review Contractor's shop drawings for commissioning related issues, and report any such issues to Consultant;
  - .2 as soon as possible after project start-up, prepare and issue a Commissioning Plan based on Contractor's construction schedule;
  - .3 prior to tests, supply pre-functional performance test commissioning data sheets for all equipment and systems to be commissioned to Contractor;
  - .4 monitor and inspect installation on a regular basis throughout construction stages, issue reports identifying any issues which may have an impact on commissioning process, and work with project team to expeditiously resolve any problems that may arise due to site conditions;
  - .5 arrange with Contractor for on-site commissioning meetings on an as-required basis, to be attended by Contractor and applicable subcontractors, Owner, and Consultant, chair meetings, and prepare and distribute meeting minutes to all attendees;
  - .6 witness and validate tests, identify deficiencies, and issue progress reports;
  - .7 coordinate commissioning scheduling with Contractor;
  - .8 review pre-functional performance test commissioning data sheets submitted by Contractor, then witness and supervise functional performance testing and supervise and direct commissioning process, validate commissioning procedures, witness completion of commissioning data sheets by Contractor, and sign completed data sheets;
  - .9 perform a preliminary review of Contractor's O & M Manuals, before they are issued to Consultant, and issue any comments to Consultant;
  - .10 coordinate with Contractor and Owner training and instructions by Contractor and his equipment and system manufacturers/suppliers to Owner's operating and maintenance personnel, and comment on quality of training and instructions to Consultant;
  - .11 prepare and issue Systems Operation Manual to Owner prior to equipment and system training by Contractor.
- .2 During post construction phase Commissioning Agent is to:
  - .1 prepare and issue final report on commissioning, identifying any deficiencies that remain outstanding;
  - .2 recommend any training and/or instructions to be given to Owner's operating and maintenance personnel in addition to training and instructions already given;



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- .3 after Substantial Performance of the Work, witness system checks and validate documentation by Contractor as follows:
  - .1 once during first month of building operation;
  - .2 once during third month of building operation;
  - .3 once between fourth and tenth month of building operation but during a season opposite to first or third month visits.
- .4 ensure any deficient work resulting from system checks described above are corrected;
- .5 3 months after Substantial Performance of the Work, attend a question and answer session(s) with Contractor to answer any questions and concerns related to commissioning work from Owner's operating personnel.

### **3.7 Responsibilities of Contractor**

- .1 During construction phase Contractor is to:
  - .1 prepare and submit an installation schedule which is to include time schedule for each activity with lead and lag time allowed and indicated, shop drawing and working detail drawing submissions, and major equipment factory testing and delivery dates;
  - .2 prepare and submit a commissioning schedule which is to include a time schedule coordinated with installation schedule referred to above, and allowances for additional time for re-tests as may be required, and update schedule on a monthly basis as required;
  - .3 when requested by Commissioning Agent, arrange site commissioning meetings with Owner, Consultant, and applicable subcontractors present, to be chaired by Commissioning Agent who will also prepare and distribute meeting minutes;
  - .4 promptly correct reported deficient work, and report when corrective work is complete;
  - .5 where required by Codes and/or Specification, retain equipment manufacturers/suppliers or independent third parties to certify correct installation of equipment/systems;
  - .6 under supervision of equipment manufacturers/suppliers, start-up and adjust all equipment to design requirements, and submit start-up sheets which include all equipment data such as manufacturer and model number, serial number where applicable, and performance parameters, all signed by equipment manufacturer/supplier and Contractor;
  - .7 complete Commissioning Agent's commissioning data sheets for all multiple items of smaller equipment, submit sheets to Commissioning Agent, accompany Commissioning Agent for an on-site check of data sheet information for each type of equipment, and perform any corrective action required as a result of site checks;
  - .8 perform system testing and adjusting, and when complete, issue a copy of final report to Commissioning Agent for review and a site check of results, and perform any corrective work required as a result of site checks by Commissioning Agent;

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- .9 in accordance with updated commissioning schedule and actual progress at site, certify in writing to Consultant and Commissioning Agent that equipment and/or systems are complete, have been checked, started and adjusted, successfully pre-functional performance tested and documented, and are ready for functional performance testing and commissioning procedures, giving Consultant and Commissioning Agent a minimum of 5 working days' notice;
- .10 perform system and subsystem functional performance testing in presence of Commissioning Agent and under supervision of Commissioning Agent, and submit to Consultant and Commissioning Agent, completed and signed functional performance testing and commissioning data sheets (issued by Commissioning Agent) and also signed by Commissioning Agent.
- .2 During post construction phase Contractor is to:
  - .1 optimize system operation in accordance with building's occupant's needs and comments using System Operation Manual prepared by Commissioning Agent as reference;
  - .2 complete commissioning procedures, activities, and performance verification procedures that were delayed or not concluded during construction phase;
  - .3 accompanied by Commissioning Agent, complete system checks and "fine tuning" with signed documentation as follows:
    - .1 once during first month of building operation;
    - .2 once during third month of building operation;
    - .3 once between fourth and tenth months in a season opposite to first and third month visits.
  - .4 correct deficiencies revealed by system checks described above, and, where required, involve equipment manufacturer's/supplier's during corrective actions, and report completion of corrective work;
  - .5 3 months after Substantial Completion of the Work conduct a question and answer session(s) at building with Owner's operating and maintenance personnel, with duration of session(s) dictated by number of questions and concerns that have to be addressed.

**END OF SECTION**

## Lighting Controls

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### **PART 1 - GENERAL**

#### **1.1 Submittals**

- .1 Submit shop drawings for products specified in this Section. In addition to requirements of Section 26 00 10, include for copies of documents of respective manufacturers confirming complete compatibility between lighting controls and luminaires.

#### **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 LED/lamp manufacturers, LV relay panel manufacturers, switches/timers manufacturers and dimmer/light sensor/occupancy sensor control manufacturers to ensure that components are compatible with each other and that interconnections do not adversely affect performance, life or any warranties.

### **PART 2 - PRODUCTS**

#### **2.1 Standalone Wall Box Dimmers**

- .1 Lutron Electronics Co. "Nova-T" Series, ULC listed and labelled, CSA certified wall box dimmers as follows:
  - .1 of type and size to control and suit intended connected loads;
  - .2 air gap accessible without removing faceplate, to meet UL20 and UL1472 short circuit test requirement for snap switches;
  - .3 withstand voltage surges up to 600 V and current surges up to 200 A as per ANSI/IEEE C62.41;
  - .4 voltage regulated;
  - .5 power failure memory;
  - .6 LC filtering to minimize RFI;
  - .7 linear slide with smooth and continuous square law dimming curve operation;
  - .8 snap on faceplate (seamless multi-gang at locations with multiple devices);
  - .9 finish to Consultant's direction.
- .2 Where noted for applications of multiple wall box dimmers located in one location, provide CSA certified, NEMA 1 type, flush wall mounting, electrical cabinet with hinged locking front door, of painted enamel painted steel construction, complete with conduit knockout entries, flush trim and sized to accommodate dimmers. Refer to applicable drawing detail.
- .3 Acceptable manufacturer is Lutron.

#### **2.2 Low Voltage Dimmers**

- .1 Lutron Electronics Co. DCLV-2 Series, ULC listed and labelled, CSA certified low voltage dimmers as follows:
  - .1 decorative rocker style;
  - .2 programmed to default to Manual-On setting;

### Lighting Controls

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- .3 if switched to Auto-On mode, defaults to 50% Partial-On if no adjustments are made, and if connected to sensor, lights fade on to preset level and fade off, based on occupancy;
  - .4 type to control and suit intended connected loads;
  - .5 24 VDC input and 0 to 10 V dimming control;
  - .6 LED indicator light;
  - .7 recalls last-used light level (preset);
  - .8 two-second fade rate;
  - .9 snap on decorative type faceplate;
  - .10 compatible with and connects to power pack and emergency lighting control units;
  - .11 input connections for occupancy sensors;
  - .12 finish to Consultant's direction.
- .2 Acceptable manufacturers are:
- .1 Legrand-Watt Stopper;
  - .2 Lutron;
  - .3 Acuity nLight / Sensor Switch;
  - .4 Leviton;
  - .5 Philips;
  - .6 Hubbell.

### 2.3 Dimming Wall Switch Occupancy Sensor

- .1 Legrand Watt Stopper, CSA certified, ULC listed, series DW-311, dual technology dimming wall switch sensor with features and functionality as follows:
- .1 turn lights OFF and ON based on occupancy and allow user to increase or decrease lighting level; factory default operation is for Manual-ON mode, so that users turn light on only when needed;
  - .2 combines passive infrared (PIR) and ultrasonic occupancy detection technologies and works with 0-10 VDC dimming drivers and ballasts to control lighting loads including LEDs;
  - .3 120/347VAC voltage operation to suit specific project design applications;
  - .4 variety of control options including Auto-ON operation, walk-through and test mode; additional settings allow choice of which sensing technologies hold ON or retrigger lighting;
  - .5 vandal resistant colour matched lens and low profile design;
  - .6 coverage: major motion: PIR 10 m x 9 m (35' x 30'), Ultrasonic 6 m x 6 m (20' x 20'); minor motion: PIR 6 m x 4.5 m (20' x 15'), Ultrasonic 4.5 m x 4.5 m (15' x 15');
  - .7 selectable walk-through mode turns lights off three minutes after room is initially occupied if no motion is detected after first 30 seconds;
  - .8 test mode allows quick and easy verification of coverage;

### Lighting Controls

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- .9 selectable audible and/or visual alerts for impending shutoff;
- .10 LED indicates occupancy detection;
- .11 service mode allows sensor to operate as a service switch in unlikely event of failure;
- .12 adjustable time delays and sensitivity;
- .13 complete with required mounting accessories.

## 2.4 Occupancy Sensors (Standard)

- .1 Legrand - Watt Stopper, CSA certified devices to provide automatic control of lighting with following components:
  - .1 power and slave packs;
  - .2 dual technology occupancy sensors;
  - .3 controls and daylight sensors;
  - .4 wiring in conduit and mounting hardware.
- .2 For applications in general areas: ceiling mounted, DT-355 series, dual technology type sensors as follows:
  - .1 line voltage operation;
  - .2 combination passive infrared and ultrasonic technologies;
  - .3 when both PIR and ultrasonic technologies detect occupancy, lights turn ON automatically; once lights are ON, detection by either technology holds lights ON until occupancy is no longer detected and time delay elapses;
  - .4 360° lens area coverage, extending out up to 6 m (20') and area of 92.9 m<sup>2</sup> (1000 ft<sup>2</sup>);
  - .5 Dip switches for setup;
  - .6 low profile ceiling mounting design;
  - .7 integral light sensor;
  - .8 adjustable sensitivity and digital time delay;
  - .9 walk-through mode;
  - .10 LED indication of occupancy detection.
- .3 For applications of wall mounting and control of two lighting loads: DW-200 Series dual technology occupancy sensors as follows:
  - .1 line voltage operation;
  - .2 dual relay, infrared and ultrasonic technologies wall switch sensor for controlling 2 independent light loads/circuits;
  - .3 when both PIR and ultrasonic technologies detect occupancy, lights turn ON automatically; once lights are ON, detection by either technology holds lights ON until occupancy is no longer detected and time delay elapses;
  - .4 colour matched vandal resistant lens and low profile design;

### Lighting Controls

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- .5 wide dispersion lens area coverage, extending out up to 10 m (35') and area of 37 m<sup>2</sup> (400 ft<sup>2</sup>);
  - .6 adjustable time delays and sensitivity;
  - .7 manual pushbutton operation (override);
  - .8 selectable walk-through, test and presentation modes;
  - .9 complete with required mounting accessories.
- .4 For applications in washrooms and small storage rooms: wall mounted DSW-301 series dual technology type wall switch occupancy sensors as follows:
- .1 line voltage operation to suit specific project design applications and LED type loads;
  - .2 wall switch sensor turns lights OFF and ON based on occupancy;
  - .3 multi-way control from one up to four control locations;
  - .4 factory default operation is for Manual-ON mode, so that users turn light on only when needed;
  - .5 variety of control options including Auto-ON operation, walk-through and test mode; additional settings allow choice of which sensing technologies hold ON or retrigger lighting;
  - .6 colour matched vandal resistant lens and low-profile design;
  - .7 wide dispersion lens area coverage for major motion, extending out up to 6 m (20') and area of 37 m<sup>2</sup> (400 ft<sup>2</sup>) for ultrasonic; 10.5 m (35') and area of 93 m<sup>2</sup> (1000 ft<sup>2</sup>) for PIR;
  - .8 passive infrared and ultrasonic technologies;
  - .9 LED indicator of occupancy detection;
  - .10 adjustable time delays and sensitivity;
  - .11 manual pushbutton operation (override);
  - .12 complete with required mounting accessories.
- .5 For applications of wall mounting and control of two lighting loads: DSW-302 series dual technology dual relays type wall switch occupancy sensors as follows:
- .1 includes two relays for control of two separate lighting loads or circuits;
  - .2 line voltage operation to suit specific project design applications and LED type loads;
  - .3 wall switch sensor turns lights OFF and ON based on occupancy;
  - .4 multi-way control from one up to four control locations;
  - .5 factory default operation is for Manual-ON mode, so that users turn light on only when needed;
  - .6 variety of control options including Auto-ON operation, walk-through and test mode; additional settings allow choice of which sensing technologies hold ON or retrigger lighting;
  - .7 colour matched vandal resistant lens and low-profile design;

### Lighting Controls

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- .8 wide dispersion lens area coverage for major motion, extending out up to 6 m (20') and area of 37 m<sup>2</sup> (400 ft<sup>2</sup>) for ultrasonic; 10.5 m (35') and area of 93 m<sup>2</sup> (1000 ft<sup>2</sup>) for PIR;
  - .9 passive infrared and ultrasonic technologies;
  - .10 LED indicator of occupancy detection;
  - .11 adjustable time delays and sensitivity;
  - .12 manual pushbutton operation (override);
  - .13 complete with required mounting accessories.
- .6 For corridors or wide space coverage: Ceiling mounted, WT series, ultrasonic technology type sensors as follows:
- .1 low voltage operation;
  - .2 ultrasonic technologies;
  - .3 when ultrasonic technology detects occupancy, lights turn ON automatically; once lights are ON, detection holds lights ON until occupancy is no longer detected and time delay elapses;
  - .4 corridor applications to include linear lens area coverage, extending out up to 13.5 m (45') in 2 directions;
  - .5 wider spaces applications to include wide dispersion coverage to suit space, up to 200 m<sup>2</sup> (2200 ft<sup>2</sup>);
  - .6 low profile ceiling mounting design;
  - .7 integral light sensor;
  - .8 adjustable digital time delay;
  - .9 LED indication of occupancy detection;
  - .10 isolated relay for interconnection to auxiliary control systems where required.
- .7 For outdoor control of lighting: Series "EW" outdoor motion sensor:
- .1 low voltage or line voltage operation to suit specific project design applications.
  - .2 weatherproof and raintight enclosure;
  - .3 operating temperature from minus 40°C to 54°C (-40°F to 130°F);
  - .4 adjustable head,
  - .5 with minimum 270° of coverage;
  - .6 adjustable light level from 5.4 lux to 2150 lux (0.5 fc to 200 fc);
  - .7 isolated relay with NO and NC outputs;
  - .8 13 mm (1/2") threaded conduit nipple for attachment to standard weatherproof electrical box with faceplate.
- .8 Where required, power packs to be self-contained, 120 VAC/24 VDC (or of voltage shown on drawings) transformer relay system. Slave packs to contain isolated relay. System to allow one sensor to control luminaires circuited to both essential power circuits and normal power circuits. Features also include:

### Lighting Controls

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- .1 switches lighting or plug loads On and Off in response to low voltage control inputs;
- .2 enables Manual-On sequences of operation, as well as Hold-On, Hold-Off, load shed applications and bi-level switching;
- .3 field-selectable Auto-On or Manual-On operation;
- .4 LED indicates status of relay or presence of low voltage overcurrent;
- .5 plenum rated.
- .9 Override switches to be wall mounting in single gang recessed outlet boxes.
- .10 Day light sensors to be provided where required for dimming or controlling lights in areas of windows and atriums/sky lights.
- .11 Where both normal and emergency power circuited luminaries exist, provide emergency power control unit that allows sensor to control both emergency power circuited luminaries as well as normal power circuited luminaries, and when normal power is lost, forces on emergency power circuited luminaries.
- .12 Relays to be provided as required to integrate sensors to BAS. Coordinate exact requirements with central lighting control system vendor and BAS vendor.
- .13 Wiring in conduit, mounting hardware and ancillary devices to be provided as per manufacturer's requirements.
- .14 System to be complete with initial 1 year parts and labour warranty, with additional extended 5 years parts warranty.
- .15 Include for and arrange for manufacturer's authorized representative to perform on site testing, verification and certification of installed system. Refer to Part 3 installation article for additional requirements.
- .16 Where sensors are interconnected to dimming system, ensure that they are 100% compatible with respective control systems, dimmers and ballasts. Confirm with respective equipment manufacturers and obtain in writing that such integrations are acceptable to each manufacturer.
- .17 Where devices are connected to central lighting control system, acceptable device manufacturers to be as recommended by manufacturers of central lighting control system.
- .18 Generally, acceptable manufacturers are:
  - .1 Legrand-Watt Stopper;
  - .2 Acuity nLight / Sensor Switch;
  - .3 Leviton;
  - .4 Philips;
  - .5 Lutron;
  - .6 Hubbell;

## 2.5 Low Voltage Lighting Relays and Switches

- .1 Legrand Watt Stopper, CSA certified, factory tested relays and associated devices for low voltage lighting control, as follows:



### Lighting Controls

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- .1 specification grade, heavy duty, 20 ampere rated plug-in relays complete with auxiliary contacts to provide status indication;
  - .2 24 V, momentary contact, switches, multi ivory pushbutton type with pilot and location light LEDs, and removable lens cap for labelling each switch with laminated tape;
  - .3 decorative style, Lexan screwless wall plates;
  - .4 type 302 stainless steel wall plates, number of gang as required, suitable for switches specified and complete with mounting brackets and matching screws;
  - .5 power supplies sized as required;
  - .6 wiring in conduit, in accordance with system manufacturer's requirements;
  - .7 NEMA 1, electrical box sized to accommodate system components and spare future 10%; identify box cover with engraved nameplate; include drip shield for surface mounted boxes.
- .2 Acceptable manufacturers are:
- .1 Legrand Watt Stopper;
  - .2 Philips;
  - .3 Hubbell;
  - .4 Lutron;
  - .5 Acuity nLight;
  - .6 Leviton.

## 2.6 Dimming System Provisions

- .1 Supply and installation of dimming system is part of Work of Division 11. Issued separately, are documents identifying electrical requirements to be provided by Electrical Contractor. Obtain such documents from Consultant and include for respective work.
- .2 Be responsibilities for, but not be limited to, providing following items to accommodate installation of dimming system:
  - .1 system conduit;
  - .2 system device backboxes;
  - .3 system grounding requirements;
  - .4 system feeder requirements;
  - .5 coordination of conduit, box and system power requirements with Division 11 successful system tenderer;
  - .6 installation of control cables as specified in Division 11.
- .3 For product general specifications, refer to respective sections for products, requirements of Division 11 and/or issued drawings.

## PART 3 - EXECUTION

### 3.1 Installation of Wall Box Dimmers and Stand Alone Dimmers

### Lighting Controls

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

#### **3.2 Installation of Dimming Wall Switch Occupancy Sensors**

- .1 Provide flush wall box dimmer occupancy sensors in locations and connect to control lighting as indicated. Confirm exact locations prior to roughing-in. Equip each dimmer with a faceplate. Review faceplate colour with Consultant prior to ordering.
- .2 Confirm device settings for automatic or manual on, and delay-off, with Owner and review with Consultant prior to installation, and make settings adjustments on each device.
- .3 Install components in accordance with manufacturer's instructions to suit specific installation requirements.
- .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 Confirm device settings for automatic or manual on, and delay-off, with Owner and review with Consultant prior to installation, and make settings adjustments on each device.
- .4 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.

### Lighting Controls

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- .5 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.
- .6 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.
- .7 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.
- .8 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.
- .9 Review finishes of sensors with Consultant prior to ordering.
- .10 Review mounting heights with Consultant and manufacturer prior to roughing-in and installation.
- .11 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.
- .12 After installation is complete, provide for manufacturer's authorized representative to inspect, test and verify system performance and installation.
- .13 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.
- .14 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. Review 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. Review exact locations 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.

### Lighting Controls

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- .7 Refer also to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

#### **3.5 Installation of Dimming Control Station**

- .1 Install dimming systems for dimming control of lighting for areas as identified and reviewed 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 Review 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 reviewed with 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 Review exact locations of components with Consultant prior to roughing-in.
- .12 Review 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:

### Lighting Controls

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- .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.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 Submittals**

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

## **PART 2 - PRODUCTS**

### **2.1 Dry Type Transformers – General Requirements**

- .1 Types, capacities and ratings: as noted or scheduled on drawings.
- .2 CSA certified and/or ULC listed and labelled, constructed and factory tested in accordance with applicable requirements of following:
  - .1 Canadian Standards Association (CSA)
    - .1 CAN/CSA-C22.2 No.47, Air-Cooled Transformers (Dry Type).
    - .2 CAN/CSA-C802.2, Minimum Efficiency Values for Dry Type Transformers.
    - .3 CSA C9, Dry-Type Transformers.
  - .2 Institute of Electrical and Electronics Engineers (IEEE)
    - .1 IEEE C57.110, IEEE Recommended Practice for Establishing Liquid Immersed and Dry-Type Power and Distribution Transformer Capability when Supplying Nonsinusoidal Load Currents.
  - .3 National Electrical Manufacturers Association (NEMA)
    - .1 NEMA ST 20, Dry Type Transformers for General Applications.
  - .4 National Research Council Canada (NRCC)
    - .1 NRCC SOR/2016 – 311, Energy Efficiency Regulations.
  - .5 U.S. Department of Energy (DOE)
    - .1 DOE 10 CFR 431.196, Code of Federal Regulations, Energy Efficiency Program for Certain Commercial and Industrial Equipment.
  - .6 Local governing authority codes and standards.
- .3 After fabrication, emergency/critical power transformers to be factory cleaned, bonderized, and finished in Sherwin Williams or approved equal, orange enamel finish approved by Owner and reviewed with Consultant.

### **2.2 Dry Type Distribution Transformers**

- .1 Hammond Power Solutions, "Sentinel G" series dry type transformers as noted or scheduled on drawings, CSA certified and/or ULC listed and labelled. Transformers to be constructed and factory tested in accordance with applicable requirements of above codes and standards, and other local governing authority codes and standards.
- .2 Transformers to be complete with:
  - .1 copper windings;

Distribution Transformers

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- .2 Class "H", 220°C class, coil insulation, such that winding temperature rise to not exceed 150°C(270°F) and enclosure temperature rise not exceed 65°C(117°F) under full load in a 40°C (104°F) ambient temperature;
- .3 core construction consisting of stacked laminations of high permeability silicone steel;
- .4 vacuum impregnated polyester or epoxy resin;
- .5 lugs or pressure type terminals to suit primary and secondary conductors;
- .6 up to 15 kVA: two - 5% full capacity taps; one above normal and one below normal; taps located on primary winding;
- .7 greater than 15 kVA: four - 2-1/2% full capacity taps; two (2) above normal and two (2) below normal; taps located on primary winding;
- .8 an integral vibration dampening system with anti-vibration pads used between coil and core and enclosure;
- .9 seismic restraint requirements to suit local governing authority requirements and codes;
- .10 unless otherwise noted, basic impulse level to meet CSA C9 standards;
- .11 unless otherwise noted, average sound level to meet NEMA ST-20 and CSA C9 standards;
- .12 for transformers as noted, low sound noise -3db below NEMA ST-20 and CSA C9 standards;
- .13 efficiency meeting or exceeding latest efficiency levels of listed above standards;
- .14 for applications such as specific medical imaging equipment include full load voltage regulation not more than 1% at 80% power factor;
- .15 unless otherwise noted, factory painted with an ANSI grey enamel finish as reviewed with Consultant and approved by Owner;
- .16 aluminum nameplate indicating impedance rating, weight, connection diagram, style and serial number, riveted to front of enclosure.
- .3 Acceptable manufacturers are:
  - .1 Hammond Power Solutions;
  - .2 Delta Group;
  - .3 Schneider Electric;
  - .4 REX Power Magnetics;
  - .5 Siemens;
  - .6 Eaton;
  - .7 ABB.

## 2.3 Dry Type K-Rated Distribution Transformers

Distribution Transformers

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- .1 Hammond Power Solutions, "Sentinel K" series dry type transformers as noted or scheduled on drawings, CSA certified and/or ULC listed and labelled, constructed and factory tested in accordance with above codes and standards, and other local governing authority codes and standards.
- .2 Transformers to be complete with:
  - .1 copper windings;
  - .2 Class "H", 220°C class, coil insulation, such that winding temperature rise to not exceed 150°C(270°F) and enclosure temperature rise not exceed 65°C(117°F) under full load in a 40°C (104°F) ambient temperature;
  - .3 core construction consisting of stacked laminations of high permeability silicone steel;
  - .4 vacuum impregnated polyester or epoxy resin;
  - .5 K factor 13 rating as per ANSI/IEEE C57-110;
  - .6 electrostatic shielding;
  - .7 neutral sized for twice rated current;
  - .8 common mode noise attenuation 60 dB minimum;
  - .9 lugs or pressure type terminals to suit primary and secondary conductors;
  - .10 up to 15 kVA: two - 5% full capacity taps; one above normal and one below normal; taps located on primary winding;
  - .11 greater than 15 kVA: four - 2-1/2% full capacity taps; two (2) above normal and two (2) below normal; taps located on primary winding;
  - .12 integral vibration dampening system with anti-vibration pads used between coil and core and enclosure;
  - .13 seismic restraint requirements to suit local governing authority requirements and codes;
  - .14 unless otherwise noted, basic impulse level to meet CSA C9 standards;
  - .15 unless otherwise noted, average sound level to meet NEMA ST-20 and CSA C9 standards;
  - .16 efficiency meeting or exceeding latest efficiency levels of listed above standards;
  - .17 unless otherwise noted, factory painted with ANSI grey enamel finish as reviewed with Consultant and approved by Owner;
  - .18 aluminum nameplate indicating impedance rating, weight, connection diagram, style and serial number, riveted to front of enclosure.
- .3 Acceptable manufacturers are:
  - .1 Hammond Power Solutions;
  - .2 Delta Group;
  - .3 Schneider Electric;
  - .4 REX Power Magnetics;
  - .5 Siemens;



Distribution Transformers

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- .6 Eaton;
- .7 ABB.

## 2.4 Harmonic Mitigating Transformers

- .1 Hammond Power Solutions, "Sentinel H " harmonic mitigating transformers, CSA certified and/or ULC listed and labelled, constructed and factory tested in accordance with above codes and standards, and other local governing authority codes and standards.
- .2 Harmonic mitigating transformers to be energy efficient, cancel current harmonics to minimize voltage distortion due to non-linear loads, use low zero sequence and phase shifting techniques. Harmonic mitigation by electromagnetic means not with use of capacitors or electronics.
- .3 Unless otherwise noted, transformers are single output types.
- .4 Transformer efficiency meeting or exceeding CSA C802.2 upgraded to DOE 2016 standards.
- .5 Treatment of triplen (3<sup>rd</sup>, 9<sup>th</sup>, and 15<sup>th</sup>) harmonics and other zero sequence currents treated within secondary windings through cancellation of zero sequence fluxes; simply trapping these currents in delta primary winding is not acceptable.
- .6 Treatment of 5<sup>th</sup>, 7<sup>th</sup>, 17<sup>th</sup>, & 19<sup>th</sup> harmonics: harmonics provide appropriate primary-secondary phase shift in order to cancel these harmonic currents with those of other loads fed from same primary supply.
- .7 Features:
  - .1 Voltage and capacity rating as shown on drawings.
  - .2 Type: ANN.
  - .3 Three-phase, three coils with common single core construction; convection air-cooled.
  - .4 Core construction: high grade non-aging, fully processed silicon steel laminations.
  - .5 Coil conductors: continuous copper windings, with terminations brazed, welded or bolted.
  - .6 Impregnation: vacuum pressure impregnated core and coils.
  - .7 Electrostatic shield minimum 60dB attenuation.
  - .8 200% rated neutral.
  - .9 Positive & negative sequence impedance at 60Hz: 2.0% to 6.0% (up to 300kVA), 3.5% to 7% (500kVA and up).
  - .10 Zero sequence impedance/reactance at 60Hz:
    - .1 <0.95% and <0.3% respectively for sizes up to 150kVA.
    - .2 <1.0% and <0.5% respectively for 225kVA and 300kVA.
    - .3 <1.5% and <1.0% for 500kVA.
  - .11 Non-Linear load profile: Standard K13 rating for non-linear loads, 60Hz.

Distribution Transformers

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- .12 In-rush currents not to exceed 15 x RMS.
- .13 Excitation current: 5% of full load current rating (max.).
- .14 Voltage taps: 2 x  $\pm 2.5\%$  (2FCAN, 2FCBN) for 30 kVA and larger, 1 x  $\pm 5\%$  for 15 kVA and all 208V primary.
- .15 Insulation: Class 220°C system.
- .16 Temperature rise: 130°C.
- .17 Basic Impulse Level (BIL): standard, or as noted on drawings.
- .18 Unless otherwise noted, average sound level as per NEMA ST-20 and C9 standards.
- .19 Efficiency meeting or exceeding latest efficiency levels of listed above standards.
- .20 Flexible copper grounding strap to ground core and coil assembly to enclosure.
- .21 Top mounted factory painted drip shield.
- .22 Anti-vibration pads to be used between core and coil and enclosure.
- .23 Mounting: complete with hardware and supports as required floor or wall or ceiling hung.
- .24 Unless otherwise noted, factory painted with an ANSI grey enamel finish as reviewed with Consultant and approved by Owner.
- .25 Warranty: 10 years pro-rated.
- .8 Acceptable manufacturers are:
  - .1 Hammond Power Solutions;
  - .2 Delta Group;
  - .3 Mirus International;
  - .4 Powersmiths International.

## 2.5 Enclosures and Drip Shields

- .1 Include following:
  - .1 for standard indoor applications: minimum NEMA 2 ventilated, drip proof enclosure with rigid end frame, removable plates, terminal compartment;
  - .2 for additional indoor protection and standard outdoor applications: minimum NEMA 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;
  - .3 for additional protection outdoor applications: minimum NEMA 4 non-ventilated, water-tight enclosure;
  - .4 for indoor industrial applications: minimum NEMA 12 non-ventilated, drip proof, dust-tight enclosure with rigid end frame, removable plates, terminal compartment;
  - .5 top mounted factory painted drip shield;

Distribution Transformers

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- .6 bottom mounted drip tray for wall/ceiling mounted transformers;
- .7 unless otherwise noted, factory painted with an ANSI grey enamel finish as reviewed with Consultant and approved by Owner.

## **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. Ensure that there is adequate ventilation for transformers to operate as specified and that there is no transfer of heat to adjacent surfaces or equipment. 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.
- .3 Secure transformers smaller than 75 KVA in place on an angle wall mounting bracket support assembly located approximately 300 mm (12") below ceiling. Provide support assembly and adequately secure to wall and/or ceiling construction.
- .4 Provide seismic restraints as required by local governing codes.
- .5 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 300 mm - 450 mm (12" to 18") of liquid-tight flexible conduit. Typically, install conduit connections in lower one-third of transformer.
- .6 Ground and bond equipment to ground electrode grids as per local governing electrical code and inspection authority requirements. Refer also requirements of Section entitled – Grounding and Bonding.
- .7 Provide engraved Lamacoid nameplates and warning signs with nomenclature reviewed with Consultant.
- .8 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.
- .9 Refer to testing, coordination and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

**END OF SECTION**

Metering

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## **PART 1 - GENERAL**

### **1.1 Submittals**

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

## **PART 2 - PRODUCTS**

### **2.1 Basic Check Metering**

- .1 Itron Inc., "Sentinel" series, solid state, electronic, multi-measurement, polyphase meters, Measurement Canada approved and as follows:
  - .1 +/-0.2 accuracy device capable of displaying a wide range of register information as well as complying with requirements of ANSI C12.20: 1997 for Class 0.2 meters;
  - .2 analogue-to-digital conversion and measurement processing;
  - .3 register, load-profile, real-time clock and communications processing;
  - .4 input and output board for pulse accumulation or event notification;
  - .5 five (5) measurement levels;
  - .6 upgradable firmware;
  - .7 error and event logging;
  - .8 flexible configuration for various metering applications;
  - .9 autoranging power supply;
  - .10 register data and program information are retained in non-volatile memory in event of a power failure;
  - .11 liquid Crystal Display (LCD) that is programmable by user;
  - .12 energy measurements and Calculations: Wh, VARh, VAh, A2h, V2h, Ah and Vh;
  - .13 demand measurements: instantaneous values updated every second; maximum, present, previous, projected, cumulative, continuous cumulative and coincident demand values;
  - .14 pulse output and inputs;
  - .15 PF (average/minimum/instantaneous);
  - .16 RS232/RS485 and Ethernet communications;
  - .17 factory programmed to provide custom requirements of Owner to suit specific onsite applications;
  - .18 jaws and sockets as required;
  - .19 CT's/PT's as required;
  - .20 auxiliary outputs for monitoring connection.
- .2 Meters and accessories to operate at voltages, as required.

## Metering

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- .3 Include for complete installation, connection, and testing to manufacturer's instructions and recommendations to suit specific project requirements and site conditions.
- .4 Acceptable manufacturers are:
  - .1 Itron;
  - .2 PML – Schneider Electric;
  - .3 QMC;
  - .4 Carma Industries.

## **PART 3 - EXECUTION**

### **3.1 Installation of Check Metering**

- .1 Provide meters, sockets and ancillary devices and connect complete.
- .2 Install components in accordance with manufacturer's instructions to suit specific installation requirements.
- .3 Install current transformers to encircle conductors.
- .4 Install wiring in conduit and required devices in accordance with recommendations of product manufacturers.
- .5 Test and adjust to manufacturer's requirements.
- .6 Obtain required approvals/inspections for metering subject to local governing authority regulations.

### **3.2 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**

Wiring Devices

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## **PART 1 - 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 with Consultant. Do not order any device unless finishes have been approved by Owner and reviewed with Consultant.

## **PART 2 - PRODUCTS**

### **2.1 Switches**

- .1 Switches to be CSA certified, ULC listed and labelled devices.
- .2 Hubbell Canada Inc., HBL 1221 Series, CSA certified, heavy duty, industrial grade, back, and side wired, AC quiet action toggle type, 20 ampere, 120-277 V switches. Switches to include steel-nickel plated bridge, nylon toggle, one-piece rivetless copper alloy spring contact arm and terminal plate, silver cadmium oxide contacts, brass binding head screws, one-piece integral grounding terminal and stainless-steel automatic grounding clips. Provide single way, 2-way, 3-way, and key type to suit specific application requirements.
- .3 Hubbell Canada Inc. No. 1221-IL, CSA certified, heavy duty, specification grade, AC quiet action, illuminated polycarbonate handle toggle type, 20 ampere, 120-277 V switches.
- .4 Acceptable manufacturers are:
  - .1 Hubbell Canada Inc.;
  - .2 Eaton - Cooper Wiring Devices (Arrow Hart);
  - .3 Legrand - Pass & Seymour;
  - .4 Leviton.

### **2.2 Receptacles**

- .1 Receptacles to be CSA certified, ULC listed, certified and labelled devices.
- .2 Hubbell Canada Inc., No. HBL 8200/8300 series, extra heavy duty hospital grade with green dot symbol, back and side wired, flush, thermoplastic polyester 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.
- .3 Hubbell Canada Inc., No. 8200/8300 series, heavy duty hospital grade with green dot symbol, power indicating LED, back and side wired, flush, thermoplastic polyester 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.

Wiring Devices

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- .4 Hubbell Canada Inc., No. 8200 TR /8300 TR series, heavy duty hospital grade with green dot symbol, tamper resistant with power indicating LED, back and side wired, flush, thermoplastic polyester 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 Inc., No. HBL SNAP8200 CSA certified, ULC listed, Hospital grade with green dot symbol, nylon face/body construction, duplex U ground, 15 ampere, 125 V, 2 pole, 3 wire grounding receptacles complete with right angled pigtailed terminal with 150 mm (6") leads, 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.
- .6 Hubbell Canada Inc., No. HBL 8200SG series, extra heavy-duty hospital grade, 15 ampere, 125 V, 2-pole, 3-wire grounding, tamper-resistant (safety shutter) duplex receptacles.
- .7 Hubbell Canada Inc., No. IG 8200 series, extra heavy-duty hospital grade, 15 ampere, 125 V, nylon construction, back and side wired, one piece mounting strap, isolated ground duplex receptacles.
- .8 Hubbell Canada, No. HBL8262SA / HBL8362SA "CIRCUITGUARD" Series, hospital grade, 15/20 ampere, 125 V, duplex, surge suppression receptacles in blue finish, complete with light and alarm, 240 joules/15000A per mode.
- .9 Hubbell Canada, No. IG8262SA / IG8362SA "CIRCUITGUARD" Series, hospital grade, 15/20 ampere, 125 V, duplex, isolated ground, surge suppression receptacles in blue finish, complete with light and alarm, 240 joules/15000A per mode.
- .10 Hubbell Canada, No. GFR8200SG / GFR8300SG "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 automatic self-test diagnostics, green power ON LED, red ground fault LED and 10ka short circuit current rating.
- .11 Hubbell Canada Inc., No. USB 8200/8300 series, hospital grade, CSA certified, ULC listed, 2- USB ports (5A, 5V DC, type A and type C port configurations, class 2.0, 3.0 and 3.1) and 15/20 ampere, 125 V rated duplex decorative style power receptacles, tamper resistant, back and side wired. Confirm exact USB port configuration and 15A or 20A power receptacle requirements with Owner prior to ordering.
- .12 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.

Wiring Devices

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- .13 Hubbell Canada Inc., No. HBL2172 / HBL2182 "Style Line", CSA certified, 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.
- .14 Hubbell Canada Inc., No. DR15TR / DR20TR "Commercial Style Line" tamper resistant, specification grade, decorator series, CSA certified, ULC listed, back and side wired, nylon face/body construction, 15/20 ampere, 125 V, 2 pole, 3 wire grounding, duplex receptacles complete with wrap around galvanized steel mounting strip and oversize terminal screws.
- .15 Hubbell Canada Inc., No. DR15C/DR20C1 " Style Line Decorator " plug load controlled series, industrial grade, permanently marked with symbol identifying controlled receptacle, CSA certified, ULC listed, back and side wired, nylon face/body construction, 15/20 ampere, 125 V, grounding, duplex receptacles; for use with automatic outlet control systems, and with factory broken split circuit tab allowing control of half of receptacle; interconnected to control module relays of lighting control system or other building control systems.
- .16 Hubbell Canada Inc., No. DR15C2/DR20C2 " Style Line Decorator " plug load controlled series, industrial grade, permanently marked with symbol identifying controlled receptacle, CSA certified, ULC listed, back and side wired, nylon face/body construction, 15/20 ampere, 125 V, grounding, duplex receptacles; for use with automatic outlet control systems allowing control of full receptacle; interconnected to control module relays of lighting control system or other building control systems.
- .17 Legrand - Pass & Seymour, No. 2122, 15 ampere, 125 V, recessed, ivory clock hanger receptacles and wall plates.
- .18 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.
- .19 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.
- .20 Hubbell Canada, No. IG 5262, heavy duty, specification grade, 15 ampere, 125 V, duplex, orange colour, nylon construction, back, and side wired isolated receptacles.
- .21 Hubbell Canada, No. BR15TR series, specification grade, 15 ampere, 125 V, 2-pole, 3-wire, tamper resistant, safety shutter receptacles.
- .22 Hubbell Canada, No. 4710, specification grade, 15 ampere, 125 V, single, 2-pole, 3-wire grounding twist lock receptacle.
- .23 Hubbell Canada, No. 15 ampere and 50 ampere receptacles complete with neutral and ground conductors required for indicated number of phases as required.
- .24 Where noted that 20 A receptacles are required, include for "T" slot type of respective series of receptacles.
- .25 Colour of special switches and receptacles (unless specified above), to be as specified in PART 3 of this Section of Specification.
- .26 Special switches and receptacles not specified above are to be specified on drawings. Low voltage lighting controls are specified in Section entitled Lighting Control.



## Wiring Devices

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.27 Acceptable manufacturers are:

- .1 Hubbell Canada Inc.;
- .2 Eaton - Cooper Wiring Devices (Arrow Hart);
- .3 Legrand - Pass & Seymour;
- .4 Leviton.

### 2.3 Faceplates

- .1 Hubbell Canada, high impact strength, and flame resistant wall plates of nylon or thermoplastic construction. Standard and mid sizes are to be provided in various colour finishes, to suit specific applications.
- .2 Legrand - Pass & Seymour, "Jumbo" 302 stainless steel wallplates.
- .3 Galvanized steel stamped faceplates.
- .4 Colours and finishes of faceplates are specified in Part 3 of this Section.
- .5 Acceptable manufacturers are as per switches and receptacles.

### 2.4 Pushbuttons Operators

- .1 Rockwell Automation (Allen-Bradley) Ltd., 800T Series operators as follows:
  - .1 emergency off pushbuttons: oversized 60 mm (2-1/2") diameter red plastic mushroom head pushbutton with shroud, thrust washer, and an aluminum faceplate with "EMERGENCY POWER OFF" identification lettering or other nomenclature as required to suit application;
  - .2 pushbuttons: standard 30 mm (1-1/4") diameter plastic pushbuttons in Red/Green colours as required for application, momentary/maintained/2 position push-pull operations as required, flush/extended/mushroom heads; non-illuminated/illuminated, with aluminum faceplate with identification lettering nomenclature as required to suit application;
  - .3 selector switches: 30 mm (1-1/4") diameter standard knob selector switches, 2/3 position maintained contact operations; non-illuminated, with aluminum faceplate with identification lettering nomenclature as required to suit application;
  - .4 key operated switches: standard 30 mm (1-1/4") diameter key cylinder lock operator, 2 or 3 position operations; non-illuminated, with aluminum faceplate with identification lettering nomenclature as required to suit application;
  - .5 pilot lamps: 30 mm (1-1/4") diameter illuminated LED pilot lights, red/green/amber/white/clear colours as required to suit application; of voltage ratings as required to suit application; with contact block; with aluminum faceplate with identification lettering nomenclature as required to suit application; push to test feature where required;
  - .6 with enamel painted steel or stainless steel faceplate for flush mounting onto recessed wall boxes or in millwork, suitable for mounting of devices;
  - .7 with NEMA 1 box for surface mounting applications in climate controlled areas, CSA certified for application and of size suitable for mounting of devices;

## Wiring Devices

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- .8 with minimum NEMA 3R box for surface mounting applications in non-climate controlled areas, CSA certified for application and of size suitable for mounting of devices;
- .9 with STI type flip open polycarbonate tamper-proof cover and audible alarm device activated when cover is open, and custom labelling.
- .2 Exact type and ratings of devices are to suit specific applications.
- .3 Acceptable manufacturers are:
  - .1 Rockwell Automation (Allen-Bradley);
  - .2 Eaton (Cutler-Hammer);
  - .3 Square D;
  - .4 GE.

### 2.5 Foot Switches

## PART 3 - EXECUTION

### 3.1 Installation of Switches

- .1 Provide devices 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 essential power circuits.
- .3 Every switch connected to essential (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. Review exact locations of switches with Consultant to ensure optimum operation of switch to door position.
- .7 Review final device finishes with Consultant as per sample board submission specified in Part 1. Do not order any devices unless final finishes have been approved by Owner and reviewed with Consultant.
- .8 Additionally, refer to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

### 3.2 Installation of Receptacles

### Wiring Devices

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- .1 Provide devices 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. Generally, install receptacles in Patient Care Areas vertically with ground pins up.
- .3 Provide separate insulated ground wire for each isolated ground receptacle. Do not install isolated ground receptacles in patient care areas.
- .4 Install USB charger receptacles in extra deep boxes in accordance with manufacturer's recommendations.
- .5 Install exterior receptacles in accordance with drawing details, and as coordinated and reviewed with Consultant. Comply with local governing electrical code with regards to wiring and installation requirements. Properly ground installations.
- .6 In patient care areas as a minimum, 15A/20A straight blade receptacles to be hospital grade.
- .7 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 engraved lamacoid nameplate on wall below each device faceplate, identifying circuit number and panelboard from where each device is fed. Review exact location for identification with Consultant.
- .8 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.
- .9 Install plug load controlled receptacles of type compatible with and coordinated with connected control system. Confirm compatibility of receptacle with control system vendor. Circuit split controlled receptacles as per local governing electrical code requirements.
- .10 Review locations and nomenclature of nameplates and labelling 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.
- .11 Review final device finishes with Consultant as per sample board submission specified in Part 1. Do not order any devices unless final finishes have been approved by Owner and reviewed with Consultant.
- .12 Additionally, refer to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

## Wiring Devices

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### 3.3 Installation of Faceplates

- .1 Provide each device 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 nylon type standard size faceplates for flush mounted devices.
- .3 Provide stainless steel type standard size faceplates for flush mounted devices.
- .4 Provide stainless steel faceplates in operating rooms, laboratories, treatment rooms, test rooms, etc.
- .5 Provide nylon type faceplates for switches and receptacles circuited to emergency power sources and/or isolated power centres. Colour finish to be red, but reviewed with Consultant.
- .6 Provide galvanized stamped steel faceplates in service areas and equipment rooms where devices are surface mounted.
- .7 Isolated ground receptacles connected to circuits fed from uninterruptible power supply units to be equipped with faceplates in orange colour.
- .8 Provide faceplates for computer equipment isolated ground receptacles with label printed with "Computer Equipment Only" lettering.
- .9 Provide faceplates for housekeeping receptacles with label printed with "Housekeeping Only" lettering.
- .10 Provide weatherproof insulated faceplates with hinged and gasketted receptacle access flaps for weatherproof receptacles denoted "WP" on drawings.
- .11 Generally, oversized faceplates to be provided where engraved lettering is required.
- .12 Faceplates for flush floor mounted receptacles in standard floor boxes to be forged brass rectangular faceplates.
- .13 For flush mounted devices, provide oversized faceplates as required to properly cover wall openings around recessed boxes.
- .14 Provide faceplates with suitable identification labels. Review exact locations for labelling with Consultant.
- .15 In addition to identification requirements specified with devices, 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.
- .16 Review 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.

### 3.4 Installation of Pushbutton Operators

- .1 Provide specified and suitable pushbutton operators and pilot lamps to suit various applications.
- .2 Where flush mounted, provide faceplate for mounting onto recessed boxes.

## Wiring Devices

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- .3 Where surface mounted climate controlled areas, provide suitable NEMA 1 box. In non-climate controlled areas, surface mounted devices to be mounted within minimum NEMA 3R rated boxes.
- .4 Install devices in accordance with manufacturer's instructions to suit application requirements of Owner. Connect complete to respective equipment being controlled. Provide required wiring in conduit.
- .5 Test and verify operation of each device. Provide engraved lamaroid nameplate to identify system being operated and any special instructions. Confirm exact nomenclature with Consultant prior to ordering.

### 3.5 Installation of Foot Switches

- .1 Install foot switches in locations confirmed with Consultant prior to roughing-in. Secure to floor. Provide required connecting cable in conduit (applicable models) and connect complete. Conduit to run within floor slab and terminate in recessed box. Confirm exact locations with Consultant prior to roughing-in.
- .2 Coordinate exact product requirements and wiring requirements with product manufacturer to ensure operation complies with Owner's requirements.
- .3 Install in accordance with manufacturer's instructions. Coordinate installation with equipment to be controlled.
- .4 Inspect, test and verify operation. Adjust as required.

### 3.6 Installation of Drop Cord Assemblies

- .1 Provide ceiling mounted Kellams type relief grips to support cables at ceiling and relief grips at both end box terminations. Install drop cord grips to coiled cord and secure grip eyes to ceiling slab as required. Refer to manufacturer's selection charts to determine appropriate grips to meet requirements of applications.
- .2 Install devices in accordance with manufacturer's instructions.
- .3 Test to verify proper operation. Adjust as required.

### 3.7 Installation of Retractable Reels

- .1 Provide retractable reels and secure to construction in accordance with manufacturer's instructions. Ceiling box to be secured to ceiling slab or ceiling structure in manner to provide adequate support to entire assembly.
- .2 Install devices in accordance with manufacturer's instructions.
- .3 Provide receptacles and boxes in required configuration and types.
- .4 Ground and bond devices as per local electrical code requirements.
- .5 Refer to and provide additional applicable testing requirements of distribution system testing and coordination study article.
- .6 Provide engraved lamaroid nameplates for equipment and components. Prior to manufacture of nameplates, confirm exact nomenclature with Consultant in writing. During installation onsite, provide temporary labelling until permanent nameplates are installed.
- .7 Label outlets with circuit number and source panel.

Wiring Devices

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- .8 Test each device and assembly. Verify proper operation. Adjust as required.

**3.8 Installation of Outdoor Power Outlet Pedestals**

- .1 Prior to start of Work, confirm and coordinate with General Trades Contractor, work required for underground conduit runs including excavation and backfilling work and provision of concrete base. Obtain base detail from pedestal manufacturer.
- .2 Confirm exact locations of pedestals prior to roughing in. Locate into position and install in accordance with manufacturer's instructions. Coordinate installation with trades pouring concrete floor slab.
- .3 Refer to manufacturer's installation drawings. Install complete with required connection wiring. Secure to concrete pad with manufacturer's recommended bolts.
- .4 Apply weatherproofing sealant as per manufacturer's instructions.
- .5 Ground and bond boxes to local governing electrical code requirements.
- .6 Test assembly to verify proper operation.

**END OF SECTION**

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Surge Protective Devices

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## **PART 1 - GENERAL**

### **1.1 Submittals**

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

## **PART 2 - PRODUCTS**

### **2.1 Surge Protective Devices**

- .1 Switchgear / switchboards to be complete with either external or integral surge protective devices (SPDs). If external, unit to be connected onto bussing through dedicated breaker as recommended by manufacturer. If integral, unit to be factory installed into separate cubicle section and connected onto bussing through integral disconnect as recommended by manufacturer. SPD features include following:
  - .1 in accordance with ANSI/UL 1449 5th Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;
  - .2 Type 1;
  - .3 maximum voltage protection rating to not exceed 700 V (120/208 V) or 1500 V (600/347V): L-N, L-G, N-G; 1200 V (120/208 V) or 3000 V (600V): L-L;
  - .4 minimum nominal discharge current rating of 10 kA;
  - .5 minimum short circuit current rating of 100 kA;
  - .6 peak surge current 250 KA per phase;
  - .7 high-performance EMI/RFI noise rejection filter;
  - .8 indicator LED on units to identify protection integrity status of metal-oxide varistors; indicator to be visible on front of switchgear/switchboard;
  - .9 diagnostic package with status indicators on each phase;
  - .10 LCD surge counter display;
  - .11 audible alarm with silence button;
  - .12 Form C alarm contacts;
  - .13 maintenance free and not require any user intervention throughout its life;
  - .14 standard manufacturer's minimum 5 years parts and labour warranty.
- .2 Distribution panelboards as scheduled to be complete with either external or integral surge protective devices (SPDs). If external, unit to be connected onto bussing through dedicated breaker as recommended by manufacturer. If integral, unit to be factory installed and connected onto bussing through integral disconnect/breaker as recommended by manufacturer. SPD features include:
  - .1 in accordance with ANSI/UL 1449 5th Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;
  - .2 Type 1;
  - .3 maximum voltage protection rating to not exceed 700 V (120/208 V) or 1500 V (600/347V): L-N, L-G, N-G; 1200 V (120/208 V) or 3000 V (600V): L-L;

### Surge Protective Devices

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- .4 minimum nominal discharge current rating of 10 kA;
  - .5 minimum short circuit current rating of 100 kA;
  - .6 peak surge current 150 KA per phase;
  - .7 indicator LED on units to identify protection integrity status of metal-oxide varistors; indicator to be visible on front of panelboard;
  - .8 high-performance EMI/RFI noise rejection filter;
  - .9 indicator LED on units to identify protection integrity status of MOVs; indicator to be visible on front of switchgear/switchboard;
  - .10 diagnostic package with status indicators on each phase;
  - .11 audible alarm;
  - .12 Form C alarm contacts;
  - .13 maintenance free and not require any user intervention throughout its life;
  - .14 standard manufacturer's minimum 5 years parts and labour warranty.
- .3 Branch circuit panelboards as scheduled to be complete with either external or integral surge protective devices (SPDs). If external, unit to be connected onto bussing through dedicated breaker as recommended by manufacturer. If integral, unit to be factory installed and connected onto bussing through integral disconnect/breaker as recommended by manufacturer. SPD features include:
- .1 in accordance with ANSI/UL 1449 5th Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;
  - .2 Type 1;
  - .3 maximum voltage protection rating to not exceed 700 V (120/208 V) (L-N, L-G, N-G);
  - .4 minimum nominal discharge current rating of 10 kA;
  - .5 minimum short circuit current rating of 100 kA;
  - .6 minimum peak surge current 100 KA per phase;
  - .7 high-performance EMI/RFI noise rejection filter;
  - .8 indicator LED on units to identify protection integrity status of metal-oxide varistors; indicator to be visible on front of panelboards;
  - .9 diagnostic package with status indicators on each phase;
  - .10 audible alarm;
  - .11 Form C alarm contacts;
  - .12 maintenance free and not require any user intervention throughout its life;
  - .13 standard manufacturer's minimum 5 years parts and labour warranty.
- .4 For applications on high resistance grounding (HRG) systems SPDs are to be rated for use on HRG systems. Typically, such SPDs are 3-wire delta-rated types. Confirm exact requirements with SPD manufacturer before ordering.

## 2.2 Acceptable Manufacturers



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Surge Protective Devices

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- .1 Acceptable manufacturers are:
  - .1 Eaton Electric;
  - .2 Schneider Electric;
  - .3 Siemens Electric;
  - .4 APT (Advanced Protection Technologies);
  - .5 ABB.

## **PART 3 - EXECUTION**

### **3.1 Installation of SPD Units**

- .1 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.
- .2 Mount SPD units adjacent to switchgear/switchboards or panelboards such that connecting conductors to dedicated breaker are of length not exceeding SPD manufacturer's requirements.
- .3 Ensure that MOV condition LED indicator is visible from front of board/panel.
- .4 Connect and make necessary incoming and outgoing power cable connections to equipment in strict accordance with equipment manufacturer's recommendations.
- .5 Ground and bond components as per local electrical code requirements. Refer also to requirements of grounding and bonding article.
- .6 Provide alarm/communications circuits as required. Include for provision of conduits, boxes and control/signal wiring for interconnection to BAS. Coordinate with Mechanical Divisions BAS Contractor on location of BAS panel to be used for monitoring points and extend wiring in conduit from SPD to location. Terminate in junction box leaving 3 m (10') of slack length of wiring (exact length to be coordinated between Mechanical and Electrical trades), for extending and termination to BAS panel by Mechanical Division BAS Contractor. Properly identify wiring and junction box.
- .7 Manufacturer representative to assist installing Contractor in installation of equipment, testing equipment, performing start-up and verification of equipment.
- .8 Be present to assist during third party testing.
- .9 Perform testing at times reviewed with Consultant.
- .10 Provide instructions on system operating and maintenance.
- .11 Additionally, refer to testing, coordination and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 Submittals**

- .1 Submit shop drawings for products of this Section, and on Schedule of Luminaires on drawings.
- .2 Submittals to include:
  - .1 luminaire dimensions, aperture dimensions, cutout dimensions;
  - .2 driver information for each luminaire, including maximum circuit loading limitations, and dimming details;
  - .3 total input watts;
  - .4 lumen rating in accordance with IESNA testing procedures;
  - .5 candlepower summary, candela distribution zonal lumen summary;
  - .6 luminaire efficiency;
  - .7 lamp life rating (based on LM-80 and TM-21);
  - .8 colour temperature;
  - .9 colour fidelity (as per TM-30 preferred);
  - .10 finishes;
  - .11 options being provided;
  - .12 other relevant information to ensure design intent.
- .3 Include copy of certification that lenses, and louvers comply with local governing building code requirements for flame spread ratings.
- .4 Include copies of documents of respective manufacturers confirming complete compatibility between lighting controls and luminaires.
- .5 For exterior site areas or parking areas, where luminaires are proposed that are not from based specified manufacturer, provide luminaire manufacturer's computer prepared detailed photometric layout drawings with complete photometry showing performance levels of proposed luminaires. Clearly identify lighting levels, quantity, locations, mounting heights, etc. Identify variances from base design.

### **1.2 Warranty**

- .1 Warranty requirements for luminaires are as follows:
  - .1 warranties to be full comprehensive product replacement direct from luminaire manufacturers;
  - .2 when LEDs and drivers, or lamps and ballasts are supplied with luminaire by luminaire manufacturer, warranty to be under responsibility of luminaire manufacturer;

## Lighting

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- .3 unless otherwise noted, warrant LED luminaires and LED drivers for a period of minimum 5 years from date of application for Certificate for Substantial Performance of the Work; include for personnel, equipment and labour for replacing products onsite, for duration of Contract warranty period defined in Division 00 or 01; for remainder of 5 years extended warranties beyond Contract warranty period, include typical conditions of product manufacturers' replacement warranty;

### 1.3 Exit Signs

- .1 Provide exit signs in compliance with local governing authority directions but ensure quality standards meet specified product. Advise Consultant where specified exit signs do not comply with local governing authority requirements.
- .2 Review each respective installation location and determine required installation accessories to suit support from either wall or ceiling construction. Provide required brackets and stem assemblies. Review with Consultant.
- .3 For suspended from ceiling installation of exit signs, mount signs with stem assembly from ceiling structure, and provide assembly that connects to sign frame directly (not with electrical box mounted onto frame). Provide continuous minimum 13 mm ( $\frac{1}{2}$ ") threaded conduit (finished painted as reviewed with Consultant) extending from ceiling mounted junction box complete with ball align hanger to threaded connector directly mounted into the top of specified exit sign.

### 1.4 Product Compatibility

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

### 1.5 Substitutions

- .1 Provide luminaires as specified in Schedule of Luminaires and as per documented List of Manufacturers, where applicable. During construction period, no substitutions are permitted unless compelling reasons are given and accepted by Owner and reviewed with Consultant. A delay caused by Contractor's failure to order luminaires to meet construction schedule is not a valid reason.
- .2 Make requests for proposed substitutions as per requirements of Section entitled Electrical Work General Instructions and Division 01. In addition, make payments for additional costs to Consultant for these reviews, based on amount of \$250 per luminaire type, and per submission.
- .3 Consideration of any proposed substitutions after Bid Period to be at Consultant's sole discretion.

## PART 2 - PRODUCTS

### 2.1 Luminaires

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- .1 Provide luminaires in accordance with Schedule of Luminaires. Luminaires including integrated LEDs and drivers are to be CSA approved or have special local electrical authority approval. Ensure luminaires and integrated LEDs and drivers are tested for full compatibility operation prior to shipping to site.
- .2 Some luminaires as noted in Contract Documents 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 luminaires, including:
  - .1 receiving and inspecting luminaires;
  - .2 complete installation;
  - .3 providing installation hardware to complete installation, and not supplied by luminaire manufacturer;
  - .4 aiming as required and connecting;
  - .5 providing power feeders and control wiring and conduit/boxes;
  - .6 cleaning, adjusting and testing;
  - .7 providing lamps where documented or as scheduled, unless otherwise reviewed with Consultant or supplied with luminaires by luminaire manufacturer; LED type luminaires are typically supplied complete;
  - .8 provide required power connections and where luminaires are controlled via remote low voltage controller, include for installation of controller and providing required low voltage wiring in conduit and necessary connections;
  - .9 coordination of exact requirements with supplier of luminaires and reviewed with Consultant prior to installation.
- .3 Provide thickness of metal as indicated in Schedule of Luminaires and details, or as required so that luminaires are rigid, stable and resists deflection, twisting, warping or bending under normal installation procedures, re-lamping etc., or no less than requirements specified herein the specifications.
- .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 Unless otherwise noted, vandal resistant luminaires to be constructed of heavy duty extruded aluminum rails and die cast end caps, complete with stainless steel torx with centre reject pin and Allen head set screws. Screw heads to be mounted and concealed under lens. Lens to be extruded UV stabilized polycarbonate lens with internal linear ribbed design.
- .6 Provide neoprene or silicone gasketing, barriers and stops where required to prevent light leaks or water/water vapour penetration.
- .7 Fabricate housings to allow for easy accessibility and replacement of parts.

## Lighting

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- .8 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.
- .9 Reflectors and reflecting cones or baffles to be free of any tooling marks, spinning lines or marks by other assembly techniques. Iridescence to be low. Finishes to be equal to first quality polished, baffled, and anodized "Alzak".
- .10 Lenses and louvers to comply with local governing building code and other local governing code flame spread rating requirements.
- .11 Unless otherwise noted, construct acrylic lens from 100% virgin acrylic and not less than 3.22 mm (0.125") thick. K12 acrylic lenses to have recessed prismatic pattern with no fade-outs or streaks and be of strain-free and uniform production. Glass lenses to be minimum 9.5 mm (0.375") thick.
- .12 Recessed luminaires with replaceable/serviceable parts such as ballasts, lamps, sockets, etc., must be accessible from lens side (i.e. room side) of fixtures to allow for proper accessibility.
- .13 Luminaires to be factory assembled and tested prior to delivery on site.
- .14 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.
- .15 When requested, submit luminaire samples.
- .16 Dimensions for coves, valances, and strips as shown on drawings are for bidding purposes only. Job measure for exact dimensions of louvers, lenses and strips.
- .17 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.
- .18 Review exact colours and finishes of luminaires with Consultant after award of contract but prior to ordering. Obtain information in time to meet installation schedule.
- .19 Coordinate with interconnected product manufacturers to ensure that components are compatible with each other and that interconnections do not affect performance, life or any warranties.
- .20 Products of same specified type to be of same manufacturer.

## 2.2 LEDS and Drivers

- .1 Typically, general features include:
  - .1 CSA approved, ULC listed and labelled;

Lighting

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- .2 NEMA 410 compliant drivers;
- .3 typical operating temperatures:
  - .1 Luminaires for applications in extreme cold, 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);
- .4 with rapid and changing development of LED technology, provide most technically proven and most advanced and successfully tested LED technology at time of installation;
- .5 specification standards to meet requirements of IES LM 79 and LM-80.
- .6 where connected to dimmers, be 100% compatible with connected dimmer controls to provide dimming down to 1%. Coordinate with dimming controls vendors to ensure that technical operations of dimmers (i.e. forward phase, reverse phase, etc.) match LED/ driver technology. Clearly identify this information in shop drawing submissions.
- .2 Typical 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 and reviewed with Consultant prior to ordering;
  - .3 minimum CRI of 85;
  - .4 minimum rated life (based on LM-80 and TM-21) from 50,000 to 70,000 hours.
- .3 Typical driver features to include:
  - .1 operate from 60 Hz input source of 120 VAC/347VAC (as applicable) 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 LEDs and drivers are to be 100% compatible with each other. Luminaire with LED and driver to be CSA approved or ULC listed, and certified and tested as a complete assembly.
- .5 Above features are general requirements to ensure that any proposed luminaires that are not base specified are to have premium quality LEDs and drivers. Refer to Schedule of Luminaires.
- .6 Acceptable LED manufacturers are:
  - .1 Cree;
  - .2 Nichia;

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- .3 Lumileds;
- .4 Toshiba;
- .5 Samsung.
- .7 Acceptable driver manufacturers are:
  - .1 Philips;
  - .2 OSRAM Sylvania;
  - .3 Lutron;
  - .4 eldoLED;
  - .5 GE.
- .8 For specialty luminaires used for accent or task lighting applications, acceptable manufacturers of LEDs and drivers to be as listed above. Additionally, for these specialty luminaires, acceptable manufacturer of LEDs and drivers to include those of base specified luminaires. Refer to Schedule of Luminaires for additional requirements.

### **2.3 Surge Protection for LED Systems**

- .1 Luminaire manufacturers supplying exterior LED luminaires are to include surge protection for LED systems in accordance with IEEE and ANSI C62.41.2 transient surge requirements. Surge protection to be level of 6 kV/3 kA for low exposure conditions (low grade level landscape lighting) and, 10 kV/10 kA for high exposure conditions (pole mounted lighting).

## **PART 3 - EXECUTION**

### **3.1 Installation of Luminaires**

- .1 Reference electrical drawings for general luminaire location, circuiting, and controls. Reference Architectural reflected ceiling plans (RCPs) for more detailed location of luminaires. Consult both sets of drawings in preparation for installation. Review final locations with Consultant prior to roughing-in.
- .2 Review construction of materials where luminaires are to be located. Comply with local governing building code requirements for providing openings in walls, partitions and floor assemblies required to be a fire separation, to be protected with fire separations and closures. Where luminaires are not specified with fire rated housings, provide other means reviewed with Consultant and meeting local governing building code requirements.
- .3 Installed luminaires may be energized for testing installation and be de-energized until system commissioning. Installed luminaires may not be used as construction lights.
- .4 Protective material to remain on luminaires until prior to commissioning. At commissioning, clean luminaires to in new condition.
- .5 Confirm with luminaire manufacturers that luminaires have been tested at factory with integrated LEDs and drivers to ensure 100% compatibility of operation between products. Document in report signed by manufacturer's authorized representative. Submit copy to Consultant.

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- .6 After shop drawing review process has been completed with Consultant, provide luminaires as required. Obtain required training from manufacturer's representative on any special installation procedures. Install products in accordance with manufacturer's instructions to suit specific installation requirements.
- .7 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 review colours and finishes with Consultant.
- .8 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.
- .9 Where outlet boxes locations are shown on drawings, they are diagrammatic only. Position outlet boxes to coincide with suspension hangers and knockouts.
- .10 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.
- .11 Cut holes for recessed luminaires to exact size so that gaps are not visible, or luminaire trims cover gaps.
- .12 Mount surface ceiling luminaires perfectly level or plumb, tightly to ceiling without showing a space or light leak between frame and ceiling.
- .13 Carefully align linear luminaires shown in continuous lines or rows, so that rows appear as straight lines. Variation in alignment not to exceed 6 mm (1/4") for any 5 m (16') run.
- .14 Provide spacers for fixtures mounted on low density ceiling material.
- .15 Provide plaster frames for recessed fixtures in plaster or gypsum board ceilings.
- .16 Prepare fixtures, trim and poles and standards required to be painted.
- .17 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.
- .18 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.



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- .3 Splices are not to be made unless properly terminated in accessible identified junction boxes.
- .19 Support luminaires directly by ceiling slab structure and not to formed steel decking, ceiling hangers, ductwork, piping, cable trays, etc. Review exact requirements with Consultant prior to start of work.
- .20 Do not tighten wing nuts, bolts, or screws that allow fixture adjustment for recessed adjustable fixtures.
- .21 Install spread lenses only where called out on Schedule of Luminaires and Specifications.
- .22 Use cloth gloves when handling reflector cones, louvers, lamps, glass, sconces and all exposed surfaces of luminaires.
- .23 Co-ordinate luminaire installation with work of other trades to ensure that necessary recessing depths and mounting spaces are provided.
- .24 Install luminaires in accordance with applicable architectural drawing reflected ceiling plans and/or wall elevations and/or field instructions issued by Consultant. Review final luminaire locations with Consultant 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.
- .25 Align and position all adjustable luminaires and ensure that luminaires with adjustable lamp holders are properly positioned to correspond to lamps specified.
- .26 Comply with requirements of local governing electrical code regarding support of luminaires in suspended ceilings.
- .27 Independently suspend luminaires in suspended ceilings from ceiling slab. For each luminaire, provide minimum two cable supports secured to ceiling slab and to luminaire. Confirm with local governing authorities and review with Consultant if a variance to this requirement can be made for specific luminaires of low weight.
- .28 Connect luminaires to power circuits and controls as required. Refer to drawings notes and schedules. Include for both normal and emergency power circuits as required.
- .29 Locate exit signs in final locations reviewed 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 directions, and as reviewed with Consultant.
- .30 For emergency lighting controls include required relays compliant with UL924 and applicable CSA C22.2 Standards.
- .31 Notify Consultant immediately and relocate if necessary as reviewed with Consultant, if:
  - .1 fixture placement conflicts 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.
- .32 Provide seismic restraints to suspended luminaires, in accordance with latest local governing building code requirements to suit zone of Place of Work.

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- .33 Ground and bond luminaires as per local governing electrical code requirements.
- .34 If requested by Owner or Consultant, demonstrate operation of luminaires intended for special applications such as building floodlights and other decorative purposes. Adjust their locations within reasonable distance to obtain effects desired.
- .35 Test and adjust exterior luminaires at times after sunset, in presence of Consultant and at times acceptable to Owner and reviewed with Consultant.
- .36 Properly identify circuits and components in manner reviewed with Consultant.
- .37 Prior to turn over of Work to Owner, clean luminaires in manner recommended by manufacturer and to satisfaction of Owner.
- .38 Lamps to be new and intact when project is complete and ready for acceptance.
- .39 Include a full lamp listing in Operating and Maintenance Instruction Manuals.
- .40 Additionally, refer to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.
- .41 Refer to Section entitled Lighting Controls for related controls work.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 Comply with all applicable national and provincial and municipal codes including, but not limited to, the following:
  - .1 National:
    - .1 Canadian Standards Association CSA C22.1.
  - .2 Provincial:
    - .1 Ontario Electrical Safety Code.
    - .2 Ontario Building Code.
- .2 Comply with applicable industry practices including but not limited to the most recently published version of the following standards in effect at time of bid including all published addenda and errata:
  - .1 Telecommunications Industry Association ([www.tiaonline.org](http://www.tiaonline.org)):
    - .1 TIA-568.0 Generic Telecommunications Cabling for Customer Premises.
    - .2 TIA-568.1 Commercial Building Telecommunications Infrastructure Standard.
    - .3 TIA-568.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
    - .4 TIA-569 Telecommunications Pathways and Spaces.
    - .5 TIA-606 Administration Standard for Telecommunications Infrastructure.
    - .6 TIA-942 Telecommunications Infrastructure Standard for Data Centers.
    - .7 TIA-1152 Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling.
    - .8 TIA-TSB-184 Guidelines for Supporting Power Delivery over Balanced Twisted-Pair Cabling.
    - .9 TIA-TSB-190 Guidelines on Shared Pathways and Shared Sheaths
  - .3 Comply with applicable industry practices including but not limited to the most recently published version of the following guides in effect at time of bid including all published addenda and errata:
    - .1 Building Industry Consulting Services International (BICSI) ([www.bicsi.org](http://www.bicsi.org)):
      - .1 BICSI/NECA-568 Standard for Installing Commercial Building Telecommunications Cabling.
      - .2 BICSI 005 Electronic Safety and Security (ESS) System Design and Implementation Best Practices.

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Structured Cabling System

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- .3 Telecommunications Project Management (TPM) reference Manual.
- .4 BICSI Telecommunications Distribution Methods Manual (TDMM).
- .5 BICSI: Information Technology Systems Installation Methods Manual.
- .2 Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.
- .3 Knowledge and execution of applicable standards and codes is the sole responsibility of the Contractor.
- .4 Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense.

## **1.2 DESIGN PERFORMANCE REQUIREMENTS**

- .1 This document provides the minimum performance criteria for the components and sub-systems comprising a complete cabling system that shall accommodate the Owner's requirements in excess of ten years.
- .2 General Scope:
  - .1 This document defines the cabling system and subsystem components to include cable, termination hardware, supporting hardware, and miscellany required to provide a complete telecommunications system. The intent of this document is to provide all pertinent information to allow the Contractor to bid the labor, supervision, tooling, and miscellaneous mounting hardware and consumables to install a complete system. However, it is the responsibility of the Contractor to propose in their bid any and all items required for a complete system if not identified in this specification.
  - .2 Product specifications, general design considerations, and installation guidelines are provided in this written document. If the bid documents are in conflict, the written specification shall take precedence. The successful Contractor shall meet or exceed all requirements for the cabling system described in this document.
  - .3 The successful Contractor shall furnish all labor, supervision, tooling, materials, supplies, miscellaneous mounting hardware and consumables for each cabling system installed in compliance with the specifications and drawings.
  - .4 The Contractor shall staff each installation crew with the appropriate number of trained personnel, in accordance with their manufacturer/warranty contract agreement, to support system Warranty requirements. After installation, the Contractor shall submit all documentation to support the warranty in accordance with the manufacturer's warranty.
  - .5 The Contractor shall provide cabling to all networked, AV and security devices. Where required the Contractor shall supply and install all the required material to form a complete structured cabling system.
  - .6 The Contractor is responsible for the supply and installation of all conduits required for structured cabling system.

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- .7 The work shall include the supply and installation of the following:
  - .1 Data Outlets.
  - .2 Category 6A horizontal distribution cable.
  - .3 Category 6A patch cords.
  - .4 Category 6A security device communication cables.
  - .5 Rack mounted copper CAT6A patch panels.
  - .6 Labelling and identification.
  - .7 Testing and commissioning of structured cabling system.
  - .8 Cable management hardware.
  - .9 Cable trays.
  - .10 Conduits.
  - .11 J-Hooks.
  - .12 Wireless Access Points (WAPs).
  - .13 All brackets, anchors, supports or other devices required to install the structured cabling infrastructure and Wireless Access Points (WAPs).
  - .14 As-built Plan Holders.
- .3 System Description:
  - .1 The Contractor shall provide new cable within protective conduit to all devices as shown.
  - .2 Conduit fill rate shall not exceed 40%.
  - .3 The structured cabling system consists of two (2) main areas:
    - .1 IT/Communication LAN/Data Rooms:
      - .1 Existing LAN/Data Rooms on Level 03.
    - .2 Horizontal cabling:
      - .1 Network data drops throughout the floor within the scope of areas identified on the drawings.

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Structured Cabling System

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- .2 All Category 6A network cable for data shall be provided by the Contractor. All cable to be in a protective conduit from wall to the nearest cable tray/J-Hooks in ceiling space in corridors. Cables to be run to the nearest LAN/Data room on Level 03 by using existing cable trays with maximum 40% fill ratio where possible. If existing cable trays are full with 40% fill ratio, provide new cable trays or J-Hooks if space is not available in corridors. The new horizontal CAT6A distribution cabling shall be installed on new CAT6A Patch Panels along with new horizontal cable managers mounted on existing IT Rack(s) in existing LAN/Data rooms.
- .4 Permits, Certificates and Fees:
  - .1 The Contractor shall include all costs associated with any permits or other fees and charges levied by the municipality or other governing authorities required to execute the work and obtain required inspections and certificates. All permits shall be obtained by the Contractor in a timely fashion.
  - .2 When work is complete, supply and turn over inspection certificated from governing authorities to the Owner's representative.
- .5 IT/Telecommunications/LAN/Data Rooms (Existing):
  - .1 Provide any required extensions/modifications to the conduit or cable tray system and new CAT6A Patch Panels along with Horizontal Cable Managers within the existing telecommunication LAN/Data rooms.
  - .2 Remove and pull back to source all existing data drops and associated cables from the field data devices as shown within the scope of areas identified on the drawings. Remove all abandoned cables from existing patch panels after pulling back to source in the existing LAN/Data Rooms.
  - .3 Prior to start of installation of any equipment, Contractor shall remove all water, dirt and debris of any kind from the telecommunications room. It shall be the responsibility of the Contractor to keep telecommunications LAN/Data rooms clean and free of dust at all times during the installation.

### 1.3 WARRANTY

- .1 General:
  - .1 Contractor shall provide a 25-year system warranty on all copper permanent cabling links.
  - .2 It is understood the warranty is a system performance warranty guaranteeing for 25 years from acceptance that the installed system shall support all data link protocols for which that Category 6A of copper cabling system is engineered to support according to current and future IEEE and TIA standards.
  - .3 The warranty may be invoked only if the cabling channel links are comprised of continuous components, including patch cords, and equipment cords.
  - .4 Upon acceptance of warranty, the manufacturer will mail a notification letter to the installer and a notification letter and warranty certificate to the Owner.

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Structured Cabling System

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.2 Contractor Warranty Obligations:

- .1 Contractor shall install all racking and support structures according to cited Standards in such fashion as to maintain both cited industry standards as well as manufacturer recommendations for uniform support, protection, and segregation of different cable types.
- .2 Contractor is responsible for maintenance of maximum pulling tensions, minimum bend radius, and approved termination methods as well as adhering to industry accepted practices of good workmanship.
- .3 Contractor is responsible for understanding and submitting to the manufacturer all documents required prior to project start to apply for the warranty.
- .4 Contractor is responsible for understanding and submitting to the manufacturer all documents required at project end. These include, but are not limited to: completed warranty forms, passing test reports and drawings of floor plans showing locations of links tested.
- .5 Test results shall be delivered in the tester native format (not Excel) and represent the full test report, summaries shall not be accepted. Contact the manufacturer representative for a current list of approved testers, test leads and latest operating systems.
- .6 The Communications Contractor will correct any problems and malfunctions that are warranty-related issues without additional charge to the Owner for the entire warranty period.
- .7 The warranty period shall commence following the final acceptance of the project by the Owner and written confirmation of Warranty from the manufacturer.

**1.4 SYSTEM VENDORS**

- .1 Vendor selected for provision of system to have following qualifications:
  - .1 Being 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 authorized distributor or established franchisee (certified system vendor) for manufacturer of product/system proposed, be experienced in installation and testing of data cabling systems, with full manufacturer's warranty privileges and be capable of providing post warranty service.
  - .3 Employ technicians who are RCDD/BICSI certified and 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.

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- .2 Vendors not meeting any of above qualifications may be disqualified at Owner's discretion and be replaced with qualified vendor.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS**

- .1 The Contractor shall be fully responsible for the ultimate design and implementation of the full system topology (physical and logical) best suited for the project, given identified and recognized physical infrastructure and constraints.
- .2 The Contractor shall use matched components from a single manufacturer, certified to deliver end-to-end system performance over the lifetime of the applications, which the cabling system was originally designed to support.
  - .1 The communications cabling system shall use matched components from a single manufacturer. Approved manufacturers are:
    - .1 R&M.
    - .2 Approved equivalent.
- .3 Comply with manufacturer's instructions and recommendations to meet the requirements of the specification.

### **2.2 NETWORK CABLING SYSTEM REQUIREMENTS**

- .1 Certified Category 6A horizontal copper cabling types shall be used. Identify clearly with Bid submission which product manufacturer is being carried.
- .2 Work must be installed by system manufacturer's certified system installers/vendors who are certified and experienced in implementing selected data cabling system and to perform related testing programs.
- .3 Work includes but is not to be limited to following:
  - .1 Provision of category grade rating Category 6A cabling system to each work area outlet identified on the drawings.
  - .2 Organized wiring in a structured cabling system using point to point distribution system incorporating modular terminations.
  - .3 Provision of data and voice cabling, data and voice communications outlets, patch panels, patch cords and associated equipment.
  - .4 System testing and verification.
  - .5 Provision of required ancillary devices as required to complete various system extensions work.
  - .6 Provision of required infrastructure of conduits, boxes, cable trays, J-Hooks, raceways, etc., necessary to support system.



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- .4 The local area network system uses standards based IETF TCP/IP and IEEE 802 protocols and specifications. Wiring configuration is based on "physical star" topology in which cabling runs emanate in radial pattern from data communications room in which intelligent ethernet routing switches are located.
- .5 Network cabling system vendor to 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 ANSI/TIA/NECA/BICSI Standards to accommodate CAT 6A required Category rating system wiring and devices, with particular emphasis on bending radii of cabling. Conduit and boxes not meeting required Category rating standard requirements to be replaced to suit.

## **2.3 CAT6A HORIZONTAL COPPER CABLING**

- .1 Horizontal cabling to data/voice outlets: Category 6A FT6 rated (i.e. suitable for use in plenum environments), unshielded twisted pair (UTP) cable in compliance with ANSI/TIA requirements for Category 6A transmission. Cable features include:
  - .1 Conductors: 4 pair, 23 AWG. solid copper conductor, UTP.
  - .2 Cable grade: Category 6A.
  - .3 Overall sheath: CMP/FT6 rated outer sheath.
  - .4 Overall outer jacket: low smoke PVC, of specific colors to identify each system as reviewed with Consultant and approved by Owner.
- .2 Category 6A system to meet or exceed ANSI/TIA standard for a Category 6A cable. Demonstrate that proposed manufacturer's solution is guaranteed to exceed Category 6A requirements across entire swept frequency range of 1 – 500 MHz minimum, by margin as per base specified product. Submit with shop drawings, ETL test reports to verify full channel performance of cable.
- .3 Approved manufacturers:
  - .1 R&M.
  - .2 Approved equivalent.

## **2.4 CAT6A UTP CONNECTING HARDWARE (FOR DATA/VOICE)**

- .1 Patch panels: Modular patch panels as follows:
  - .1 Category 6A patch panels, standard 8-position, RJ-45 style, FCC-compliant receptacle; panel frames to be black powder coated steel and sized in 24 ports configurations for each 1-RU rack mount unit.
  - .2 CAT6A Modular IDC style jacks to be approved by Owner and reviewed with Consultant.
  - .3 Panels designed for 4-pair, 100 ohm balanced UTP cable.
  - .4 Panels to have individual port identification numbers on front and rear of panel.
  - .5 Provide separate panels for each system.

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- .2 Each jack connector module to have a T568B eight pin RJ 45 jack on front and IDC type 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 Approved manufacturers:
  - .1 R&M.
  - .2 Approved equivalent.

## **2.5 CAT6A COPPER PATCHCORDS**

- .1 Patch cords: "CAT6A" series as follows:
  - .1 Category 6A patch cords constructed with polycarbonate 8-position plug, having vertically staggered, trifurcated gold-plated contacts.
  - .2 Patch cords with snag-less feature and integral to strain relief boot on each end; strain relief boot to be moulded PVC, and color matched to cable jacket.
  - .3 Standard patch cord lengths range from 600 mm to 3m.
  - .4 Of specific colors to identify each system as confirmed with Owner and reviewed with Consultant.
- .2 Provide sufficient quantity of patch cords at patch panel to activate each additional port. In addition, include required patch cords, jumper assemblies to connect additional ports to active switches / servers. Confirm exact requirements with Owner and review with Consultant.
- .3 Approved manufacturers:
  - .1 R&M.
  - .2 Approved equivalent.

## **2.6 CAT6A DATA/VOICE OUTLETS**

- .1 Data/voice outlets: "CAT6A" and meeting following specifications:
  - .1 Flush wall mounting faceplate to fit on single or dual gang recessed outlet box, complete with device bracket or provisions to hold jacks securely in place; with top and bottom labelling windows;
  - .2 Faceplates for wall mount phone applications to include suitable mounting studs;
  - .3 Modules: Category 6A, eight-position, RJ45, T568B configuration pinned; Modular IDC style jacks to be approved by Owner and reviewed with Consultant;

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- .4 Modules to be of specific colors to identify each system and reviewed with Consultant and approved by Owner.
- .2 Approved manufacturers:
  - .1 R&M.
  - .2 Approved equivalent.
- .3 Modular furniture faceplates:
  - .1 Modular furniture faceplates to be installed in furniture outlets that have a modular furniture knockout and unless otherwise noted, to consist of a minimum of 3 ports;
  - .2 Each outlet to be installed with specified and designated termination modules; provide blank cover insert on unused openings;
  - .3 Each outlet to be connected with home run wiring back to designated patch panel; do not splice wiring runs;
  - .4 Verify furniture manufacturer and model, and modular faceplate requirements prior to placing order;
  - .5 Final color and finishes approved by Owner and reviewed with Consultant.
- .4 Approved manufacturers:
  - .1 R&M.
  - .2 Approved equivalent.
- .5 Wall mounted telephone outlets to include features as follows:
  - .1 Required Category 6A 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 Accepts wall mountable phones with short patch cord connections to jack module.
- .6 Approved manufacturers:
  - .1 R&M.
  - .2 Approved equivalent.

## **2.7 CAT6A CABLE TESTING AND SYSTEM CERTIFICATION**

- .1 The cabling system will require 100% cable testing and verification.

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- .2 The Contractor shall be required to verify each cable and document results on a cable testing sheet which shall form part of the electronic and hard copy documentation supplied at the end of the installation. The testing sheets will list the detailed performance test measurements as requested and as required to prove compliance with the referenced standards. The Vendor will be required to submit a sample of test sheet with shop drawings.
- .3 Compliance with manufacturer's testing and certification procedures will be mandatory.

## **2.8 CAT6A CABLE TEST INSTRUMENTS**

- .1 Use only one style of test instrument for all measurements: use instruments of only one manufacturer for all measurements of one medium.
- .2 Use instruments manufactured by one of the following:
  - .1 Fluke Versiv cable tester (Versiv/DSX-5000/8000).
  - .2 VIAVI/JDSU NGC-4500 series.
- .3 Adapters:
  - .1 Use adapters designated by manufacturer as appropriate for the subject test.
  - .2 Indicate in test reports the product identification number of adapters used in test.

## **2.9 WIRE-MESH BASKET CABLE TRAYS**

- .1 Approved manufacturers:
  - .1 Cooper B-Line, Inc.
  - .2 MP Husky.
  - .3 Approved equivalent.
- .2 Description:
  - .1 Configuration: Wires are formed into a standard 50 mm (2 inch) by 101 mm (4 inch) wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.
  - .2 Materials: High-strength-steel longitudinal wires with no bends.
  - .3 Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing and T-weld is used to assemble the top longitudinal wires of the basket flanges and the U-shaped cross wires to maintain integrity of cables and installer safety.
- .4 Certifications:
  - .1 ULc or UL Canada or Certification acceptable to the AHJ.
  - .2 CSA 22.2 No 126.1 Metal Cable Tray Systems.

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- .3 NEMA VE 1.
- .5 Sizes:
  - .1 Straight sections shall be furnished in standard lengths and stackable.
  - .2 Wire-Basket Depth and Width: 50 mm usable loading depth by 100 mm width.
- .6 Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
- .7 Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
- .8 Hardware and Fasteners: Shall be of the same manufacture as cable tray.
- .3 Materials And Finishes:
  - .1 Steel:
    - .1 Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1011/A 1011M, SS, Grade 33 or ASTM A 1008/A 1008M, Grade 33, Type 2 or ASTM A510, Grade 1008.
    - .2 Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
  - .3 Finishes:
    - .1 Painted black, white.
    - .2 Zinc electroplated.
  - .4 Finish: Factory-standard primer, ready for field painting, with chromium-zinc-plated hardware according to ASTM F 1136.
  - .5 Finish: Black oxide finish for support accessories and miscellaneous hardware according to ASTM D 769.
- .4 Cable Tray Accessories:
  - .1 Fittings: Tees, crosses, risers, elbows and other fittings as indicated, of same materials and finishes as cable tray.
  - .2 Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.
  - .3 Accessories as required.
    - .1 Splicing kit.
    - .2 Edge hanger.
    - .3 Cantilever brackets.

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- .4 Underfloor C bracket.
- .5 Split bolt grounding lug and clamp.
- .6 Divider.
- .7 Radius drop.
- .8 Side bracket.
- .9 Radius control side wall brackets.
- .10 Vertical radius bracket.
- .11 Conduit bracket.
- .12 Solid liner insert.
- .13 Side supported cable hanger brackets.

## **2.10 WIDE BASE CABLE SUPPORTS**

- .1 J-hooks - Galvanized loop with integrated cable retainers, complies with TIA structured cabling system requirements.
- .2 Accessories: Provide applicable accessories to independently support J- hooks from structure. This includes extender bracket for mounting multiple J-hooks on a single support, fasteners and clamps for connecting to wall, beams, rods, dedicated support wires and C and Z Purlins as required for specific construction.
- .3 J-hooks shall be made of metal and/or plastic and shall be Plenum rated.
- .4 J-hooks shall be supplied and installed with all necessary fastening suitable for the building structure being used to support the cabling and as per the manufacturer's installation requirements or guidelines.
- .5 Approved Manufacturers:
  - .1 ERICO Caddy CableCat™ series.
  - .2 Cooper B-Line.
  - .3 Approved equivalent.

## **2.11 CABLE RETENTION WRAPS**

- .1 Only hook-and-loop ("Velcro") cable ties are permitted and only for use to retain cables in bundles and patch cords in bundles and cables in rack cable management.
- .2 Cable retention wraps permitted only of the type and where expressly indicated.
- .3 Hard nylon cable retention wraps (Tiewrap™) or like Products not permitted as communications cable retainers nor permitted to be in direct contact with cable jacket.
- .4 Velcro wraps shall be black.

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.5 Approved manufacturers:

.1 Thomas & Betts Corporation.

.2 Approved equivalent.

## **2.12 LABELS**

.1 General:

.1 All identifier labels shall be of a size, color, and contrast to be readily visible by those maintaining the system.

.2 All components of the Structured Cabling System shall be numbered including the following components:

.1 Horizontal cabling.

.2 Face Plates.

.3 Patch Panels.

.4 Patch panel ports.

.5 Patch Cords.

.6 IT Racks.

.7 Wireless Access Points (WAPs).

.3 Labels should be resistant to environmental conditions likely to be encountered where they are installed, such as moisture or heat, and should be designed to have a useful life equal or greater to that of the component labelled.

.4 Where possible, industrial grade adhesive should be used on labels.

.5 Device labels shall be installed on the exterior of all devices, when possible. Device labels may be installed on the interior of a device at the primary access point.

.2 Acceptable manufacturers:

.1 Brother International Corporation.

.2 Hellermann Tyton.

.3 Approved equivalent.

.3 Patch Panel, Cable, WAP and Conduit Labels:

.1 Labels shall use black lettering on a white background.

.2 To maximize legibility, all labels shall be printed or generated by a mechanical device and shall not be written by hand.

.3 Hand-written labels are only acceptable on a temporary basis during installation.

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- .4 Labels shall be able to withstand high and low temperatures without detaching.
- .5 Labels in exterior spaces shall be able to withstand extended submersion.
- .6 Labels shall be self-adhesive type.
- .7 The minimum font sizes are defined below:
  - .1 Patch Panel: Arial 10 point.
  - .2 Cable Label: Arial 10 point.
  - .3 WAP Label: Arial 10 point.

.4 IT Rack Labels

- .1 Each IT Rack shall be numbered and identified with a 19 mm x 50 mm ( $\frac{3}{4}$ " x 2") engraved lamacoid plate.
- .2 All labels shall use white lettering on a black background.
- .3 Label identifiers shall be Arial 24 font size.
- .4 Nameplates shall be securely fastened.

**2.13 FIRE STOP SYSTEM**

- .1 A fire stop system is comprised of an item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Fire stop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.
- .2 All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate fire stop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire stopped.
- .3 Fire stop systems shall be UL Classified to ASTM E814 (UL 1479) and shall be approved by a qualified Professional Engineer (P. Eng), licensed (actual or reciprocal) in Canada.
- .4 Acceptable rack manufacturer:
  - .1 EZ Path (STI Firestop).
  - .2 Approved equivalent.

**2.14 MISCELLANEOUS EQUIPMENT**

- .1 The Contractor shall provide any necessary screws, anchors, clamps, miscellaneous grounding, WAP mounting brackets and accessories, and support hardware, etc., necessary to facilitate the installation of the equipment cabinets and WAPs.

**2.15 SPECIAL EQUIPMENT AND TOOLS**



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- .1 It shall be the responsibility of the Contractor to furnish any special installation equipment or tools necessary to properly complete the System.

## **2.16 WIRELESS ACCESS POINT (WAP)**

- .1 Wireless Access Points (WAPs) shall be provided as indicated on the floor plans.
- .2 Contractor is responsible for installation, configuration, integration with existing wireless networks, testing and commissioning of all Wireless Access Points (WAPs).
- .3 The WAP shall have the following features:
  - .1 Wi-Fi 6 (802.11ax).
  - .2 Cisco RF ASIC.
  - .3 Uplink/downlink OFDMA.
  - .4 MU MIMO technology.
  - .5 BSS coloring.
  - .6 Dual 5-GHz radio support.
  - .7 Cisco Embedded Wireless Controller.
- .4 Acceptable rack manufacturer:
  - .1 Cisco Catalyst 9120AX Series Access Point.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 The cabling system shall be installed in accordance with manufacturer's recommendations and best industry practices.
- .2 All cables must be properly handled and installed in accordance with the manufacturer's specifications. Undue pulling tension, abrasion or rough handling must be avoided to ensure that the cables will permit transmission up to their designed speed for data cables.
- .3 All cables are to be secured to terminals and connectors such that a 10N pull force shall not affect the connection.
- .4 All cables must be installed without splices or cuts to ensure the elimination of reflections, discontinuities, impedance mismatches, etc.
- .5 Care shall be taken to ensure that during the installation, nicks, abrasions, burning and scuffing of cable is prevented.
- .6 Cables found to be damaged will be replaced at the Contractor's expense regardless of whether the cable passes the performance testing standards or not.
- .7 All bundled cables shall be correctly secured by Velcro straps.

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- .8 All wires and cables shall be formed, neatly laced or tie wrapped, and clamped in position. No adhesive or stick-on clamps are permitted. The use of any tape, such as masking tape or electrical tape is not acceptable.
  - .1 Wires and cables shall be continuous between termination and connection points. Connectors and splices shall be located within secure enclosures and are not permitted inside conduit.
- .9 Waterfall (rounded transition) fittings shall be used for cable changing from a horizontal path to a vertical one. This maintains the minimum bend radius for Category 6A cabling system.
- .10 All cables placed in the cable tray system in server room must be protected against any damage.
- .11 Cable ties shall be tightened so as not to deform cable jackets and thus affect cable performance.
- .12 Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA-568 standard document, manufacturer's recommendations, and best industry practice.
  - .1 Allow easy disconnection of equipment.
- .13 Allow a minimum of three re-terminations of each cable or wire in the event of breakage.
- .14 In the case of video cameras, 3m of slack cable in flexible conduit shall be provided to enable future relocation at each and every camera location.
- .15 All cables placed in cable tray in server room shall have slack placed where expansion joints occur. Expansion joints are installed to handle the effects of a seismic event that may cause tray movement.
- .16 Where wires run through holes or conduit, they shall be protected by suitable grommets.
- .17 Wires and cables external to equipment and enclosures shall be run in conduit. PVC conduit may be used underground. Where free movement of equipment is required, flexible conduit shall be employed. Once installed in the conduit, all cable shall be tested for continuity, insulation breakdown (skinning) and ground faults.
- .18 Provide conduits and raceways where required, provide stainless steel cover plates for back boxes that are not being used.
- .19 Care shall be taken so as not to damage cable during the installation process and that manufacturer's pull tension specification is not exceeded.
- .20 Wires and cables shall be located so that inductive and capacitive effects do not degrade system operation.

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- .21 All wires shall be terminated by soldering or by the use of solder-less terminals. Crimp lug terminals shall only be used on stranded wire. For devices utilizing solid wire, the solid wire shall be soldered to the terminal and the soldered portion insulated.
  - .1 All soldered joints shall be made mechanically sound before soldering. Leads shall not be wrapped more than once around a terminal. The wiring insulation shall not be heat damaged or stripped back more than 2 mm from the joint or termination. Flux residue shall be removed immediately after soldering by appropriate non-corrosive cleaners. Acid flux shall not be used for soldering.
- .22 Terminal and connecting blocks shall be of the screw type. As a minimum, all terminal blocks shall have 10% spare capacity. A barrier shall separate each termination. No more than two terminal lugs shall be clamped under each terminal screw. Solder, wire wrap and pressure termination type terminal blocks shall only be used with prior approval and where the need for this type of device has been demonstrated. No more than one wire may be connected to each terminal, except in permanent daisy chaining requirements.
- .23 Terminal lugs shall be suitably electroplated or treated by commercially acceptable methods to ensure good electrical contact and prevent corrosion.
- .24 No more than one wire shall be connected to each pin of a cable connector unless that pin has been designed to accept more than one wire. All strands of the wires shall fit into the pin receptacle. All cable connectors shall be field replaceable. Provision shall be made to fix the cable connector covers to a chassis or to each other by means of screws.
  - .1 Panels, doors and access shields shall be fastened with a suitable style of fastening compatible with the degree of security required for each enclosure and the frequency of access. There shall be no sign of cross-threading or mutilation on any screws or fasteners. All nuts shall be of standard size and preferably of hexagonal design. All threaded parts shall be secured by the use of lock washers except under counter sunk screw heads, coaxial plugs and similar connectors, terminal binding screws, etc.

### **3.2 HORIZONTAL DISTRIBUTION CABLE INSTALLATION**

- .1 A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.
- .2 Cable raceways shall not be filled greater than the ANSI/TIA-569 maximum fill for the particular raceway type or 40%.
- .3 The maximum horizontal cable length from the workstation to the network switch shall not exceed 90 m (295').
- .4 Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points that are within secure enclosures and are not permitted inside the conduit.
- .5 Where cables are installed in an air return plenum, riser rated cable shall be installed in metallic conduit.
- .6 Where transition points, or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.
- .7 The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.

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- .8 Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.
- .9 Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.
- .10 Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable.
- .11 Cables shall not be attached to or rest on liquid carrying pipes, medical gas pipes, electrical conduits.
- .12 The support system shall meet requirements for Category 6A bend radii.
- .13 Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
- .14 Cable supports must be installed every 4-5 feet at on irregular interval. At no point shall cable(s) rest on acoustic ceiling grids or panels.
- .15 Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the Contractor shall install appropriate carriers to support the cabling.
- .16 The Contractor shall not install cables under such strain as to require tying to supports.
- .17 All cables are to be installed in a neatly-dressed manner to their point of termination.
- .18 The Contractor is responsible to obtain and follow the manufacturers' installation instructions for products for correct termination and wire management of cables on respective products.
- .19 Cable routing is to avoid crossovers and congestion at all times.
- .20 Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification and the most recent ANSI/TIA-606 standard. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.

### **3.3 HORIZONTAL CABLE TERMINATIONS - CABINETS / ENCLOSURES**

- .1 All horizontal cable shall be installed per manufacturer instructions to ensure a manufacturer certified solution.
- .2 The Contractor shall neatly dress cables to their respective patch panel and within the cabinet with cable management using Velcro cable ties and/or rack cable management loops. Cables shall not be bundled outside of a rack but shall be loose and random in cable tray.
- .3 Provide identification labels for each cable.

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### **3.4 WORK AREA**

- .1 Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturer's bend radius. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. No more than 12" of UTP and 36" of fiber slack shall be stored in an in-wall box, modular furniture raceway, or insulated walls.
- .2 The Contractor shall leave 3m (10') of slack, be neatly coiled and stored in the ceiling above each drop location.
- .3 Prevent undue stress and strain on connectors and cables.
- .4 Allow easy disconnection of equipment.
- .5 Pair untwist at the termination shall not exceed 13 mm (one-half inch).
- .6 The Contractor shall install blank modules in faceplates as needed.
- .7 The Contractor shall install work area outlets as shown on the Communications/Systems Layout drawings.
- .8 The Contractor shall label outlets as shown on the drawings.
- .9 LAN/Data Rooms must be free from dust, dirt, and other foreign materials before the installation of any termination hardware or the termination of copper cables.
- .10 Bend radius of the cable in the termination area shall not be less than 4 times the outside diameter of the cable.

### **3.5 CABLE MATERIAL ACCEPTANCE**

- .1 Before installing any cable on site, perform the following material acceptance tests:
  - .1 Perform visual inspection tests on communications cables after delivery to site and before installation. Reject material which fails performance tests or appears physically damaged.
  - .2 Perform full performance testing on samples removed from each spool of communications cable after delivery to site and before installation. Submit the test results to the Engineer for review as a Shop Drawing. Record the manufacturer's production data as imprinted on the cable sheath. Use a cable sample of physical length 50 meters  $\pm$  500 mm. Retain sample for further testing until after Shop Drawings are returned as "Reviewed as Submitted".

### **3.6 VISUAL AND MECHANICAL INSPECTION**

- .1 Immediately following installation of cables and connector hardware, perform the following visual and mechanical inspections:
  - .1 Compare cable, connectors and splice data with Contract Drawings and Specifications.
  - .2 Inspect cable and connectors and connections for physical and mechanical damage.

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- .3 Verify that all connectors and splices are correctly installed.
- .4 Verify color and marking identification is correctly installed.

### **3.7 CAT6A COPPER CABLE TESTING**

- .1 Test CAT6A horizontal copper cables according to the following criteria:
  - .1 Cable length measurement and construction defect inspections.
  - .2 Connector integrity tests.
  - .3 Cable and connector attenuation and performance testing.
  - .4 For CAT6A horizontal UTP cabling, perform tests on the permanent link, testing for length, attenuation, near end crosstalk, far end crosstalk, delay, and delay skew. Comply with TIA 568 standard and limits. Report on actual measured values and deviation (headroom) from the standard values. Channel testing is not acceptable. Permanent links which report as outside the tolerance of the test instrument (\*) (conditional PASS) will be interpreted as FAIL.
  - .5 For Category 6A cabling, and on request of the Engineer, conduct tests to 500 MHz for alien cross talk measurements on an audit basis as per TIA 568 (latest) standard on two samples of six-around-one cable sets selected by the Engineer.
  - .6 Test coax cabling for center conductor continuity, shield continuity, impedance (75 ohms), and attenuation to limits dependent on the application as described in TIA 942 (latest).
- .2 Test Values
  - .1 Assemble test results and submit to the Engineer in a timely manner.
  - .2 Analyze the results and repair or replace cabling so that the Work results comply with the Specifications.
  - .3 Verify that the installed cabling conforms to the manufacturer's Specifications.
  - .4 Test all installed cabling to the full extent of the specifications.
  - .5 Cables with marginal PASS are not acceptable. A marginal pass is one typically indicated as \*PASS.

### **3.8 REPAIRS**

- .1 Replace defective or damaged cables and components and re-execute tests.
- .2 Replace defective cables without splicing where splicing is not permitted.

### **3.9 CABLE AND EQUIPMENT LABELLING**

- .1 Functional or alpha-numerical mechanically printed labelling shall be installed on all equipment. All visible wires and cables typically accessed for service shall be labelled at both ends. As well, all connecting strips, terminal blocks, plugs and sockets shall be labelled. The marking on the labels shall be consistent with the As-Built Drawings.

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Structured Cabling System

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- .2 Approved materials for labels include alphanumeric labels protected by clear heat shrink material, tie-wrap labels, lamacoid strips, etched metal or indelible ink. The use of Dymo tape (or equivalent) labelling is not permitted.
- .3 The Contractor is required to submit their cable and equipment labelling standard to the Consultant for prior approval. Handwritten labels are not acceptable.

### **3.10 CABLE MANAGEMENT – HORIZONTAL**

- .1 General Requirements:
  - .1 All horizontal and vertical wire and cable management devices or assemblies shall be placed and installed as not to impede the efficient use or connection to adjacent panels, enclosures or equipment.
  - .2 All covers, doors, and panels removed for the purpose of placement or fastening shall be replaced upon completion of the task.
- .2 Horizontal Cable Managers:
  - .1 When more than one horizontal cable manager is used on a cabinet or group of cabinets, use the same make, and style of cable manager on the rack/frame/cabinet or racks/frames/cabinets.
  - .2 The color of the cabinet(s) and cable manager(s) must match.
  - .3 Attach horizontal cable managers to the rack/frame/cabinet with four screws according to the manufacturer's installation instructions. Each cable manager should be centered within the allocated rack-mount space (RU).
  - .4 Horizontal managers will be located so that the number of ports (cables) they support will not exceed the cable fill capacity of the cable manager.
  - .5 Covers should be attached to the cable manager and in the closed position after cabling is complete.
  - .6 Equipment rack horizontal cable/wire management panels will be installed directly adjacent to (above and below) all distribution enclosures, patch panels, and termination hardware within the rack as depicted in appropriate project details.

### **3.11 J-HOOKS**

- .1 Support all cables not supported in conduits and cable tray with J-Hooks.
- .2 Suspended ceiling and T-Bar hangers shall not be acceptable in any situation.
- .3 J-Hooks shall be installed every 915 mm (36 inch) to 1200 mm (47.24 inch) to support cabling (ensure that the distance between j-hooks is not consistent; do not place j-hooks the same distance apart repeatedly if at all possible).
- .4 All cabling shall be installed to have no more than 76 mm (3 inch) sag between J-hooks. All cabling shall be fastened using Velcro Ty-Wraps only. The Communications Contractor will be responsible for all costs associated with removing other fasteners and install the specified product.

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Structured Cabling System

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- .5 Install supports to route cables parallel and perpendicular to building lines. Hang cable supports from 3/8-inch all thread rods, dedicated #8 galvanized ceiling drop wire or wall brackets connected directly to structure. Do not support from the ceiling grid or ceiling wire system.
- .6 Provide the appropriately sized J- hooks as required. Minimum 25 mm (1 inch) width and flared edges where cables enter and leave support. 50 mm (2 inch) diameter loop for (25) 4-pair UTP cables and 101 mm (4 inch) diameter loop for (50) 4-pair UTP cables.
- .7 Provide multiple hooks at each hanger location as required by cable count and cable segregation requirements.
- .8 Install cable bundles no closer than 127 mm (5 inch) in all directions from ballasted light fixtures.
- .9 Where main pathways are indicated on the contract drawings, contractor shall follow indicated pathway as closely as possible according to field conditions. Pathway for smaller cable counts shall be laid out and documented on the as-built drawings by the contractor.
- .10 Where specific main pathways are not indicated, the cable pathways for all communication systems shall be laid out by the contractor and coordinated with other disciplines and the systems designer.
- .11 Do not tie wrap cables to the J-hooks. Provide cable retainers at each J-hook.
- .12 Provide applicable accessories to independently support J-hooks from structure, including extender bracket for mounting multiple J-hooks on a single support, fasteners and clamps for connecting to wall, beams, rods, dedicated support wires and C and Z Purlins as required for specific construction.
- .13 At a minimum, brace multiple J-hook assemblies from structure with diagonal braces at each change of direction.
- .14 Coordinate the allocation of ceiling space and the mounting elevations of various systems to allow maintenance and accessibility for future modifications. Cable supports shall be as close to the ceiling as possible while allowing ceiling tiles to be removed. Supports shall be located to avoid interference with maintenance access to other equipment.
- .15 If the quantity of cables exceeds 80% of the manufacturer's capacity rating install the next larger size or substitute with cable slings at no additional cost to the Owner.
- .16 J-hooks shall be installed in coordination with other building services and without interruption to the Owner within the building.

### **3.12 CABLE CONTAINMENT**

- .1 Cable exits shall be strictly controlled such that additional cables can be easily and neatly added in the future.
- .2 Loose laid cables shall not be permitted. All cables must enter and leave the cable containment system in the most direct manner.
- .3 Cables shall not be laid on areas exposed to external weather conditions. Cable shall not be laid on wet or damp concrete surfaces and any water or moisture subsequently detected after cable placement shall be assessed for remedial action.



## Structured Cabling System

- .4 Conduits shall not exceed a fill ratio of 40% to allow for future installation of cables.
- .5 Cables shall enter and exit conduit such that complete separation between communications and power compartments is maintained.
- .6 The number of cables in each conduit shall be controlled to allow for future cable installation and to stay within the manufacturer's maximum allowable cable pulling tension.

### 3.13 CABLE RETENTION WRAPS

- .1 Velcro wraps shall be installed at every J-hook, between every pair of J-hooks or within 50 mm (2 inch) of a J-hook to bundle cabling neatly.
- .2 Velcro wraps shall be installed every 915 mm (36 inch) to bundle cabling installed in cable tray neatly.
- .3 Velcro wraps shall be installed every 152 mm (6 inch) to neatly bundle cabling at all locations on racks, cabinets, patch panels and IDC mounts.

### 3.14 SEPARATION FROM SOURCES OF ELECTROMAGNETIC INTERFERENCE (EMI)

- .1 All cables shall be separated from sources of electromagnetic radiation in accordance with TIA Standard Proposal SP 2072 and the following:

Item	Minimum Separation Distances		
	<2kVA	2-5kVA	>5kVA
Unshielded power lines or electrical equipment in proximity to open or non-metallic pathway.	127 mm (5")	305 mm (12")	610 mm (24")
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway.	64 mm (2.5")	152 mm (6")	305 mm (12")
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway	-	76 mm (3")	152 mm (6")
Motors	1.2 m (4'-0")		
Transformers	1.2 m (4'-0")		
Conduit and cables used for electrical distribution less than 1kV	0.3 m (1'-0")		
Conduit and cables used for electrical distribution greater than 1kV	1.0 m (3'-0")		
Fluorescent Luminaires	300 mm (12")		
Pipes (gas, oil, water, etc.)	120 mm (5")		
HVAC (equipment, ducts, etc.)	150 mm (6")		

**3.15 IDENTIFICATION LOG**

- .1 Cable Identification Log shall be recorded in Excel.
- .2 A hard and soft copy Cable Identification Log is to be handed over to the Consultant within 30 days of substantial completion.

**3.16 FIRESTOP SYSTEM**

- .1 The Contractor is responsible to Fix / Make right all Firestop penetrations that cables have passed through where disrupted existing firestop with the same product.

**3.17 AS-BUILT DOCUMENTATION**

- .1 The Contractor shall provide full-size hard copies of each as-built floor plan showing the voice and data outlets on each floor within the scope of areas identified on the drawings.
- .2 All cables, patch panel ports and outlet ports with the corresponding existing telecommunications LAN/Data room number shall be recorded in excel spreadsheets for submittal.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 Submittals**

- .1 Submit shop drawings for products specified in this Section.
- .2 Submit documents as outlined in requirements for system vendor qualifications.

### **1.2 Software Nomenclature Reprogramming**

- .1 Include for system manufacturer to make necessary on site final changes to applicable system/equipment software. Software revisions to incorporate final room names/area names/building names, equipment identification naming and Owner approved and reviewed with Consultant sequence of operations. 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 review with Consultant.

### **1.3 System Vendor/Supplier Qualifications**

- .1 Supplier/installer of system to be an established communications and electronics contractor that has and currently maintains a locally run and operated business for at least 5 years and holds applicable provincial and local licenses.
- .2 Supplier/installer to be a valid authorized distributor for product/system proposed with full manufacturer's warranty privileges.
- .3 Supplier/installer to employ technicians who have attended and successfully completed manufacturer's technical certification training for proposed system.
- .4 Supplier/installer to maintain a fully equipped service organization capable of furnishing adequate inspection and service to system. Supplier/installer to maintain at their facility necessary spare parts in proper proportion as recommended by system manufacturer to maintain and service equipment being supplied.
- .5 Submit with shop drawings documents that show satisfactory evidence of above requirements.

## **PART 2 - PRODUCTS**

### **2.1 Paging and Public Address System - General**

- .1 Scope of Work:
  - .1 Electrical infrastructure work to be provided by electrical contractor to accommodate public address (PA) system and include but not limited to provision of following:
    - .1 engaging qualified sound system vendor to provide PA system work;
    - .2 rough-in conduit for system complete with nylon fish cord in any conduits 20 mm (3/4") diameter or less and 3 mm (1/8") nylon rope in any conduits larger than 20 mm (3/4") diameter;
    - .3 termination of rough-in conduit in designated room in a junction box of minimum dimension 300 mm x 300 mm (12" x 12"), located adjacent to conduits leading to PA communications cabinet;

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- .4 120 VAC dual gang twist lock outlet within 1m (3.3') of PA cabinet;
- .5 as coordinated with PA system vendor, installation of wiring into conduits/raceways; wiring to be supplied by PA system vendor;
- .6 Coordination of work with various trades and system vendors.
- .2 PA system vendor to provide PA system and include but not be limited to provision of following:
  - .1 control equipment, amplifiers, mixers, equalizers, software, equipment racks, power supplies and accessories required for a complete operating system to distribute audio throughout areas;
  - .2 system programming;
  - .3 final terminations of cabling system components;
  - .4 system installation, inspecting, set-up, adjusting, testing and verifying entire system including, speakers and interconnected equipment, as applicable.
- .2 System to be integrated system with required CSA approvals, ULC listings and ESA inspection approvals, as required.
- .3 System to provide paging on a zoned basis and all call throughout project areas and in selected zones. Unless otherwise noted, minimum number of zones are identified on drawings. Include additional spare 20% number of zones for future requirements. System supplier to provide detailed design of system to meet specific requirements of Owner and submit detailed drawings with shop drawing submission. Provide additional components to supplement specified components as required to provide a fully integrated system.
- .4 System to be typically based on 70 V distributed system but system vendor is to review project requirements and determine system best suitable for project applications and review with Consultant prior to start of work. Submit detailed design requirements with shop drawing submission.

## **2.2 Paging and Public Address System Components**

- .1 Products herein specified are typical requirements for pricing and outline general minimum performance requirements. Sound system vendor to be responsible for ensuring products provided are suitable for specific applications to perform functionality to Owner's approval. Where specified products have become discontinued, provide suitable latest replacements as per manufacturer's recommendations.
- .2 System head end: microprocessor based and controlled public address system with following features:
  - .1 LCD type screen for display of system menu with system functions, zones and operating commands;
  - .2 program distribution and paging functions;
  - .3 built-in and remote diagnostics;
  - .4 built-in tone generator and chime;
  - .5 user programmable inputs and outputs;
  - .6 user option of handset or push to talk speaker/microphone communications;

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- .7 keypad control or selection switches for paging to selected zones and all call;
- .8 speaker zoning configuration to be easily revised through software programming; include for paging zones as specified above; each paging device to be capable of zone selection;
- .9 distribution of program sources to be accomplished from console keypad and distributed to zones on an All Call or selected zone basis;
- .10 background music interface connections and distribution;
- .11 bridging control to override any local amplifiers in event of emergency paging.
- .3 System PA management system (DSP) providing functionality as follows:
  - .1 programming and testing of system;
  - .2 switching of audio channels to required zone drivers;
  - .3 supplies power to system devices as required;
  - .4 interfacing telephone circuits to required zones; provides appropriate paging telephone interface;
  - .5 audio input channels that can each provide an audio output on any pre-configured group combination or manually selected zone; ALL Call broadcast to all zones simultaneously; system to be programmed to provide paging to individual zones, page combination of zones or page to all loudspeaker zones. Each loudspeaker zone to have dedicated cable homerun back to dedicated output channel on head end PA equipment;
  - .6 appropriate zone driver and zone relay plug-in cards for the requisite number of drivers/zones within system; audio channels are interfaced to driver input/output circuits by zone driver and relay cards;
  - .7 AUDIOSTAT Ambient Level Sensing control system that provides automatic ambient noise compensation to any required loudspeaker zone;
  - .8 configurable automatic Day/Night audio level capability;
  - .9 automatic Daylight saving time adjustments;
  - .10 capable of broadcasting simultaneous pages from paging devices, providing there is no zone conflict; when PA announcements to a common zone (or zones) are initiated from different paging sources at same time, PA management system to control broadcast sequence; priority of message broadcast to be programmable based on paging source and having priority as confirmed with Owner and reviewed with Consultant;
  - .11 system partitioned such that zones may have different sources at same time.
- .4 TOA M9000M2 Digital Mixer:
  - .1 LCD screen for display of control functions.
  - .2 GUI for PC programming.
  - .3 Digital signal processing.
  - .4 eight input channels and eight output channels.
  - .5 Digital audio signal reference level: -20 dB FS.

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- .6 Frequency Response: 20 Hz – 20 kHz, +1, -3 dB.
- .7 Total Harmonic Distortion: 0.008% (at 22 kHz LPF, 1 kHz, +10 dB (\*1) output).
- .8 Signal to noise ratio: At Input short, 20 Hz – 20 kHz, set to ALL FLAT or OFF setting.
- .9 Output volume min.: 90 dB.
- .10 Output volume max.: 61 dB (Input 1 volume: 0 dB, Other Inputs: OFF).
- .11 Cross talk: 64 dB or more (at 20 kHz).
- .12 Tone Control: Bass:  $\pm 12$  dB (at 100 Hz), Treble:  $\pm 12$  dB (at 10 kHz).
- .13 Parametric equalizer: 10 bands, Frequency: 20 Hz – 20 kHz, 31 points, Variable range:  $\pm 12$  dB, Q: 0.3-5.
- .14 Speaker equalizer: 10 (setup software has 30 TOA speaker presets).
- .15 High-pass filter: -12 dB/ oct, Variable frequency range: 20 Hz – 20 kHz, 31 points.
- .16 Low-pass filter: -12 dB/ oct, Variable frequency range: 20 Hz – 20 kHz, 31 points.
- .5 TOA DA250FH series amplifiers:
  - .1 Solid state modular 4 channels amplifiers.
  - .2 Frequency response: within  $\pm 1$  dB from 20 Hz to 20 kHz, HPF off.
  - .3 Total harmonic distortion at full rated output: less than 0.3%.
  - .4 Power output rated at 1000W at 1 kHz, all channels driven; 250W for 70V channels.
  - .5 System components protected by electrical current limiting and thermal overload devices.
  - .6 Incorporate a 70 volt output transformer and output wiring via dual parallel terminals; one set of terminals used only for 70 volt monitoring purposes.
  - .7 Inputs: one (1) balanced on screw terminals and one (1) unbalanced Phono jack.
  - .8 120 VAC supply to power amplifiers.
  - .9 Built in monitoring outputs available for Overload, Overtemp and Power On in addition to a combined OR output.
  - .10 Safeguards: short circuit, peak overload, current limiting, thermal runaway and DC output.
  - .11 An input Gain adjustment provided on front cover in addition to status LEDs indications of Power On, Overload and Overtemp.
  - .12 Maximum working load on any amplifier not to exceed 75%.
  - .13 Maximum 1U high and convection cooled.
  - .14 AC circuit breaker mounted on front panel.
  - .15 Automatic volume adjustments provided via controller over range of -30 dBm. to +3 dBm. at amplifier input and this adjustment is controlled via a real time clock.

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- .16 Provide quantity of amplifiers to accommodate connected dedicated circuited speaker loads and 20% future provisions. Do not load speaker circuits more than system manufacturers' recommendations, but no greater than 80%.
- .6 Music Sources:
  - .1 System to include Ethernet interface components to allow for connection to third party music source signal.
  - .2 System to include MP3 docking station, with suitable output and connections to allow users to play their selected audio recordings.
- .7 Review speaker mounting requirements on drawings, onsite and with Consultant to suit and coordinate with wall and/or ceiling structure of room and areas. Where speakers are recessed mounted, ensure that speaker assembly can be accommodated within ceiling space / wall cavity and that speaker is mounted within a back box that is acoustical type and ULC approved for application. Provide suitable ULC listed insulated back cans for plenum installation applications.
- .8 Climate Controlled Finished Areas Speakers: TOA "PC-580RU" series 305 mm (12") diameter ceiling speaker system as follows:
  - .1 Rated input: 10 W (speaker); 5W (transformer, 70.7 V line and 25 V line).
  - .2 200 mm (8") dual cone type speaker.
  - .3 Magnet: 272g (10 oz).
  - .4 Frequency response from 50 Hz to 16.5 kHz.
  - .5 Sensitivity of 97 dB (SPL 1w/1m).
  - .6 70 V or 25 V transformers, as required.
  - .7 Finished painted white steel plate baffle.
  - .8 Ceiling mounting accessories: back box, rails, trim ring and hardware to suit specific installation requirements.
  - .9 Plenum rated applications with metal back can.
- .9 Exterior Speaker Horns: TOA "SC-630T" series paging horn speaker as follows:
  - .1 outdoor rated, weather-resistant, IP65 rated;
  - .2 sealed high compression driver with DC blocking capacitor for audio supervision;
  - .3 30W tap with 70 V / 25 V line matching transformer, as required;
  - .4 113 dB (1 W, 1 m at 500 Hz to 2.5 kHz peak level);
  - .5 Frequency Response: 250 Hz - 10 kHz;
  - .6 Finishes:
    - .1 Horn flare: Aluminum, off-white, powder coating.
    - .2 Reflector horn and rear cover: ABS resin, off-white.
    - .3 Bracket, screws and bolts: Stainless steel.
    - .4 Speaker cable: Polyvinyl chloride insulated cab tire cable.
  - .7 weather-proof back box suitable for mounting applications.

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.10 Ambient Noise Sensors:

- .1 Ceiling mounting;
- .2 Sensitivity:  $-35 \pm 4$  dB(0 dB = 1V/pa, 1 kHz);
- .3 Directivity: Omnidirectional;
- .4 Frequency Range: 20-20,000 Hz;
- .5 S/N Ratio: More than 62 dB;
- .6 Measurement Range: 35 to 95 dB at 17 mV/Pa;

.11 Equipment Enclosure: system head end equipment installed in modular designed 19" EIA floor mount cabinet enclosure with following features:

- .1 suitable for 19", 35 U of rack mount equipment;
- .2 hinged lockable front and rear door;
- .3 ventilation louvers on front and sides;
- .4 150 mm (6") high cabinet base with heavy duty swivel castors, supporting cabinet frame structure;
- .5 external dimensions of approximately 559 mm W x 635 mm D x 1500 mm H (22" x 25" x 60");
- .6 welded steel construction with internal mounting rails with wire and cable entry points located at the top of cabinet only;
- .7 textured black powder coat finish;
- .8 cables entry from overhead via conduit; conduit to be sized appropriate for number of communication and power cables required;
- .9 feeder speaker cables entering cabinet connected shall be horizontally mounted "quick disconnect" terminal rail; quick disconnect facility to allow an individual outgoing P.A. zone to be quickly disconnected from controller without the use of a screwdriver; rail to be suitably marked to identify each respective zone/cable and incoming cables to be immediately tie wrapped to rigid internal cable bars to prevent undue movement and then routed through cabinets cable duct; termination rail also provides individual earth terminals to allow screen of each zone cable to be grounded; terminal rail diagram to be included in system manual; "quick disconnect" terminal rail also accommodates all incoming audio, control, telephone and 4 wire cables providing adequate terminal segregation from cables; cables to be installed, dressed and terminated and meet or exceed prevailing documented installation and equipment standards; route cables through internal cable management ducts to prevent deflection and undue movement caused during delivery, installation, calibration and or servicing;
- .10 wiring ducts for cable management;
- .11 grounding and bonding components;
- .12 drawing pocket attached to inside of rear door of cabinet and a terminal wiring diagram to be inserted;
- .13 uniquely stamped stainless steel label installed on front door of cabinet identifying serial number, equipment supplier/manufacturer;



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- .14 incorporate required lacing bars, power strips suitably wired to their respective control circuits and terminal rail connections;
  - .15 unused cabinet spaces to be provided with appropriate vent and blanking plates;
  - .16 internal wiring to be marked with point-to-point identification using heat shrink sleeve markers;
  - .17 CSA approved and bear the correct labels, unique serial number and certification.
- .12 Power Supplies and Surge Protection:
- .1 PA Control cabinet to be powered from +/-5vdc and +24vdc, CSA approved low voltage power supplies.
  - .2 Control system power supplies to be installed on quick disconnect DIN rail.
- .13 Paging Microphones and Outlets:
- .1 Handset microphone at head end:
    - .1 moving coil microphone with a large talk switch and a lock lever;
    - .2 Frequency Response: 100 Hz – 10 kHz;
    - .3 Microphone Head: zinc plated steel wire, gray baked paint.
  - .2 Remote Desktop Microphone Station:
    - .1 Unidirectional electret condenser microphone;
    - .2 Minimum 3 zone selection functionality keys;
    - .3 all call key, cancel key, talk key and lock lever;
    - .4 Microphone volume control;
    - .5 Distortion 1% or less;
    - .6 S/N Ratio 60dB or more;
    - .7 Frequency Response: 100 Hz – 15 kHz;
  - .3 Microphone Outlets:
    - .1 XLR, 3 pin type jacks suitable for microphones; mounted on stainless steel faceplate and suitable for mounting on flush, wall boxes; include wiring extending to interconnect box or back to head end equipment, to suit system design.
- .14 Volume Controls: Multiple step volume attenuators as follows:
- .1 auto transformers with silver plated contacts;
  - .2 ten position, non-shorting rotary switch without stop, attenuation rate is 1.5dB per step;
  - .3 OFF control;
  - .4 decorative skirted control knob;
  - .5 decorative single gang thermoplastic or thermoplastic, single gang faceplate;
  - .6 final finish as reviewed with Consultant and approved by Owner.
- .15 Wiring and Ancillary Devices:

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- .1 Wiring and ancillary devices to be provided to complete total installation of system in accordance with the equipment manufacturer's requirements.
- .2 Telephone system interface compatible with building telephone head end equipment to allow for paging through telephone system.
- .16 System Start-up, Testing and Verification:
  - .1 Provide system start-up, testing, inspection and verification work.
- .17 Instructions:
  - .1 Provide instruction on operating and maintenance of system.
- .18 Acceptable Manufacturers/Installers:
  - .1 Acceptable paging system components manufacturers are:
    - .1 TOA Canada;
    - .2 Bogen;
    - .3 Telecor;
    - .4 Rauland;
  - .2 Refer to Part 1 requirements for acceptable system suppliers and installers and if complying with Part 1 requirements, may include:
    - .1 Chubb Edwards;
    - .2 Minelec;
    - .3 AATEL Communications;
    - .4 Barrie Communications;
    - .5 Other local qualified sound system vendors approved by Owner and reviewed with Consultant.
  - .3 Systems to be installed by system manufacturer's authorized and trained vendors. Submit proof of vendors valid qualifications with shop drawing submission.

## **2.3 Integrated Systems Work**

- .1 Sound system work includes integration to auxiliary building systems including:
  - .1 fire alarm;
  - .2 building automation;
  - .3 security.
- .2 Coordinate with and engage respective system vendor to provide required integration work to respective system to accommodate interconnections.
- .3 Provide alarm/communications circuits as required. Include for provision of conduits, boxes and control/signal wiring for interconnection to various integrated systems. Coordinate with existing system vendors on location of connection panel to be used for monitoring points and extend wiring in conduit from electrical equipment to location. Terminate in junction box leaving 3 m (10') of slack length of wiring (exact length to be coordinated between vendors and Electrical trades), for extending and termination to systems by system vendors. Properly identify wiring and junction box.

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- .4 Include for required programming and testing of each integrated system and certification that each system is proper working order.

## **PART 3 - EXECUTION**

### **3.1 General PA Installation Requirements**

- .1 System vendor to review Contract Documents and submit as part of shop drawings:
  - .1 proposed equipment and system operation functionality;
  - .2 detailed design installation drawings, equipment layouts, wiring diagrams and associated design and installation documents;
  - .3 identify paging zones;
  - .4 identify typical design sound levels.
- .2 Provide complete PA system fully installed, programmed, tested, verified and certified.
- .3 Obtain required training from manufacturer's representative on any special installation procedures. Install products in accordance with manufacturer's instructions to suit specific installation requirements.
- .4 Confirm wiring types and conduit and box requirements with system vendor and/or manufacturer. Verify exact conduit system configuration and routing on site.
- .5 Typically install wiring in conduit or raceways. Where permitted by Owner and reviewed with Consultant, use "J" hooks in accessible ceiling spaces, to ensure proper installation of cables that are not installed in conduit or raceway systems. UTP structured cabling must follow TIA/EIA standard methodology as noted in TIA/EIA 568.
- .6 Provide supervision and execution of installation of cabling for pulling tensions, quantities, types, lengths, routing cable, group separation, and identification.
- .7 Review installation and location of outlets with Consultant. Install cover plates to outlets.
- .8 Where ceiling tiles have been installed, be responsible for removal and re-installation of tiles. Tiles and grid members which have been marked or damaged during installation of this system to be replaced by this Contract. Verify conditions on site.
- .9 Co-ordinate work of each vendor/trade on site.
- .10 For installation of wiring and equipment ensure that following guidelines are met:
  - .1 manufacturer's recommended installation specifications for equipment and materials;
  - .2 avoid sources of EMI (electro-magnetic interference);
  - .3 maintain minimum of 125 mm (5") of separation from fluorescent lighting ballasts;
  - .4 do not run data/voice/paging and power cables together in a shared conduit or pull box;
  - .5 avoid sources of heat such as heating ducts and hot water pipes;
  - .6 use proper cabling paths to improve cable management;
  - .7 use same pin/pair assignments throughout entire system;
  - .8 maintain pair twists as close as possible to point of mechanical termination;

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- .9 never exceed a 90 degree bend radius for any cabling;
- .10 never tighten ties around cabling to a point where they are not able to be moved;
- .11 use appropriate professional methods for dressing and securing cables;
- .12 never allow cabling to rest on drop ceilings;
- .13 leave slack (minimum 450 mm [18"]) on each end of cable run in event of servicing or other requirements;
- .14 do not install microphone wiring in same conduit as speaker wiring;
- .15 make connections of 2 pair cable to multi conductor cable with approved crimp connectors;
- .16 do not splice wiring;
- .17 balance audio circuits to ground.
- .11 Ground and bond system as required by local governing electrical code and authority and system manufacturer. Ground and bond equipment used in installation that has potential to conduct current, i.e. equipment racks, metallic pathways, and wall mount enclosures. Ground and bond each equipment rack.
- .12 Identification:
  - .1 Permanently identify cables, racks, terminal blocks, and junction ports at each cable end and component demarcation with information necessary for troubleshooting and in a manner approved by Owner and reviewed with Consultant. Labels to reflect home run wiring closet and termination port.
  - .2 Label cables with room numbers.
  - .3 Ensure that system cables are tested, certified, and labelled.
- .13 Wiring Closet Layout:
  - .1 Termination equipment installation locations such as P.A. cabinet, telephone cabinet, BIX blocks, IDFs and other equipment to be installed as shown on drawings or reviewed with Consultant. Bolt floor standing equipment racks to floor, maintaining minimum 900 mm (36") clearance at front of rack, 1200 mm (48") clearance at rear of rack, and 900 mm (36") on at least one side of rack.
- .14 Acceptance Testing:
  - .1 Test cables for correct continuity and polarity and for shorts.
  - .2 Provide programming and adjusting of features and balancing of components to satisfaction of Owner and reviewed with Consultant.
  - .3 Measure sound levels and identify if levels meet design requirements;
  - .4 System will be deemed fully installed and accepted when Owner and Consultant has agreed that installation tasks are complete, issues resolved and requirements met.
  - .5 Demonstrate operation of system including integrated auxiliary systems functionality to Owner and Consultant.
- .15 Training:

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- .1 Perform on-site training of users (including provision of user guides) prior to cut-over and to attend at site week following cutover to ensure that Owner's staff are properly trained in operation of system. Training to consist of two full days of basic use, and detailed training on functional use of system.
  - .2 Train up to 4 selected appointees in complete administration of system and of its component subsystems. Include also for in-house training on software operation of system to up to 4 designated Owner staff.
- .16 Documentation:
- .1 Provide manufacturer technical documentation indicating equipment specifications and hardware modules included in system to Owner. Provide complete warranty details for hardware and labour used in system.

### **3.2 Installation of PA System Components**

- .1 Provide system components to serve areas for PA operations.
- .2 Obtain required training from manufacturer's representative on any special installation procedures. Install products in accordance with manufacturer's instructions to suit specific installation requirements.
- .3 Install central control unit/paging console and remote microphones in locations as confirmed with Owner and reviewed with Consultant. Connect complete. Provide paging zones and system sequence of operation as confirmed with Owner and reviewed with Consultant prior to start of Work. Programme system to suit Owner's requirements. Partition system such that zones may have different sources at same time.
- .4 Typically provide each paging zone with dedicated amplifier.
- .5 Confirm music source requirements with Owner. Connect sources to control equipment.
- .6 Mount control equipment in equipment rack.
- .7 Install microphone outlets, remote interconnect boxes and auxiliary devices where required. Secure each in wall mounted outlet boxes and connect complete. Review exact type of outlets with Consultant prior to ordering.
- .8 Mount recessed speakers and enclosures recessed in ceiling structure in accordance with manufacturer's recommendations and reviewed with Consultant. Secure speakers with suspension chains from ceiling slab. Do not support speaker assembly from suspended ceiling system.
- .9 Mount surface speakers and enclosures to ceiling slab in accordance with manufacturer's recommendations and reviewed with Consultant.
- .10 Confirm exact height and locations prior to roughing in. To maintain maximum flexibility in use of areas, each speaker to be "home run" wired back to central equipment rack and connected to monitor panel/speaker selector switches, as applicable. Review requirements with Consultant. Review finishes with Consultant prior to ordering.
- .11 Exact speaker locations and aiming to be co-ordinated on site with sound system contractor and reviewed with Consultant to ensure minimum feedback effects and proper coverage of areas, prior to roughing in work. Prepare drawing of proposed speaker locations and submit as part of shop drawings.

Intercom and Public Address Systems

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- .12 Install ambient noise sensors in each zone in quantities to providing proper coverage of each zone.
- .13 Install devices in accordance with manufacturer's recommendations and reviewed with Consultant. Secure speakers with suspension chains from ceiling slab. Do not support speaker assembly from suspended ceiling system.
- .14 Provide required relays/contacts to connect system to auxiliary sound system bridging controls to allow for emergency procedures provisions. Include for required interconnections to fire alarm system and building automation systems.
- .15 Install system wiring in conduit in accordance with certified "reviewed" wiring schematic shop drawings. Provide shielded cabling for applications recommended by system vendor and/or manufacturer. Ensure that wiring is in accordance with system supplier's recommendations and is colour coded and properly identified terminals.
- .16 Refer to system riser on drawings which is diagrammatic only and is not to be used for quantities.
- .17 Provide integration work to auxiliary systems as specified in Part 2.
- .18 Provide operating and maintenance instructions to Owner's designated personnel.

### **3.3 Testing and Verification**

- .1 After completion of installation work, make arrangement with Consultant and Owner and manufacturer of equipment to have a final functional witness acceptance test, giving minimum 7 working days' notice to parties concerned to be present. Exact schedule of testing work must be approved in writing by Owner and reviewed with Consultant.
- .2 Tests to include following:
  - .1 check of devices to ensure proper connections and supervision;
  - .2 operation of an initiating device on each circuit to verify required operation of alarm devices, annunciator and other installations;
  - .3 testing of signal devices for correct operation and function;
  - .4 testing of sequence of operation of system with integrated systems and equipment;
  - .5 submission of detailed test report of system performance, signed by authorized testing technician;
  - .6 include for system manufacturer's authorized technician to program, test, adjust and verify system and provide minimum one hard copy and electronic copy of signed report of documented test results.
- .3 Additionally, refer to testing, coordination and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

**END OF SECTION**

Assistance Call Systems

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## **PART 1 - GENERAL**

### **1.1 Submittals**

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

### **1.2 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 review with Consultant. Software revisions to incorporate final room names/area names/building names and equipment identification.

### **1.3 System Supplier/Installer Qualifications**

- .1 System supplier/installer to be an established communications and electronics contractor that currently maintains locally run and operated business for at least 5 years and holds applicable provincial and local licenses.
- .2 Supplier/installer to be valid authorized distributor for product/system proposed with full manufacturer's warranty privileges.
- .3 Supplier/installer to employ technicians who have attended and successfully completed manufacturer's technical certification training for proposed system.
- .4 Supplier/installer to show satisfactory evidence, upon request, that they maintain a fully equipped service organization capable of furnishing adequate inspection and service to system. Supplier/installer to maintain at their facility, necessary spare parts in proper proportion as recommended by system manufacturer to maintain and service equipment being supplied.

## **PART 2 - PRODUCTS**

### **2.1 Universal Washroom Assistance Call System**

- .1 Provide assistance call system in designated washrooms as required by local governing codes. System to consist of CSA approved and/or ULC listed components to provide system in compliance with local governing codes and standards, with following operations:
  - .1 activated call station in washroom sends signal to audible and visual devices that indicates that someone in washroom needs assistance;
  - .2 audible devices and visual devices located over washroom door illuminates and sound tone when remote stations are activated; visual and audible signals to be distinct and of different type of signals from other building systems; audible device sound levels to be user adjustable;
  - .3 call stations, audible devices and visual devices to only be reset when call has been responded to and activated station locally reset.

Assistance Call Systems

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- .2 Verify system sequence of operation with local governing authority inspector and review with Consultant.
- .3 System based on Camden Door Controls components consisting of following flush mount series components:
  - .1 CM-AF540SO series, double gang, stainless steel faceplate, 'PRESS FOR EMERGENCY ASSISTANCE' red 40 mm (1-5/8") mushroom push button (push to activate – pull to deactivate and reset), LED "Assistance Requested" annunciator with adjustable sounder; N/O and N/C contacts and maintained as required;
  - .2 CM-AF141SO series, single gang LED dome light with 'ASSISTANCE REQUIRED' identification lettering and 93 dB adjustable sounder; impact resistant polycarbonate lens and weather resistant with gasketting;
  - .3 CM-SE21A series, instruction sign: solid, white, fire rated PVC, 150 mm x 270 mm (6" x 10-5/8"), engraved lamacoid emergency sign that contains wording – "IN EVENT OF EMERGENCY PUSH EMERGENCY BUTTON AND AUDIBLE AND VISUAL SIGNAL WILL ACTIVATE" in letters at least 25 mm (1") high with 5 mm (3/16") stroke and that is posted above call station. Exact sizing and nomenclature to be as per local governing code requirements and reviewed with Consultant prior to ordering.
  - .4 Auxiliary contacts for remote connection to central monitoring station or connection to other building system to allow for annunciation of calls. Activated automatically when emergency assistance call pushbutton pressed and automatically reset when call pushbutton is reset.
- .4 Audible signals to be distinct from other building systems. Review visual LED colour selection with Consultant prior to ordering. Sounder devices to include tamper-resistant adjustable level control.
- .5 Provide power supplies, wiring, mounting hardware and ancillary devices as required and as recommended by system manufacturer for a complete system.
- .6 Wiring to be of type in accordance with applicable local governing codes and standards.
- .7 Provide system components compatible to suit application as required. Ensure that stations meet requirements of each application and voltage ratings, as recommended by manufacturer. Include required accessories to suit. Provide weatherproof and corrosion resistant devices for devices located in non-climate controlled areas.
- .8 Manufacturer's authorized vendor to supply, install, test, start-up and certify complete systems as required.
- .9 Acceptable manufacturers/suppliers are:
  - .1 Camden Door Controls;
  - .2 Edwards (Chubb Edwards);
  - .3 Aiphone;
  - .4 TOA;
  - .5 Telecor;



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Assistance Call Systems

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- .6 Rauland;
- .7 Mircom;
- .8 Jeron.

## **2.2 Universal Washroom Assistance Call System and Door Control System**

- .1 Provide assistance call and door controls system in designated washrooms as required by local governing codes. System to consist of CSA approved and/or ULC listed components to provide system in compliance with local governing codes and standards, with following operations:
  - .1 open and close electrically operated doors and identify vacancy/occupied status;
  - .2 activated call station in washroom sends signal to audible and visual devices that indicates that someone in washroom needs assistance;
  - .3 audible devices and visual devices located over washroom door illuminates and sound tone when remote stations are activated; visual and audible signals to be distinct and of different type of signals from other building systems; audible device sound levels to be user adjustable;
  - .4 call stations, audible devices and visual devices to only be reset when call has been responded to and activated station locally reset;
  - .5 Verify system sequence of operation with local governing authority inspector and review with Consultant.
- .2 Assistance call system is based on Camden Door Controls components consisting of following flush mount series components:
  - .1 CM-AF540SO series, double gang, stainless steel faceplate, 'PRESS FOR EMERGENCY ASSISTANCE' red 40 mm (1-5/8") mushroom push button (push to activate – pull to deactivate and reset), LED "Assistance Requested" annunciator with adjustable sounder; N/O and N/C contacts and maintained as required;
  - .2 CM-AF141SO series, single gang LED dome light with 'ASSISTANCE REQUIRED' identification lettering and 93 dB adjustable sounder; impact resistant polycarbonate lens and weather resistant with gasketing;
  - .3 CM-SE21A series, instruction sign: solid, white, fire rated PVC, 150 mm x 270 mm (6" x 10-5/8"), engraved lamacoid emergency sign that contains wording – "IN EVENT OF EMERGENCY PUSH EMERGENCY BUTTON AND AUDIBLE AND VISUAL SIGNAL WILL ACTIVATE" in letters at least 25 mm (1") high with 5 mm (3/16") stroke and that is posted above call station. Exact sizing and nomenclature to be as per local governing code requirements and reviewed with Consultant prior to ordering.
- .3 Door control system is based on Camden Door Controls components consisting of following flush mount series components:
  - .1 "Aura" illuminated push plate switch system combining door activation and annunciation (both "occupied" and "locked" status);
  - .2 CX-33 controller;

### Assistance Call Systems

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- .3 CM-45/8/GRFSE1 114 mm (4 ½") illuminated push plate switches (PUSH TO LOCK), with signage;
- .4 CM-45/4/GRFSE1 114 mm (4 ½") illuminated push plates (PUSH TO OPEN), with signage;
- .5 CM-2520 series combination PUSH TO OPEN/PUSH TO CLOSE switches, complete ready-to-install assemblies, N.O. tubular switches, heavy-duty, ADA-compliant door controls; 113 mm x 113 mm (4 1/2" x 4 1/2") rectangular stainless-steel faceplates to install on double gang electric box, supplied with stainless steel screws and Allen wrench for mounting.
- .6 CX-MDC magnetic door contact;
- .7 include additional devices based on kit components on both sides of door to allow person to open door, and to lock door when inside (as applicable).
- .4 Provide required power supplies, mounting hardware, wiring and ancillary devices and as recommended by system manufacturer for a complete system.
- .5 Provide auxiliary contacts for remote connection to central monitoring station or connection to other building system to allow for annunciation of calls. Activated automatically when emergency assistance call pushbutton pressed and automatically reset when call pushbutton is reset.
- .6 Audible signals to be distinct from other building systems. Review visual LED colour selection with Consultant prior to ordering. Sounder devices to include tamper-resistant adjustable level control.
- .7 Wiring to be of type in accordance with applicable local governing codes and standards.
- .8 Provide system components compatible to suit application as required. Ensure that stations meet requirements of each application and voltage ratings, as recommended by manufacturer. Include required accessories to suit. Provide weatherproof and corrosion resistant devices for devices located in non-climate controlled areas.
- .9 Manufacturer's authorized vendor to supply, install, test, start-up and certify complete systems as required.
- .10 Acceptable manufacturers/suppliers are:
  - .1 Camden Door Controls;
  - .2 Edwards (Chubb Edwards);
  - .3 Aiphone;
  - .4 TOA;
  - .5 Telecor;
  - .6 Rauland;
  - .7 Mircom;
  - .8 Jeron.

## 2.3 Basic Assistance Call System

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Assistance Call Systems

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- .1 Provide assistance call system in areas as required. System to consist of CSA approved and/or ULC listed components to provide system with following operations:
  - .1 activated call station sends signal to audible and visual devices that indicates that someone in area needs assistance;
  - .2 connected audible devices and visual devices illuminates and sound tone when remote stations are activated; visual and audible signals to be distinct and of different type of signals from other building systems;
  - .3 call stations, audible devices and visual devices to only be reset when call has been responded to and activated station locally reset.
- .2 Verify system sequence of operation with Owner and review with Consultant.
- .3 Assistance call system is based on components consisting of following flush mount series components:
  - .1 Camden Door Controls, CM-450R12 series, single gang, stainless steel faceplate, push/pull, 'PRESS FOR EMERGENCY ASSISTANCE' red 40 mm (1-5/8") mushroom push button (push to activate – pull to deactivate and reset); N/O and N/C contacts and maintained as required;
  - .2 Camden Door Controls, CM-AF141SO series, single gang LED wedge shaped dome light with 'ASSISTANCE REQUIRED' identification lettering and 93 dB adjustable sounder; impact resistant polycarbonate lens and weather resistant with gasketting;
- .4 Review visual LED colour selection with Consultant prior to ordering.
- .5 Provide power supplies, wiring, mounting hardware and ancillary devices as required and as recommended by system manufacturer to complete system.
- .6 Wiring to be of type in accordance with applicable local governing codes and standards.
- .7 Provide system components compatible to suit application as required. Ensure that stations meet requirements of each application and voltage ratings, as recommended by manufacturer. Include required accessories to suit. Provide weatherproof and corrosion resistant devices for devices located in non-climate controlled areas.
- .8 Manufacturer's authorized vendor to supply, install, test, start-up and certify complete systems as required.
- .9 Acceptable manufacturers/suppliers are:
  - .1 Camden Door Controls;
  - .2 Edwards;
  - .3 Rutherford Controls;
  - .4 GE;
  - .5 Aiphone;
  - .6 Mircom.

### **PART 3 - EXECUTION**

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Assistance Call Systems

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### **3.1 Installation of Washroom Assistance Call System**

- .1 Provide specified assistance call systems components and connect complete. Program sequence of operation as required and confirmed with Owner and review with Consultant. Exact programming requirements to be verified with local governing authority, approved by Owner and reviewed with Consultant.
- .2 Obtain required training from manufacturer's representative on any special installation procedures.
- .3 Install devices in locations as reviewed with Consultant prior to roughing-in. Install components at mounting heights as noted on drawings and reviewed with Consultant. Generally, mount devices on recessed back boxes. Typically locate audible/visual devices above doorframe. Locate power supplies in service room accessible location reviewed with Consultant. Provide power wiring to devices as required.
- .4 Set sound level of interior audible devices at level required by local governing authorities, acceptable to Owner and reviewed with Consultant. Adjust as required.
- .5 Provide required system wiring. Wiring to be copper conductor, colour coded, and in accordance with system manufacturer's recommendations and instructions. Connect equipment in accordance with system manufacturer's certified wiring diagrams and instructions and under direct supervision of manufacturer. Run conductors in conduit.
- .6 Install devices and perform work in accordance with manufacturer's instructions and requirements and in accordance to applicable codes of local governing bodies having jurisdiction.
- .7 Provide a lamacoid identification nameplate for each enclosure. Confirm wording of identification nameplates and colour finishes of devices with Owner and review with Consultant prior to ordering.
- .8 Install signage as required. Locate in position and secure to wall with proper mechanical fasteners. Review exact nomenclature, sizing and locations with Consultant prior to ordering.
- .9 Where applicable, extend wiring in conduit from system auxiliary contacts to remote monitoring station to allow for annunciation of call at station.
- .10 After installation is complete, test, adjust and verify operation of system. Demonstrate system operation and maintenance with Owner's staff.
- .11 Obtain approvals from local governing inspection authorities and submit copies of approvals to Consultant.

### **3.2 Installation of Basic Assistance Call System**

- .1 Provide specified assistance call systems components and connect complete. Provide sequence of operation as required and confirmed with Owner and review with Consultant.
- .2 Obtain required training from manufacturer's representative on any special installation procedures.

### Assistance Call Systems

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- .3 Install devices in locations as reviewed with Consultant prior to roughing-in. Install components at mounting heights as noted on drawings and reviewed with Consultant. Generally, mount devices on recessed back boxes. Typically locate audible/visual devices above doorframe. Locate power supplies in service room accessible location reviewed with Consultant. Provide power wiring to devices as required.
- .4 Set sound level of interior audible devices at level required by local governing authorities where applicable, acceptable to Owner and reviewed with Consultant. Adjust as required.
- .5 Provide required system wiring. Wiring to be copper conductor, colour coded, and in accordance with system manufacturer's recommendations and instructions. Connect equipment in accordance with system manufacturer's certified wiring diagrams and instructions and under direct supervision of manufacturer. Run conductors in conduit.
- .6 Install devices and perform work in accordance with manufacturer's instructions and requirements and in accordance to applicable codes of local governing bodies having jurisdiction.
- .7 Provide a lamacoid identification nameplate for each enclosure. Confirm wording of identification nameplates and colour finishes of devices with Owner and review with Consultant prior to ordering.
- .8 After installation is complete, test, adjust and verify operation of system. Demonstrate system operation and maintenance with Owner's staff.

### 3.3 Testing and Verification of System

- .1 After completion of installation work, make arrangement with Consultant and Owner and manufacturer of equipment to have final functional witness acceptance test, giving minimum 7 working days' notice to each party concerned to be present. Manufacturer's authorized technician to perform work. Exact schedule of testing work to be approved in writing by Owner and reviewed with Consultant.
- .2 Include minimally following, as applicable:
  - .1 check of devices to ensure proper connections and supervision;
  - .2 operation of an initiating device on each circuit to verify required operation of alarm devices, annunciator and other installations;
  - .3 testing of signal devices for correct operation and function;
  - .4 testing of each secured door access control components and review of events reported at head end;
  - .5 testing of sequence of operation of system with integrated systems and equipment (as applicable);
  - .6 start-up procedures;
  - .7 submission of detailed test report of system performance, signed by authorized testing technician.
- .3 Provide minimum one hard copy and electronic copy of signed report of the documented test results.

Assistance Call Systems

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- .4 Additionally, refer to testing, coordination and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

### **3.4 Training**

- .1 Manufacturer's authorized 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**

## **PART 1 - GENERAL**

### **1.1 Reference Standards**

- .1 CSA Group (CSA):
  - .1 CSA C22.2 No. 205-17(R2022), Signal Equipment.
- .2 Underwriters Laboratories (UL):
  - .1 UL 1069-2007, Hospital Signaling and Nurse Call Equipment.
- .3 NEMA:
  - .1 NEMA Installation Guide for Nurse Call Systems (R2007).

### **1.2 Submittals**

- .1 Product Data:
  - .1 Submit manufacturer product literature, specifications, installation instructions and datasheets.
  - .2 Include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop Drawings:
  - .1 Submit shop drawings for products of this Section, including:
    - .1 Detail assembly and internal wiring diagrams for control units, consoles and auxiliary cabinets. Identify dimensions and layouts.
    - .2 System riser diagram identifying control and annunciation equipment, stations, devices, zones, special conductors and raceways, and integration to other building equipment and systems.
    - .3 System riser wiring diagram identifying control equipment, initiating zones, signaling circuits, terminations, terminal numbers, and conductors.
    - .4 Details for stations and devices.
    - .5 Details and performance specifications for control, annunciation and peripherals.
    - .6 Sample software screens, graphic displays and nomenclature.
    - .7 Step-by-step operating sequence, cross referenced to logic flow diagram.
    - .8 Annunciator schedules.
- .3 Submit compliance certificates, and testing and verification reports.

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Existing Nurse Call System Work

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### **1.3 Quality Assurance**

- .1 Products provided directly by system manufacturers or by system manufacturer authorized and certified regional vendors.
- .2 Products to be standard product of same manufacturer.
- .3 System vendor is authorized and trained by system manufacturer to calculate, design, install, test and maintain system.

## **PART 2 - PRODUCTS**

### **2.1 Nurse Call System**

- .1 Existing Rauland R5 nurse call system presently serves existing building and shall be extended to serve renovation areas. Include for and engage Hospital existing system vendor - Aatel Communications Inc, to provide system work and products. Contact person for existing system vendor is Laura Graham. Telephone (905) 526-2378, Email [laurag@aatel.com](mailto:laurag@aatel.com).
- .2 Existing Rauland 5 voice over IP based audio/visual nurse call system is multiplexed solid-state microprocessor based networked system providing two-way full duplex voice communications between any console and patient stations, and staff/duty stations. Provide equipment, accessories and material required for renovation work.
- .3 System vendor shall be responsible for but not be limited to provisioning the following:
  - .1 Required software, modifications and components to existing system head end units to accommodate additional devices for renovation areas.
  - .2 Product programming and setup.
  - .3 Nurse consoles.
  - .4 Emergency call stations.
  - .5 Staff and duty stations.
  - .6 Single or dual patient bed stations.
  - .7 Rauland Enhanced Responder 5 UL 1069 compliant, pillow speakers at each patient bed station, with integrated lighting and TV controls, complete with headphone receptacle and cord with plug; confirm exact requirements to ensure compatibility with TV (by others) and ensure integrated components provide sequence of operation acceptable to Owner.
  - .8 Corridor dome lights.
  - .9 Remote annunciators.
  - .10 Wiring to system manufacturer requirements, run in conduit and provision of required ancillary devices. Coordinate supply and installation of wiring with Electrical Contractor.
  - .11 Plexi-covers for stations as noted including emergency response buttons.
  - .12 Ring tones to match other devices serving same area.
  - .13 Nurse call devices to ring at consoles designated by Owner.



Existing Nurse Call System Work

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- .14 Ancillary devices as required for complete system.
- .15 Existing system stations and components disconnected and not re-located for use on this project, to be properly decommissioned, packaged, identified with label and turned over to Owner.
- .16 Testing and verification of additional and retrofitted products on system with plant and users as part of verification training. Preparation of test reports.
- .17 Providing technical assistance and coordinate with Electrical Contractor with regards to conduit, wiring and component installation requirements.
- .4 Electrical Contractor is responsible for following:
  - .1 Arranging and coordination of system vendor work to clearly identify responsibilities of system vendor and Electrical Contractor.
  - .2 Supervision of system vendor onsite.
  - .3 Provision of system conduits and boxes, power feeders, to suit system requirements to system manufacturer requirements.
  - .4 Installing system components, wiring, wiring accessories, and identification and labelling of each wiring run. Coordinate supply and installation of system wiring with system vendor.
  - .5 Assist system vendor in onsite system testing, inspection and verification work.
  - .6 Submission of copies of testing and verification reports signed by manufacturer authorized representative and by Electrical Contractor.
  - .7 Preparing as-built drawings and other submittals.

Existing Nurse Call System Work

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## 2.2 VoIP Nurse Console

- .1 The VoIP Nurse Console shall be typically located at a local nursing station, workstation, centralized communications center, or any place where staff receive calls, communicate with staff, or initiate any Responder 5 related features. The console shall be desk or wall mounted. The VoIP Nurse Console shall provide complete information concerning incoming calls including: patient or staff member's room location, bed (if applicable), call priority, and length of time call has been waiting.
- .2 The VoIP Nurse Console shall be configured for up to twenty-four (24) functions including Setting/Review Service Requirements, Emergency Call Upgrade, Day/Night tones, Staff Follow, Sequential Room Monitor, Swinging Groups of Rooms, etc.
- .3 Features shall include:
  - .1 VoIP device;
  - .2 Full-Duplex audio;
  - .3 Color Display Screen;
  - .4 Over 990 possible unique facility-defined call priorities;
  - .5 Thirty-two (32) programmable functions;
  - .6 5-line display with associated function/scroll/select buttons;
  - .7 Day/Night tones;
  - .8 Console speaker level adjustment;
  - .9 Optional tone mute of calls in progress;
  - .10 Displays up to three (3) incoming calls with the ability to scroll to see additional pending calls;
  - .11 Twelve (12) unique call-in tones;
  - .12 Choice of instant 2-way communication with handset or push-to-talk operation via speaker-microphone;
  - .13 Room swing capabilities;
  - .14 Continuously supervised with self-diagnosing error messages and distinctive console failure audio alert;
  - .15 PoE (802.3af compliant) 26-56VDC 9 watts;
  - .16 Connection: 10/100 Mb Ethernet;
- .4 Approved manufacturer:
  - .1 Rauland (Model # 351206 - VoIP Nurse Console V3)

Existing Nurse Call System Work

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## 2.3 STAFF TERMINAL

- .1 The VoIP Staff Terminal shall be a dynamic device that functions as a patient or procedure room communications tool while providing staff with “soft” touch-points to initiate an instantaneous notification of an in room need. Additionally, this terminal shall be used as a functional nurse call console. When configured as a patient or procedure room communications tool, user-configurable soft keys shall be assigned per staff terminal. Specific needs such as Emergency, Staff Assist, Transport, Cleaning Needed, Order, Stat Order, etc. and speed dialing to any location shall be initiated from the staff terminal soft keys. The VoIP Staff Terminal shall also be configured to provide one (1) or three (3) lines for call annunciation.
- .2 A call shall be answered with Push-to-Talk key for a hands-free conversation. When functioning as a Nurse Console, the VoIP Staff Terminal shall be configured for functions including Setting/Review Service Requirements, Emergency Call Upgrade, Day/Night tones, Staff Follow, Sequential Room Monitor, Swinging Groups of Rooms, etc. The VoIP Staff Terminal shall be continually supervised for both power and signal. The VoIP Staff Terminal shall receive operational power via a Power-over-Ethernet (PoE) connection to a Responder 5 system Ethernet switch or the Responder Branch Regional Controller.
- .3 Features shall include:
  - .1 Functions as a patient room communications tool with touch-points to initiate an instantaneous notification of an in room need, duplex intercom station, or nurse call console;
  - .2 VoIP device with Full-Duplex audio;
  - .3 Color Touch Screen;
  - .4 Includes Bio-Seal infection control overlay on Touch Screen;
  - .5 Over 990 possible unique facility-defined call priorities;
  - .6 Up to fifty (50) programmable functions;
  - .7 Optional tone mute of calls in progress;
  - .8 Displays up to three (3) incoming calls with the ability to scroll to see additional pending calls;
  - .9 Ability to dial rooms through touch key pad on screen;
  - .10 Twelve (12) unique call-in tones;
  - .11 Instant 2-way communication with operation via speaker-microphone with Push-to-Talk capability;
  - .12 Continuously supervised with self-diagnosing error messages sent to network status application and distinctive console failure audio alert;
  - .13 PoE (802.3af compliant) 26-56VDC 9 watts;

Existing Nurse Call System Work

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.4 Approved manufacturer:

- .1 Rauland (Model # 351311 – Staff Terminal V3)

**2.4 SINGLE PATIENT STATION**

- .1 The Single Patient Station shall allow both patients and staff to place different call-ins, depending on their requirements, to the assigned nurse console(s), staff terminal(s), along with other annunciation devices such as wireless phones. The patient station shall interface with entertainment handsets and specialty beds to initiate calls, control entertainment, control lighting, and provide nurse call audio and entertainment audio through the respective speakers.
- .2 The patient station shall be connected to its associated corridor light or domeless room controller and shall be continually supervised for both power and data. Through programming, a message shall annunciate at the associated console(s) and / or the remote network status application if a problem occurs.
- .3 Features shall include:
  - .1 Multiple call-in priorities available;
  - .2 Speaker and microphone provide full-duplex audio to speak with the patient;
  - .3 Tilt/Release DIN receptacle for Pillow Speakers with patient entertainment controls and handset intercom with entertainment muting during nurse call;
  - .4 Tilt/Release DIN receptacle allows for ease of disconnecting Pillow Speaker from the patient station;
  - .5 Auxiliary device receptacle with separate call-in priority setting;
  - .6 Interfaces with specialty beds via separate receptacle and control module;
  - .7 Interfaces with a remote Pillow Speaker via separate station;
  - .8 Output for lighting control options direct to low voltage lighting controller;
  - .9 Cancel button for localized call cancellation;
  - .10 3-gang adapter plate included;
  - .11 Continuous supervision of station for loss of data and/or power faults;
  - .12 Plug-in connectors for easy service;
  - .13 Bio-seal option to cover cancel button and allow for easy disinfecting of the station;
- .4 Approved manufacturer:
  - .1 Rauland (Model # 353000 – Single Patient Station)

Existing Nurse Call System Work

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## **2.5 QUAD PUSH BUTTON**

- .1 Quad push button shall be four (4) unique call priorities (Code Blue, Staff Assistant, Code Pink, Code White) from single station.
- .2 It shall include the following features;
  - .1 Bioseal option;
  - .2 Back-lit for easier location in dark room;
  - .3 Outputs for elapsed timers;
  - .4 No visible screws/easy to clean;
  - .5 Customizable for unique call-ins;
  - .6 Continually supervised;
- .3 Approved manufacturer:
  - .1 Aatel (Model # CB-SA-CP-CW)

## **2.6 BED STATUS STATION**

- .1 The Bed Status Station shall provide four (4) distinct call-in priorities: "Transport", "Cleaning Needed", "Cleaning in Progress" and "Bed Ready". These buttons shall be customized for any other types of calls such as "Staff Assist" or for Staff Registration.
- .2 The Bed Status Button Station shall be used to notify Transport when a patient has been discharged. The station shall also be used to notify Environmental Services that a room / bed needs to be cleaned as well as providing the state of cleaning by indicating that cleaning is in progress, or the bed is ready for another patient to be admitted.
- .3 Features shall include:
  - .1 Four (4) call-in buttons with call assurance LED's;
  - .2 Large back-lit buttons for easier activation;
  - .3 Elapsed timer output;
  - .4 Plug-in connectors for easy service;
  - .5 Continuous supervision of station;
  - .6 2-gang adapter plate included;
  - .7 Optional antimicrobial Bio-seal to cover buttons and allow for easy disinfecting of the station;
- .4 Approved manufacturer:
  - .1 Rauland (Model # 354016)

## **2.7 STAFF STATION**

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- .1 The Staff Station shall be typically located in a room or on a floor where staff members may be working. The station shall also be used in patient areas such as day rooms or visitor's lounges or wherever call-in and two-way audio communication is desired. The station shall also interface with a patient bed. The station shall provide a call-in pushbutton in the audio-visual system. The staff or patients shall communicate through the stations built-in speaker/microphone.
- .2 Features shall include:
  - .1 Pushbutton for two-way intercom in audio-visual system with built-in Call-Assurance LED;
  - .2 Speaker and microphone provide full-duplex audio to speak with the patient if desired;
  - .3 Cancel button for localized call cancellation;
  - .4 Interfaces with specialty beds via separate receptacle and control module;
  - .5 LED to indicate specialty bed is not connected;
  - .6 Interfaces with a remote pillow speaker via separate station;
  - .7 Output for lighting control options direct to low voltage lighting controller;
  - .8 3-gang adapter plate included;
  - .9 Continuous supervision of station for loss of data and/or power faults;
  - .10 Plug-in connectors for easy service;
  - .11 Bio-seal option to cover buttons and allow for easy disinfecting of the station;
- .3 Approved manufacturer:
  - .1 Rauland (Model # 353101)

## **2.8 DUTY STATION**

- .1 The Duty Station shall be typically located in a utility room or an area where staff members may be working and need notification of active calls within their area. In an audiovisual system, the station shall also provide a call-in pushbutton, which allows for two-way audio communication. The four (4) LED indicators shall provide visual indication of calls by mimicking the corridor light. Each LED can light one of seven colors. The station shall also provides audible indication of calls.
- .2 Features shall include;
  - .1 Four (4) LED indicators mimic the corridor light behavior of a call in progress;
  - .2 Call tone indication of calls are the same as at the nurse console(s);
  - .3 Pushbutton for two-way intercom in an audio-visual system with built-in Call-Assurance LED;
  - .4 Speaker and microphone provide full-duplex audio to speak from station if desired;
  - .5 Day/Night tone level control (from console) with tone mute for calls;
  - .6 Monitor LED indicates active audio;

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- .7 Cancel button for localized call cancellation;
- .8 3-gang adapter plate included;
- .9 Continuous supervision of station for loss of data and/or power faults;
- .10 Network control through associated corridor light;
- .11 Easy Plug-in connectors for wiring to corridor lights and attached devices;
- .12 Bio-seal option to cover buttons and allow for easy disinfecting of the station;
- .3 Approved manufacturer:
  - .1 Rauland (Model # 353100)

## **2.9 CODE STATION**

- .1 The Code Station is a call pushbutton station that shall provide the ability to place a code call. Pressing the cancel button cancels the call. This station shall provide an output for an elapsed timer supporting a momentary or latched contact closure output. The Code Blue button shall be back-lit for easier location in dark room. Using special buttons, the stations shall be customized for unique call-ins such as "Code Pink".
- .2 Features shall include;
  - .1 Extra large back-lit button for easier activation;
  - .2 Elapsed timer output;
  - .3 Call-assurance LED;
  - .4 Plug-in connectors for easy service;
  - .5 Continuous supervision of station;
  - .6 1-gang adapter plate included;
  - .7 Optional antimicrobial Bio-seal to cover buttons and allow for easy disinfecting of the station;
- .3 Approved manufacturer:
  - .1 Rauland (Model # 354011)

## **2.10 STAFF ASSIST/CODE STATION**

- .1 The Staff Assist / Code Station is an emergency dual pushbutton station that shall have the ability to place two (2) unique call priorities from a single station. Using special buttons, the station shall be customized for unique call-ins such as: "Code Pink", "Push for Help", etc. The buttons shall also be used for staff registration such as: "Nurse in Room", etc. The Cancel button shall allow for cancellation of the call at the station. This type of station shall be normally located at a patient room head wall for placing a call for help, staff emergency and/or code call.
- .2 Features shall include;
  - .1 Two (2) call points with Call-Assurance LEDs;
  - .2 Back-lit pushbuttons for easy activation;
  - .3 Cancel button;
  - .4 Continuous supervision of station;
  - .5 Plug-in connectors for easy service;
  - .6 Elapsed timer outputs;
  - .7 1-gang adapter plate included;
  - .8 Optional antimicrobial Bio-seal to cover buttons and allow for easy disinfecting of the station;
- .3 Approved manufacturer:
  - .1 Rauland (Model # 354015)

## **2.11 TERMINAL CABINET**

- .1 Features shall include;
  - .1 Flush or surface-mount cabinet;
  - .2 Removable trim ring;
  - .3 Front vented door;
  - .4 Includes conduit knockouts;
  - .5 Four (4) three-prong power outlets;
- .2 Approved manufacturer:
  - .1 Rauland (Model # NC2828)



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## **2.12 BRANCH REGIONAL CONTROLLER**

- .1 Features shall include;
  - .1 Data & audio control for four (4) L-Net connections
  - .2 Supports up to ninety-six (96) Corridor Lights and/or Domeless Controllers;
  - .3 One (1) PoE Ethernet connection for network connectivity;
  - .4 Supports up to sixteen (16) Nurse Consoles and up to eighty (80) Staff Terminals;
  - .5 Continuously supervises local consoles, staff terminals, corridor lights, and domeless controllers for power and signal;
  - .6 Stores local console, staff terminal, corridor light, and station configurations;
  - .7 RJ connectors for easy service;
  - .8 Removable power terminal block for easy installation;
- .2 Approved manufacturer:
  - .1 Rauland (Model # 351007 Branch Regional Controller V4)

## **2.13 POWER SUPPLY**

- .1 Features shall include;
  - .1 Self-contained unit;
  - .2 Status LED indicators;
  - .3 Three (3) energy limited outputs (in parallel);
  - .4 Removable Output connector for easy installation;
  - .5 Meets Class 2 energy limited requirements;
  - .6 Power failure output (Battery Backup) built in;
- .2 Approved manufacturer:
  - .1 Rauland (Model # 351003GSA – Power supply with battery back up)

## **2.14 POE ETHERNET SWITCH**

- .1 Features shall include;
  - .1 Provides power over Ethernet (PoE) to the Nurse Consoles and Staff Terminals through any of the eight (8) 10/100 Ethernet ports;
  - .2 Eight (8) 10/100 Mbps Ethernet ports with auto-speed negotiation;
  - .3 Two (2) 10/100/1000Mbps additional ports (No PoE);
  - .4 10/100 port LED indicators for active PoE (Amber) and Link/Activity (Green);
  - .5 10/100/1000 port LED indicators for speed (Amber) and Link/Activity (Green);
- .2 Approved manufacturer:
  - .1 Rauland (Model # 351004 – 8 Port PoE Ethernet Switch)

## **2.15 CORRIDOR LIGHT**

- .1 Features shall include;
  - .1 LED visual indication for high visibility, long life, low maintenance, and low power consumption;
  - .2 Programmable colors and flash rates to indicate pending calls, service requirements, staff presence, and patient status;
  - .3 Supports up to sixteen (16) call-in stations, three (3) of which can have audio capability;
  - .4 Module status LED indicates when unit is not functioning properly;
  - .5 Serves as hub for all room wiring;
  - .6 Contains a frosted lens for uniform color distribution;
- .2 Approved manufacturer:
  - .1 Rauland (Model # 352010 – Corridor Light – 4 Position V2)

## **2.16 DOMELESS CORRIDOR CONTROLLER**

- .1 Features shall include;
  - .1 Located in areas where a corridor light is not needed or desired;
  - .2 Other corridor lights can be programmed to reflect calls placed on patient stations connected to a domeless room controller;
  - .3 Supports up to sixteen (16) call-in stations, three (3) of which can have audio capability;
  - .4 Serves as hub for all room wiring;
- .2 Approved manufacturer:
  - .1 Rauland (Model # 352020 – Domeless Corridor Controller)

## **2.17 RESPONDER 5 FEATURE BED RECEPTACLE**

- .1 Features shall include;
  - .1 Interfaces Feature Bed Side Rail Controls with Responder 5;
  - .2 Simple, easy plug-on connectors to the Responder 5 Feature Bed Control Module;
  - .3 Provides dedicated Bed Port for Professional Installation of Feature Beds;
  - .4 Stainless Steel Wallplate;
  - .5 Dummy Plug for use when Bed is not plugged into the Receptacle;
- .2 Approved manufacturer:
  - .1 Rauland (Model # NCBED5 – Responder 5 Feature Bed Receptacle)

## **2.18 FEATURE BED CONTROL MODULE**

- .1 Features shall include;

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- .1 Interface between feature beds and Responder 5 bed stations;
- .2 Transfers all nurse call and entertainment functions to the bed with entertainment muting;
- .3 Simple, easy plug-on connectors;
- .4 Typically fits in back-box at or near feature bed wall connector;
- .2 Approved manufacturer:
  - .1 Rauland (Model # 350304 – Feature Bed Control Module V2)

**2.19 pull cord station with audio**

- .1 Features shall include;
  - .1 Plastic pull-cord for easy activation;
  - .2 Smooth, non-porous PVC coating on the cord provides an easily cleaned surface;
  - .3 Large, easy to grab bell;
  - .4 Call-in button provides an additional call-in priority with built-in call-assurance LED;
  - .5 Speaker and microphone provide full-duplex audio to the bathroom to speak with the patient if desired;
  - .6 Monitor LED and Call-Assurance LED with Cancel button;
  - .7 Monitor LED indicates microphone activation;
  - .8 Cancel button for localized call cancellation;
  - .9 Continuous supervision of station;
  - .10 2-gang adapter plate included;
  - .11 Plug-in connectors for easy service;
  - .12 Bio-seal option to cover buttons and allow for easy disinfecting of the station;
- .2 Approved manufacturer:
  - .1 Rauland (Model # 354000)

**2.20 pull cord station**

- .1 Features shall include;
  - .1 IP68-rated waterproof pull cord station;
  - .2 Sealed design allows continuous contact with water and fluids;
  - .3 Can be located anywhere within a wet environment - (Mounting location subject to Authorities Having Jurisdiction (AHJ));
  - .4 Plastic pull cord for easy activation;
  - .5 Smooth, non-porous PVC coating on the cord provides an easily cleaned surface;
  - .6 Call-Assurance LED;
  - .7 Cancel button;

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- .8 Contains two (2) large, easy to grab bells for placement anywhere on pullcord;
- .9 Continuous supervision of station;
- .2 Approved manufacturer:
  - .1 Rauland (Model # 354001WP – IP68 Waterproof Pull cord station)

## **2.21 Integration to Other Building Systems and Equipment**

- .1 IT systems.
- .2 Patient wandering system.
- .3 Staff assist system.
- .4 Telephone system.
- .5 System to be integrated through IP Ethernet connection to hospital LAN with other existing security and communication systems including integration engine for system faults within facility. Review integration points with CVH. These include but are not limited to following:
  - .1 Pocket pagers.
  - .2 Wireless telephone.
  - .3 Integrated to telephone system. Review requirements with CAMH.
  - .4 Facility voice communication (telephone) system.
  - .5 Patient database management system.
  - .6 Fire alarm system.
  - .7 Patient wandering system.
  - .8 Integration Engine.
  - .9 Video monitoring System.
- .6 Include with system, communications interface to allow system integration such that system annunciates a trouble signal in event of an alarm condition and can communicate location of device in alarm, to designate other building systems and to wireless devices.

## **PART 3 - EXECUTION**

### **3.1 Installation Work**

- .1 Delete and/or relocate existing nurse call system devices as noted. Include for following:
  - .1 Disconnecting and decommissioning of devices.
  - .2 Removal of obsolete boxes, wiring and conduit.
  - .3 Patching and making good surfaces as coordinated with general trades contractor.
  - .4 Provision of additional boxes, wiring and conduit for relocated devices.
  - .5 Engaging Owner existing system vendor to decommission devices, re-program existing system to suit renovations work, test and verify operation of existing system is in proper order after system changes.
  - .6 Turn over deleted devices to owner if requested by Owner.

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- .7 Proper disposal of materials not wanted by Owner.
- .2 Coordinate work of trades for scheduling, demolition, rough-in, power, and conduit requirements, installation and testing.
- .3 Provide nurse call systems components in areas as noted in the specification and the drawings. Programme system on servers/terminals/nurse consoles. Obtain Owner approval of room nomenclature prior to start of programming. Customize software to suit Owner specific applications. Program sequence of operation and user information. Include for system manufacturer authorized representative to program systems. Programme exact programming requirements as confirmed with Owner and reviewed with Consultant prior to start of Work. Utilize manufacturer 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.
- .4 Locate additional head end equipment in locations as noted. Provide terminal cabinets/panels as required and locate in electrical or telecom closets as reviewed with 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 to system manufacture instructions and recommendations.
- .5 Provide power receptacles, feeders, data jack/drop as required to accommodate for installation of additional head-end equipment. Confirm locations with Consultant prior to roughing-in. Coordinate work of trades.
- .6 Provide dedicated conduit feeders into equipment cabinets. Generally, required sizing of breakers, feeders and conduits are as noted, 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. Provide dedicated circuit breakers 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 facility essential power circuits of panels serving area of work. Connect network system power supplies and equipment cabinets to common earth ground utilizing copper conductors as required. Comply with governing electrical code requirements. Provide required data drops.
- .7 Provide stations and install into locations. Install components at mounting heights as noted on architectural elevations and as reviewed with Consultant. Generally, wall mount devices onto recessed boxes. Provide conduits and backboxes to accommodate device installations. Confirm back box requirements with system vendor prior to roughing-in.
- .8 Where stations are mounted in headwall units, coordinate dimensions (supply samples of devices) with manufacturer of headwall units.
- .9 Generally, install dome lights in locations as noted but reviewed with Consultant prior to roughing-in. Connect patient room smoke detectors to dome lights and remote communicators, as applicable. 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. Review colours for dome lights with Consultant prior to ordering.

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- .10 Generally, install emergency call stations of pull cord type in locations as noted. Silicone seal between wall and device to prevent water from entering device for devices located in wet locations including but not limited to showers.
- .11 Provide system wiring of copper conductors, colour coded, and in to system manufacturer recommendations and instructions. Connect equipment to system manufacturer certified wiring diagrams and instructions and under direct supervision of manufacturer. Provide and arrange for authorized system manufacturer representative to make final equipment connections. Run conductors in conduit or where identified on drawings, in cable tray.
- .12 Where existing system wiring is UTP telecommunications type wiring, comply with ANSI/TIA 568 cabling installation requirements for category of cabling. Confirm cabling standards with system manufacturer and perform installation to suit standards. Clearly label each cable run and port.
- .13 training from manufacturer representative on any special installation procedures. Install devices and perform work to manufacturer instructions and requirements and to applicable codes of authorities having jurisdiction.
- .14 Review locations of devices with Consultant prior to roughing-in.
- .15 Perform system integration connections to various systems. Include for system service vendors to perform required integration and programming requirements.
- .16 Ground and bond system as required by governing electrical code and authority and system manufacturer.

### **3.2 IDENTIFICATION**

- .1 Provide product identification.
- .2 Number wiring with markers intended for such applications. Colour conductors for each part of system in accordance with system equipment manufacturer recommendations.
- .3 Nameplates:
  - .1 Provide engraved lamicoid identification nameplates for each equipment or wiring housing and secure to front of housing.
  - .2 Size 4 unless otherwise noted.

### **3.3 Field Quality Control**

- .1 Manufacturer Authorized Technician Services:
  - .1 Provide technical training and assistance to certified installers of system.
  - .2 Perform onsite inspection, start-up, testing, verification and certification of installed system.
  - .3 Prepare and sign testing and verification reports for submittal to Consultant.
  - .4 Where directed by Owner, perform onsite training of each user (with provision of user guides) prior to project completion and instruct in operation and maintenances of system.
- .2 Submit to Consultant, proposed schedule for testing and verification of system. Notify Consultant and Commissioning Agent minimum 7 working days in advance of testing.

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- .3 Arrange for system manufacturer technician to inspect, test, verify, commission and certify system components and wiring, individually and as complete system. Work includes but is not limited to verifying following:
  - .1 Type of equipment installed is that designated by Contract Documents.
  - .2 Wiring connections to equipment components show that installer observed code requirements.
  - .3 Equipment installed in accordance manufacturer recommendations, and signaling devices operated or tested verifying operation.
  - .4 Supervisory wiring of equipment connected to supervised circuit is operating and governmental regulations, concerning such supervisory wiring, are in accordance with requirements of AHJ.
  - .5 Sequence of operation is in accordance with specified sequence of operation and approved by AHJ.
  - .6 System and devices are commissioned and operable.
  - .7 Testing system battery power supplies and demonstrate that battery supplies are capable of providing required duration of power.
  - .8 Testing of integrated electromagnetic door locks to verify performance is in accordance with Specifications.
  - .9 Testing of integrated signalling to fire alarm systems.
  - .10 Coordinating with AHJ to obtain certificates of approvals.
- .4 Where project work is phased and requires occupancy at various stages, provide system inspection, testing, commissioning, verification and certification after completion of each phase of work, to approval of AHJ. Upon Substantial Performance of the Project Work, include for providing system inspection, testing, commissioning, verification and certification of entire system work.
- .5 Contact and coordinate with AHJ, for inspections. Integrate AHJ inspection requirements with inspection, testing, commissioning, verification and certification work. Obtain AHJ approval and compliance certifications. Submit copies to Consultant.
- .6 Correct failures or deficiencies found in system during testing, witnessed or directed by AHJ, Consultant, or Commissioning Agent. Re-test and re-verify failures and deficiencies until successfully passed.
- .7 Arrange for manufacturers to supply reasonable amounts of technical assistance with respect to changes required to conform to paragraphs above. During periods of inspection, testing, commissioning, verification and certification work, make electricians available to perform correction work and to assist during this Work. Include for presence of trades responsible for integrated components and systems, during inspection, testing, commissioning, verification and certification work.
- .8 Prepare detailed test sheets of tested components. Submit documentation in form in accordance with referenced standards, acceptable to AHJ, and reviewed with Consultant. Submit testing report documents additionally in electronic format, as reviewed with Consultant.

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- .9 On completion of inspection, testing, commissioning and verification of system, obtain from testing technician and forward to Consultant, compliance certificate together with detailed inspection reports listing each and every system component, its location in building and its acceptability. Prepare compliance certificate and inspection reports signed by certified testing technician. Signed test reports certify that systems are installed and perform in accordance with Specification.



.10 Combine required documentation into reports. Submit to Consultant.

**END OF SECTION**

Access Control System

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## **PART 1 - GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 Comply with all applicable national and provincial and municipal codes including, but not limited to, the following:
  - .1 National:
    - .1 CSA C22.1-24, Canadian Electrical Code, Part 1 (25<sup>th</sup> edition) Safety Standard for Electrical Installations or the latest edition I.
    - .2 CSA z8000 Canadian Healthcare Standards.
    - .3 Canadian Standards Association CSA C22.1.
    - .4 UL 294- Edition 7 -Standard for Access Control System Units.
    - .5 C282-15 Emergency Power Supply for Buildings.
    - .6 National Fire Code of Canada (NFC)
    - .7 National Fire Protection Association (NFPA)
  - .2 Provincial:
    - .1 Ontario Electrical Safety Code.
    - .2 Ontario Building Code.
- .2 Comply with applicable industry practices including but not limited to the most recently published version of the following guides in effect at time of bid including all published addenda and errata:
  - .1 ANSI/TIA/EIA-568-B.3 and its addendum
  - .2 BICSI Telecommunications Distribution Methods Manual – Most current Edition
  - .3 BICSI Network Design Reference Manual – Most current Edition
  - .4 BICSI Information Transport Systems Installation Manual – Most current Edition
  - .5 American Society for Testing Materials (ASTM).
  - .6 Institute of Electrical and Electronic Engineers (IEEE).
  - .7 Manufacturer's specifications, latest issue.
  - .8 American Society for Testing Materials (ASTM).
  - .9 Institute of Electrical and Electronic Engineers (IEEE).
  - .10 Manufacturer's installation and specification manuals latest issue.

Access Control System

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## **1.2 DESIGN PERFORMANCE REQUIREMENTS**

### **.1 Quality Assurance:**

#### **.1 Product Qualifications:**

- .1 The control equipment for the Access Control System, shall be provided by a qualified Electronic Security System Contractor (ESSC)
- .2 All equipment supplied by the ESSC shall be by ISO 9001/9002 certified manufacturers.

### **.2 Electronic Security Systems Supplier Qualifications (ESSC):**

- .1 Project managers and technicians shall be the employees of the ESSC. Technicians shall be factory trained and certified in the various systems. The supplier will be a Microsoft-certified solutions provider (MCSP), staffed with a dedicated Microsoft-certified System Engineer (MCSE) which will be assigned to the project.
- .2 Acceptable Suppliers: The systems, equipment and materials of this Section shall be provided by an authorized, trained and certified Genetec equipment supplier and trained technical staff. All suppliers, equipment and services will be subject to compliance with the Contract Documents, including the Quality Assurance provisions stated herein.
- .3 Any request for substitute suppliers other than certified and authorized equipment suppliers shall submit a substitution request in writing to the authority having jurisdiction (AHJ).

### **.3 General Scope:**

- .1 The ESSC shall be responsible for the systems specified in this Section, including coordination with related trades.
- .2 The ESSC shall coordinate all work and submittal details with the electronic door hardware supplier to ensure proper sizing of control equipment and shall be responsible for proper sizing of interface equipment (i.e., relays, contact ratings, etc.) to eliminate interface problems.

### **.4 Related work specified elsewhere shall be coordinated by the ESSC:**

- .1 Door Hardware/ Electronic Locks.
- .2 Interface of all related systems.
- .3 Electrical Work, except as specified herein.
- .4 Control Work and/or annunciation, except as specified herein.
- .5 All 120 Volt wiring and connections from power panels to terminal strips in electronic low-voltage panels, power supplies and devices (Division 26).
- .6 All raceway, conduit to the device(s), including all back boxes and pull strings and the installation of all special back boxes.
- .7 Wiring.

## **1.3 SYSTEM DOCUMENTATION**

Access Control System

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.1 Submittals:

- .1 The ESSC shall submit complete sets of documentation for approval within thirty (30) days of notification to proceed, pending receipt of all approved information required for coordination. The submittal documents shall include, as a minimum, the following:
  - .1 A complete Bill of Materials. This shall include model numbers, component description, manufacturer name, data sheet reference numbers and quantities of each device to be provided.
  - .2 Original manufacturer's product data sheets for all equipment to be provided. The product data sheets shall be annotated to clearly identify the equipment and devices being supplied that are applicable to the project.
  - .3 System theory of operation that clearly define the operating parameters of all systems being supplied.
  - .4 A functional system block diagram showing single-line inter-connection of all integrated systems and the major components of each system.
  - .5 Final documentation will include copies of a Training Manual tailored for this project as described elsewhere in these documents.
  - .6 Complete Control Panel and device schedules to include:
    - .1 Control Panels and equipment depicting location and designation.
    - .2 All monitored Control Points and Status Indicators.
    - .3 Doors (list door No's.).
    - .4 Misc. Controls.
    - .5 Zone Schedules.
    - .6 All electronic door locking/control panel interface drawings shall be coordinated with the electronic locking hardware. Detailed integrated point-to-point drawings shall be compiled showing all integration between the electronic locking systems, RTLS Systems, Elevator controls, and Door hardware Security Interlock Door Systems as required.
  - .7 Door schedules and control panel schedules are intended to serve as an overall guide to panel requirements and in no way, by omission of content alleviate the ESSC from supplying those items needed to provide a complete and functional panel incorporating all systems and components referenced in this specification.

### Access Control System

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- .2 The ESSC shall provide a draft copy of the Operator's Training Manual within 30-days from approval of the Equipment Submittals. The Manual must provide a concise overview of all training that will take place during the system commissioning. Training will be tailored for the specific project and will cover all Operator Instructions, Procedures and Operating Sequences. The Training Manual shall provide details on the operation of each individual type of control sequence as well as a screen-by-screen review of the overall operation of the system. Upon review of the draft copy of the manual by the CVH Representative, the ESSC shall make necessary modifications and changes to the satisfaction of the CVH Representative.
- .3 Operations & Maintenance (O & M) Manuals:
  - .1 Draft O&M manuals shall be submitted to the System designer for approval prior to completion of the final documents.
  - .2 Final O&M Manuals shall be provided prior to the project completion. The manuals shall include, but not be limited to:
    - .1 Manufacturer's product data sheets for required equipment and major components provided. The product data sheets shall be annotated to clearly identify only those specific functions and features that are applicable to the project.
    - .2 Two (2) sets of disks that contain all submittal information and project documentation as described above. Provide data in Microsoft Word format and Adobe Acrobat .PDF format data sheets.
    - .3 System theory of operations that clearly define the installed operating parameters of all systems supplied.
    - .4 A functional system block diagram showing single-line inter-connection of all integrated systems and the major components of each system.
    - .5 Riser diagram of each subsystem.
    - .6 Device schedules that show relationships between different devices.
    - .7 Operator's Training Manual.
  - .3 All O&M manuals shall be provided in three-ring binders and shall include the project name, Construction Manager's name, architect's name, engineer/consultant's name, and the name of the ESS Supplier. Provide six (6) copies of the O & M manuals.
  - .4 One (1) soft copy of the project manual shall be handed over to the security communication consultant at the completion of the project.

#### **1.4 GENERAL SYSTEM REQUIREMENTS**

- .1 The existing Access Control System (ACS) shall be fully integrated with integration with the Graphical Interface Platform System, Video Badging, CCTV, RTLS Systems, Visitor Management, and Intrusion Alarms. The work specified herein is to add the required access control system peripherals to the existing Genetec Security Centre System.
- .2 The ACS shall interface with the RTLS in order to lock up the respective doors as required by CVH.

## Access Control System

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- .3 ESSC to provide sufficient Security Control (SCP), power supplies, and micro-control-Alarm Panels to support monitoring and control of field devices as needed per the requirements of this design.
- .4 The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within an SCP field panel. Loss of primary and secondary power shall not erase the instructions stored in memory.
- .5 Full flexibility for selective input/output control functions based on ANDing, ORing, NOTing, timing, point lists and predefined templates shall also be incorporated in the resident software programming of the system. Inputs and Outputs shall have the ability to be prioritized such that an input or series of inputs of a higher priority will take precedence over events controlled by lower priority inputs. Conversely, lower priority events may not override higher priority events. Priorities of points may be automatically changed on a timed basis.
- .6 Resident software shall allow for full configuration of circuits so that additional hardware or firmware reprogramming shall not be necessary to accommodate field changes. For instance, changing from sensing of normally open contact devices to sensing of normally closed contact devices, or changing from sensing of normally open contact devices to sensing a combination of current limited and non-current limited devices shall be accommodated without the need for special tools, equipment, or firmware replacement.

### 1.5 POWER REQUIREMENTS

- .1 All 120 VAC power shall be furnished and installed.
- .2 Power supplies for electronic door locks and will be provided by the ESSC, who will be responsible for coordination between the Electrical trade and the electronic door lock systems.
- .3 Back-up power supplies to support 100% of the systems operation for 24 hours minimum.

## PART 2 - PRODUCTS

### 2.1 ACCESS CONTROL SYSTEM (ACS)

- .1 The existing ACS serves the existing system and shall be extended to serve the renovated areas and shall be integrated with the Real Time Locating System (RTLS).
- .2 Furnish and install a complete ACS as described herein and as shown on the plans; to be wired, connected, and left in first class operating condition. The ACS shall consist of redundant network servers with remote Security Control Panels (SCPs), CCTV subsystem integration and Graphical Interface Platform System.
- .3 The system will support data transfer between related IT/ICAT systems. It will be the responsibility of the ESSC to coordinate data transfer protocol procedures with the designated CVH Representative. (where required)
- .4 The ACS is made up of the existing Genetec Security Centre system and this project shall facilitate the addition of ACS door peripherals to fit up the required doors in these shell spaces per the drawings and specifications herein.

Access Control System

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- .5 The ESSC shall be fully responsible for the design and implementation of the full system topology, best suited for the project, given identified and recognized existing ACS infrastructure.
- .6 The ESSC shall use matched components from a single manufacturer, certified to deliver end-to-end system performance to extend the existing Genetec system and maintain or increase performance of the system as it is presently.
- .7 All the stated components and peripherals to be installed per Manufacturer recommended best practices.
- .8 The ACS shall use matched components from a single manufacturer. Approved manufacturer is:
  - .1 Genetec.
  - .2 Approved equivalent.
- .9 Comply with manufacturer's instructions and recommendations to meet the requirements of the specification.
- .10 The quantities of following peripherals and devices shall be confirmed by the ESSC based upon the requirements to extend the ACS doors and peripherals onsite based upon using the spare capacity of the existing systems already installed on site presently.
- .11 Power Supplies:
  - .1 The ACS power supplies shall consist of the Genetec Power Management Systems to support the required Access Control peripherals, and the direct integration with the door locking control equipment.
  - .2 The ACS power supply shall adhere to the required quantity of doors, devices and peripherals and the required integration to provide one unified power solution.
- .12 ACS Door Reader Controller:
  - .1 The ACS reader controller shall be made up of HID Mercury Security LP1501 Intelligent controllers.
  - .2 The LP1502 controller has direct hardware support for two doors and can scale up to 64 readers. Supporting a range of wired and wireless technology, the LP1502 is managed by the Synergis Cloud Link gateway appliance over IP.
- .13 ACS Interface Module:
  - .1 The ACS Interface Module shall be made up of the Mercury Security MR52 which seamlessly integrates with the Genetec Synergis IP Access Control System.
  - .2 The MR52 two door interface module connects up to two readers, controlling either one or two doors. Supporting a range of wired and wireless reader technology, the
  - .3 MR52 is managed by a Mercury Security EP/LP1501, EP/LP1502, EP/LP2500 and EP/LP4502 controller through a high-speed RS-485 network and ultimately, the Synergis Cloud Link appliance over IP.
  - .4 Connects to Mercury Security Controllers over high-speed RS-485 Network.
  - .5 ODSP v1 and v2 supported.
  - .6 Manages up to four (4) ODSP readers or two (2) doors.

### Access Control System

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- .7 Readers: two (2) reader ports, supporting two (2) OSDP readers (entry and exit) each.
- .8 Inputs: eight (8) general purpose: programmable circuit type (two (2) dedicated for Tamper and Power Monitor).
- .9 Outputs: six (6) relays: Form C, 5 Amp 30 Vdc.
- .14 ACS Card Readers:
  - .1 The ACS card readers shall be HID Signo readers.
  - .2 HID Signo™ is the signature line of physical access control readers from HID Global.
  - .3 ESSC shall provide the reader that best suits the clients needs. The final selection of the type of card reader and placement shall be accepted by the CVH representative.
- .15 ACS Door Contacts:
  - .1 The recessed door position switch (door contact) shall be a George Risk Industries (GRI) 180 Series ¾ inch and 1 inch steel door recessed switch set.
  - .2 The door position switch shall be provided by the ESSC to meet the requirements of this specification.
  - .3 The SMS shall allow for the segmentation of data in the systems database such that different user groups can access only the data in their own partitions or in partitions designated as shared. The system shall also have the ability to assign any combination of partitions to a particular user, while assigning one as the "home" partition.
- .16 Request to Exit Detector (T-Rex):
  - .1 The request to exit (REX) motion detector shall be a Tyco T.Rex request to exit type motion detector or approved equivalent.
  - .2 The REX shall be installed as per the manufacturer recommendations.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- .1 Provide and install the system including but not limited to plans and specifications, all applicable codes and the manufacturer's recommendations.
- .2 Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate subcontractors.
- .3 ESSC shall clean all dirt and debris from the inside and the outside of the Electronic Security equipment after completion of the installation.
- .4 The manufacturer's authorized representative shall provide onsite supervision of installation, as required.
- .5 Wiring color code shall be maintained throughout the installation.

### 3.2 TESTING



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Access Control System

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- .1 Systems commissioning to be provided per Commissioning Practices for CVH with the AHJ.
- .2 Once all equipment is installed, the completed ACS shall be fully tested by the ESSC in the presence of the CVH Representative. Upon completion of a successful test, the contactor shall so certify in writing to the CVH Representative, and others as deemed necessary.
- .3 Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate subcontractors.

### **3.3 WIRING**

- .1 All systems wiring shall be installed in accordance with the latest edition of the Canadian Electrical Code (CA). All wiring shall be plenum rated and sized to meet distance requirements between panels and remote devices.
- .2 Wiring shall be grouped and laced with nylon tie straps with a maximum spacing of one inch (1"). Straps will be placed within ½" on each side of all bundle breakouts. Wiring will be supported on intervals not exceeding four inches provided each manufacturer meets all requirements.
- .3 The wiring that extends from the electronic control relay terminal strips to the locks, lights, etc., shall be Class 1, 2 or 3 as defined in Article 725 of the National Electric Code. All conductors shall be a minimum number 14 THHN or THWN, 600 volt rated, and shall be installed in raceways and equipment enclosures with other conductors, within limitations defined by Article 725 of the National Electric Code.
- .4 All control wiring systems shall use plenum rated solid or stranded copper conductors.
- .5 Stranded conductors shall be acceptable only where all terminations can be made to lugs. Where stranded conductors are used, all terminations shall be made with crimp type lugs, correctly sized for termination, and applied to conductor with crimping tool intended for use with the lug used.
- .6 Control wiring between relays and terminal strips within the relay cabinets shall be stripped, tinned and fastened to terminal strips with screws fitted with pressure plates.
- .7 All wiring systems shall be labeled, and color coded with labeling and coding shown on shop drawings. White conductors shall be used only for neutral conductors and green only for grounding conductors. All conductors within junction boxes, pull boxes and equipment enclosures shall be grouped and laced with nylon tie straps with identification tags in individual sets, serving individual locks or groups. Conductor group shall be identified on the tag with respect to room or area served. Control system conductors shall not be spliced; control conductors shall be continuous between the control panel and the relay cabinet.
- .8 All locking systems shall be interfaced with the Fire alarm life safety systems as required by applicable codes and the local AHJ to support proper unlocking functions.
- .9 Electronic locking functions during power failures shall be installed in compliance with life safety codes and local AHJ approvals.

### **3.4 TRAINING**

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Access Control System

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- .1 The ESSC is responsible for providing a custom Operating Training Agenda and Training Manual developed for the specific project. Training shall be provided by to designated Operators, and is intended to provide the trainees with the tools necessary to conduct subsequent training of on-site staff.
- .2 The Training Agenda shall review detailed procedures for operating the entire system, including each subsystem and shall cover the following topics:
  - .1 Actual System Configuration.
  - .2 System Components.
  - .3 Sequence of Operation.
  - .4 System Control Functions.
  - .5 System Maintenance and Troubleshooting Procedures.
- .3 The ACS supplier shall provide a draft copy of the Training Agenda for each Session as part of the original equipment Submittals, and a final approved copy forty-five days prior to project substantial completion.
- .4 Provide a draft copy of the Training Manual within 60 days from the approval of the equipment submittals, and a final approved copy 10 days prior to commencement of the User Acceptance Testing.
- .5 Initial System Administrator Training will take place at the facility on the actual project equipment. This training will be conducted at the time of final testing prior to final acceptance of the equipment, will demonstrate the system capabilities, and will provide a detailed review of System Programming and Administration Operations.
- .6 Provide the following Training Sessions:
  - .1 (coordinate training schedules with the facility representative):
    - .1 One 4-hour Operator Training sessions (on-site).
    - .2 One 4-hour System Administrator session (on-site).
- .7 Provide the CVH Representative with copies of all applicable Training Agendas, user manuals and related training documentation.
- .8 The ACS supplier shall allow all Training Sessions to be videotaped at the CVH Representative Discretion and expense.

### **3.5 WARRANTY**

- .1 ESSC shall warranty the completed Electronic Security system wiring and equipment to be free from inherent mechanical and electrical defects for a period of two (2) years from the date of the completed and certified acceptance test or from the date of first beneficial use.
- .2 The security systems supplier shall provide two (2) -hour response to any service requests during the warranty period within two (2) hours of notification. On site response shall be within four (4)-hours of the notification.

**END OF SECTION**

Existing Fire Alarm System Work

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## **PART 1 - GENERAL**

### **1.1 Submittals**

- .1 Submit shop drawings for products specified in this Section. Include annunciator schedules, revised system programming and sample of revised graphic annunciator layout and nomenclature.
- .2 Submit copies of final system testing and verification reports and certificates of approvals from local governing inspection authority.

## **PART 2 - PRODUCTS**

### **2.1 Existing Fire Alarm System**

- .1 Existing fire alarm system serving complex is Siemens Desigo 2 Stage addressable system. Provide additional devices and work to retrofit and extend system to serve additional and renovated areas. Additional devices to be 100% compatible with and of same manufacturer as per existing system. Include provision of necessary control panel and annunciator work of existing system to accommodate integration of additional devices.

Include for and engage Owner's existing system manufacturer's authorized technicians to provide and perform required system products and work. Contact for existing system is as follows:

Gerry Thibeault  
([gerry.thibeault@siemens.com](mailto:gerry.thibeault@siemens.com)),  
Fire Detection & Security Solutions  
Siemens Canada Limited, Smart Infrastructure  
1577 North Service Road East  
Oakville ON L6H 0H6, Canada  
Mobile: 416-617-3786

- .2 Verify with existing fire alarm system manufacturer during Bid period, exact requirements needed to provide renovation work. If necessary, visit site with manufacturer to review existing conditions. Confirm and coordinate exact work responsibilities with system vendor. Review items of clarification or proposed revisions to Bid Documents with Consultant during Bid Period.

### **2.2 Additional Fire Alarm System Work**

- .1 System retrofit work to include but not be limited to provision of following:
  - .1 modifications to existing head end equipment including provision of additional device connection modules, zone modules, amplifiers and system re-programming, modification of existing loops;
  - .2 additional transponders/data gathering panels (DGP);
  - .3 additional initiating devices (manual stations, heat/smoke/flame detectors);
  - .4 additional alarm indicating devices (speakers, horns, strobes);
  - .5 additional interfaces and interconnections to auxiliary building systems;

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Existing Fire Alarm System Work

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- .6 review of existing battery backup capacity and amplifiers (as applicable) and increasing capacities to accommodate additional device loading and to meet applicable governing local code requirements;
- .7 additional wiring in conduit and/or fire rated cables, and ancillary devices.
- .2 Additional system components to be listed as products of a single manufacturer under appropriate category, by Underwriter's Laboratories of Canada and bear ULC label. System components and work in conjunction with system installation to meet specific application requirements of local governing authorities, codes, standards, regulations and requirements of following:
  - .1 CAN/ULC-S524, Standard for Installation of Fire Alarm Systems;
  - .2 CAN/ULC-S527, Control Units for Fire Alarm Systems;
  - .3 CAN/ULC-S537, Standard for Verification of Fire Alarm Systems;
  - .4 CAN/ULC-S1001, Integrated Systems Testing of Fire Protection and Life Safety Systems;
  - .5 local governing building code;
  - .6 local governing electrical code;
  - .7 local governing building permit applications for approvals;
  - .8 other requirements of local governing authorities.

## **2.3 Retrofit Work and Devices**

- .1 Retrofit control panels and annunciators to supervise and annunciate additional and relocated devices. Additional initiating devices shall be devices that are 100% compatible with existing controls and be ULC listed and labelled for connecting to respective control units. Include costs for manufacturer's authorized representative to perform control panel/transponder work and to reprogram system software to accommodate renovation work. Provide additional zone modules as required and additional batteries as required to supply back-up battery capacity to the additional components.
- .2 Additional devices to be ULC listed and labelled devices suitable for fire alarm applications. Power supplies and other components to be CSA certified where required by local governing authorities and codes.
- .3 Exact type of device to be used in each area of installation to be as recommended by system manufacturer to suit specific applications and to be approved for such use as per ULC standards. Devices in non-climatic controlled areas to be weatherproof, corrosion resistant and ULC listed for use in below freezing temperatures. System manufacturer to be responsible for ensuring compliance with these requirements.
- .4 Devices:
  - .1 Additional manual stations, smoke detectors and heat detectors: to be of type and rating to suit specific application as per existing system manufacturer's recommendations.
  - .2 Audible Devices: of type to match existing system device standards.

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Existing Fire Alarm System Work

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- .3 EVC Speakers: units to include speaker, baffle, back box and ancillary devices to match existing speaker units; speaker grilles to be of finish reviewed with Consultant,
- .4 Strobes and combinations strobes/audible devices: of type to match existing system device standards; include additional strobes to meet latest governing building code requirements.
- .5 Signal devices (audible and visual) to have similar sound and pattern matching existing devices.
- .6 Addressable modules as required for connection of additional devices.
- .7 Ancillary devices as required to complete system.
- .5 End-Of-Line Resistors and Isolators:
  - .1 End-of-line resistors for standard alarm and signalling circuits to be sized to ensure correct supervisory current flows in each circuit, as per local governing code requirements and system manufacturer's recommendations.
  - .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.
  - .3 Isolators to be provided in accordance with local governing code requirements and installed as per system manufacturer's requirements to isolate/monitor zones, loops, group of devices within building and between buildings.
- .6 Refer to drawings for additional device requirements.
- .7 Wiring:
  - .1 CSA certified 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.
  - .2 Sized and installed in accordance with system manufacturer's instructions and local governing electrical code.
  - .3 Fire rated MI for wiring as required by local governing building code, local governing authorities and as noted on drawings, for connections and interconnections to equipment for life safety applications.
  - .4 To be mechanically protected to satisfaction of local fire authority.
  - .5 nVent "Pyrotenax" type "MI" ULC listed and labelled, 2-hour fire rated, mineral insulated, copper sheathed, copper conductors for power, control and signal wiring to and between each transponder/control panel, and for other local code required or local governing authority required applications with regards to life safety equipment.

## **2.4 Testing and Verification Work**

- .1 Refer to Part 3 for system testing, verification and certification Work.

## **PART 3 - EXECUTION**

### **3.1 Installation – General**

Existing Fire Alarm System Work

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- .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 types of system wiring and required sizing taking in consideration applications and voltage drop;
  - .6 system circuiting and device quantities per circuit while maintaining limitations in Specifications;
  - .7 proposed revisions required to existing 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 Perform Work in conjunction with this installation to meet requirements of latest editions of Ontario 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 In addition, work to meet Owner's standards, and recommendations and instructions from system manufacturer.
- .6 During work to existing fire alarm system, obtain Owner approval of proposed time and duration of interruption and review with Consultant. At any time due to emergency situations, Owner may request by-passed zone(s) to be re-instated immediately. In areas where renovation work requires shutdown of any part of fire alarm protection system, provide manual fire alarm protection (Fire Warden) by means of supervising area as approved by local governing authorities. At no time allow fire alarm system or any one zone to be left inoperative overnight. Provide required bypass wiring and temporary wiring to maintain all parts of fire alarm system operative during construction and alterations.
- .7 Perform Work in phases as specified in Divisions 00 and/or 01 and as noted on drawings.
- .8 Fire alarm system manufacturer's authorized technician to supervise control panel, transponder, and annunciator work.
- .9 Provide sequence of operation for fire alarm system as approved by local fire authority and reviewed with Consultant. Refer to additional requirements on drawings.
- .10 Demonstrate system to local Fire Department and obtain their approval for complete system.

Existing Fire Alarm System Work

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### 3.2 Installation of Devices

- .1 Install required devices. Do not install devices in locations that may hamper proper operation of devices including adjacent devices.
- .2 Obtain required training from manufacturer's representative on any special installation procedures. Install devices and perform work in accordance with manufacturer's instructions and requirements and in accordance to applicable codes of local governing authorities having jurisdiction.
- .3 Review device finishes with Consultant prior to ordering.
- .4 Install manual stations in boxes as required, recessed outlet boxes with plaster rings, except in unfinished areas where manual 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.
- .5 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.
- .6 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.
- .7 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 and include required conductors, interconnections and programming.
- .8 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.
- .9 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 100 mm (4") outlet box as close as possible or practicable to detector. Do not locate duct detectors within 1 m (3') of duct size increaser or decreaser fittings or any duct elbow. Provide wiring in conduit and extend to connect back to system control unit.
- .10 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 manual station). Provide required conductors and connections to fire alarm system and to electromagnetic locks.
- .11 Provide required horns and combination horn/strobes. Horns are flush and surface mounted type as indicated to suit architectural wall/ceiling types, each complete with a proper backbox and as required trim plate.
- .12 Provide required speakers. Speakers are flush and surface mounted cone type and as indicated to suit architectural wall/ceiling types, each complete with a proper backbox.
- .13 Exterior speakers/horns to be weatherproof and mounted with weather sealed gland nut connection at proper dispersion angle.

Existing Fire Alarm System Work

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- .14 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 reviewed with Consultant.
- .15 Mount speakers in stairwells and wire vertically connected to specific zone as approved by local fire authority and reviewed with Consultant. Refer to drawing riser and annunciator schedule.
- .16 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.
- .17 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.
- .18 Install amplifiers sized as required to power additional speakers and include spare capacity as specified.
- .19 Install specified telephone handsets and mount in recessed wall mounting boxes. Connect complete with wiring in conduit to local transponder.
- .20 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.
- .21 Typically, install visual notification appliances 2400 mm (8') above floor or 300 mm (12") 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. Typically, provide minimum 2 circuits per floor and connect devices in alternating scheme.
- .22 Relocate devices to accommodate ceiling and wall demolitions and installation of ceilings and walls. Maintain fire alarm protection in areas of Work to satisfaction of Owner and local fire authority. Provide required temporary supporting structures to support temporary located devices in order to maintain proper operation and fire protection. Obtain required inspections and approvals from local fire authority and Owner. Relocate devices to suit local fire authority directions.
- .23 When ceiling and/or wall work has been completed, disconnect temporary devices and existing devices in temporary locations. Locate devices in permanent locations to suit renovations work as per issued drawings and Consultant's directions. Connect, adjust, test and verify.
- .24 Provide required additional devices and install existing devices as required. Circuit device's to existing standards and in compliance with local governing codes and authorities. Determine exact quantities of circuits based on requirements of governing codes and standards, and recommendations of system manufacturer.



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Existing Fire Alarm System Work

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- .25 Install and circuit as required in accordance with manufacturer's instructions for specific applications. Unless otherwise noted in Contract Documents, do not load device circuits more than 80% capacity.
- .26 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.

### **3.3 Requirements for Integrated Systems and Equipment**

- .1 Perform required fire alarm system wiring connections to mechanical equipment and other building systems to perform required interrelated functions. Provide required wiring, relays and/or contactors between fire alarm system and various equipment to achieve automatic or manual control and monitoring of equipment and to perform required integrated to fire alarm system functions. Provide shunt trip breakers as required. Provide fire rated conductors where required by local codes and local authorities.
- .2 Provision of fire alarm supervisory wiring connections to include but not be limited to following (where applicable):
  - .1 fire protection system piping supervised valves and flow switches for alarm initiation;
  - .2 fire protection system piping supervised valves and flow switches for trouble indication;
  - .3 fire protection piping pressure detectors for loss of pressure trouble indication;
  - .4 fan equipment starters;
  - .5 pumps;
  - .6 dampers;
  - .7 fire suppression systems;
  - .8 door holders/releases and electromagnetic locks;
  - .9 integrated equipment such as gensets, elevators, BAS and dimming systems;
  - .10 devices and equipment as shown on drawings.

### **3.4 Additional Requirements**

- .1 Provide required system wiring in accordance to requirements of applicable governing electrical code, other local governing code and standards requirements, system manufacturer's recommendations and based on specific applications and consideration of voltage drop.

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Existing Fire Alarm System Work

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- .2 Install wiring in conduit unless otherwise approved by Owner and reviewed with Consultant, and except for MI fire rated type conductors. Do not splice wiring. Perform wiring connections associated with fire alarm system on terminal strips in junction boxes and colour coded. Provide wiring colour coding consistent for entire length of each run. When pulling wires into conduit, use lubricant and run wires straight and 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.
- .3 Where existing devices are relocated and existing wiring is of insufficient length to connect to relocated position, provide replacement wiring and conduit of sufficient length.
- .4 Where required by local governing codes and/or local governing authorities, provide ULC listed, fire rated conductors (MI) for connections to and interconnections between equipment for life safety applications requiring fire rating. Install MI type conductors in accordance with manufacturer's instructions and requirements in Specification.
- .5 Run alarm indicating circuits (speakers) and alarm receiving circuits (manual stations, detectors) in separate conduits from each other.
- .6 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.
- .7 Provide engraved Lamacoid identification nameplates for each equipment or wiring housing and secure to front of housing. Review exact wording designations and sizes to with Consultant prior to manufacture. Label devices as required by ULC S524 and local governing authorities.
- .8 Review nomenclature of annunciator identification with Consultant prior to ordering.
- .9 Install end-of-line resistors to electrically supervise wiring. Generally, locate end-of-line resistors at ceiling lines above manual 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.
- .10 Refer to drawing riser diagram. Riser drawings are diagrammatic and are not to be used for determining quantities or lengths. Quantities of components to be as per floor plans. Determine exact quantities of circuits based on drawings information, connected devices, requirements of governing codes and standards, and recommendations of system manufacturer.
- .11 Review exact location of components with Consultant prior to roughing-in.
- .12 Ground and bond system as required by local governing electrical code and authority and system manufacturer.

### **3.5 System Testing, Verification and Certification**

- .1 Manufacturer Authorized Technician Services:
  - .1 Provide technical training and assistance to certified installers of system.
  - .2 Perform onsite inspection, start-up, testing, verification and certification of installed system.

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Existing Fire Alarm System Work

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- .3 Prepare and sign testing and verification reports for submittal to Consultant.
- .4 Perform onsite training of each user (with provision of user guides) prior to project completion and instruct in operation and maintenances of system.
- .2 Testing Technicians:
  - .1 Registered technicians in good standing with Canadian Fire Alarm Association (CFAA) or be Certified Fire Alarm Electrician (CFAE) with local Electrical Contractors Association as deemed acceptable to Provincial Fire Marshall.
  - .2 Submit with test reports, copies of valid certification of testing company and technicians.
  - .3 Engage Integrated Testing Coordinator with qualifications in accordance with CAN/ULC-S1001.
- .3 Submit to Owner and Consultant, proposed schedule for inspection, start-up, testing and verification of system. Obtain such reviews prior to start of work. 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 7 working days in advance of work.
- .4 Include for fire alarm system manufacturer to inspect, start-up, test, verify and certify system components and wiring, individually and as a complete system, in accordance with requirements of CAN/ULC S537 and CAN/ULC-S1001. 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 with ULC S524 and 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 existing sequence of operation and any modifications identified on documents and are approved by local fire authority;
  - .6 to ensure that system and devices are commissioned and operable.
- .5 Integrated Testing:
  - .1 Engage Integrated Testing Coordinator to prepare Integrated Testing Plan and provide requirements in accordance with CAN/ULC-S1001.

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Existing Fire Alarm System Work

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- .2 Include for but not be limited to full review, testing and verification of operation of integrated systems such as fire suppression systems, life safety systems, elevators and their emergency sequence of operation, HVAC equipment, 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, and other integrated components.
- .3 Coordinate requirements with trades responsible for integrated components and systems, and arrange trades to be present at time of testing, and verification and commissioning work.
- .6 System manufacturer to also be responsible for but not be limited to provision of following additional work to existing systems:
  - .1 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 duration 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 and review 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.
  - .2 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.
  - .3 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 requirements of local governing building code and is approved by local fire authority.
  - .4 Assist in testing and verification of electromagnetic door locks to meet requirements of authorities having jurisdiction and to obtain overall approval of installation.
  - .5 Coordination with Electrical Divisions and local fire authority to provide requirements to obtain certificates of approvals from local fire authority.
- .7 Where project work is phased and Owner requires occupancy at various stages, include for providing system testing, verification and certification after completion of each phase of work, to approval of local governing authorities. Upon Substantial Performance of the Work, include for providing system testing, verification and certification of entire system work.
- .8 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 compliance certifications. Submit copies to Consultant.
- .9 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. Re-test and re-verify until successfully passed, at no extra cost to Owner.

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Existing Fire Alarm System Work

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- .10 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.
- .11 Provide full detailed test sheets of tested components and provide certification that system work has been fully tested, that devices have passed testing and that system is in proper work order in compliance to local governing code requirements and project documents. Documentation to be in form in compliance with referenced standards, acceptable to local governing authorities and reviewed with Consultant. Testing report documents to be additionally provided in electronic format as confirmed with Consultant.
- .12 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.
- .13 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 CDN) that is to be registered for this project to show satisfactory proof of manufacturer's liability coverage for both their product and personnel.
- .14 Do not use open flame and/or smoke for testing unless approved by Owner and reviewed with Consultant.
- .15 Additionally, refer to testing, coordination and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

### **3.6 Monitoring of Systems**

- .1 In areas that remain occupied and used by Owner during Work, daily monitor and supervise existing fire alarm system and other fire protection systems serving renovation/working areas. Ensure that system is left in proper operating condition at end of each working day. Include for but not be limited to performing following:
  - .1 under presence of Owner's representative, check each morning and evening (start and end of work) of each day, system to ensure that it is in proper working condition;
  - .2 if portions of 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 area affected;
  - .3 document and sign off with Owner's representative signing off also, each respective daily check condition;
  - .4 retrofitting work to system in manner that does not affect portion of system serving areas outside of renovation/working areas.
- .2 Maintain fire protection of areas which may include fire watch during temporary shutdowns of existing systems, in accordance with requirements of local governing code and local governing authorities.

**END OF SECTION**