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END OF SECTION

Part 1 General

1.1 FEES, PERMITS AND CERTIFICATES

- .1 Pay all fees and obtain all permits.
- .2 Provide authorities with plans and information for acceptance certificates. Provide inspection certificates as evidence that Work conforms to requirements of Authority having jurisdiction.
- .3 Obtain inspection certificates as evidence that work conforms to requirements of Authority Having Jurisdiction.

1.2 FIRE SAFETY REQUIREMENTS

- .1 Comply with both the National Building Code of Canada 2015 and the National Fire Code of Canada 2015 for safety of persons in buildings in the event of a fire and the protection of buildings from the effects of fire, as follows:
 - .1 The National Building Code (NBC) for fire safety and fire protection features that are required to be incorporated in building during Work.
 - .2 The National Fire Code of Canada (NFC)
 - .1 The use and continuous maintenance of fire safety and fire prevention devices that are part of the buildings.
 - .2 The conduct of activities that might cause fire hazards in and around buildings.
 - .3 The limitations on hazardous contents in and around buildings.
 - .4 The establishment of fire safety plans.
 - .5 Fire safety at construction and demolition sites.
- .2 Welding and Cutting
 - .1 Before welding, soldering, grinding and/or cutting work, obtain a permit, as directed by the Departmental Representative. Store flammable liquids in approved CSA containers.
 - .2 At least one week prior to commencing cutting, welding or soldering procedure, provide to Departmental Representative:
 - .1 Notice of intent, indicating devices affected, time and duration of isolation or bypass.
 - .2 Completed welding permit as defined in NFC.
 - .3 Return welding permit to Departmental Representative immediately upon completion of procedures for which permit was issued.
 - .3 “Fire Watchers” as described in NFC must be assigned when welding or cutting operations are carried out in areas where combustible materials within 15 m may be ignited by conduction or radiation.
- .3 Where Work requires interruption or cause activation of fire alarms or fire suppression, extinguishing or protection systems:
 - .1 Provide “Watchman Service” as described in NFC; in general, watchman service is

defined as an individual conversant with “Fire Emergency Procedures”, performing fire picket duty within an unprotected and unoccupied (no workers) area once per hour.

- .2 Retain services of manufacturer for fire protection systems on daily basis or as approved by Departmental Representative, to isolate and protect all devices relating to:
 - .1 Modification of fire alarms, fire suppression, extinguishing or protection systems; and/or
 - .2 Cutting, welding, soldering or other construction activities that might activate fire protection systems.
- .3 Immediately upon completion of Work, restore fire protection systems to normal operation and verify that all devices are fully operational.
- .4 Inform fire alarm system monitoring agency and local fire department immediately prior to isolation and immediately upon restoration of normal operation.

1.3 SCHEDULE

- .1 Schedule and execute work with least possible interference or disturbance to the normal use of premises.
- .2 Submit equipment details and delivery schedule for the new UPS within five (5) working days of Contract Award. Once the delivery date is confirmed by the Contractor, the date of installation of the UPS can be coordinated with the Department Representative.
 - .1 The replacement of the UPS shall take place within one single period over a week-end.
 - .2 The Contractor shall target to conduct the replacement of the UPS from Friday, May 1, 2020 at 7:00 AM and be finished by Sunday, May 3, 2020 at 12:00 PM (noon).
 - .3 Do not change schedule without notifying the Departmental Representative first. Notify the Department Representative immediately if the indicated target date is not reasonable.
- .3 If adjustments are needed after the installation of the new equipment, the Contractor shall do so outside of regular business hours. Adjustments shall be performed:
 - .1 From Monday to Thursday, between 9:00 PM and 6:00 AM, and on weekends from Friday 6:00 PM until 6:00 AM on the following Monday morning.
- .4 Ensure to coordinate and reserve the start-up and commissioning of the new UPS system by the manufacturer within the project work period. The Contractor must allow for the time required to do the start-up and commissioning in the project schedule.

1.4 TEMPORARY UTILITIES

- .1 Existing services required for Work excluding power required for space temporary heating may be used by the Contractor without charge. Ensure capacity is adequate prior to imposing additional loads. Connect and disconnect at own expense and responsibility.
- .2 Notify the Departmental Representative and utility companies of intended interruption of services and obtain requisite permission.

- .3 Each necessary interruption of any mechanical or electrical services throughout the course of the Work shall be coordinated with and approved by the Departmental Representative prior to the interruptions. Keep duration of these interruptions to a minimum.

1.5 TEMPORARY BARRIERS AND ENCLOSURES

- .1 Maintain existing services to building and provide for personnel and vehicle existing traffic routes clear at all times.
- .2 Protection.
 - .1 Protect structures against damage until takeover.
 - .2 Protect against the spread of dust and dirt beyond the work areas.
 - .3 Protect operatives and other users of site from all hazards.
- .3 Work areas.
 - .1 The Work locations include all areas indicated on the drawings.
 - .2 The contractor shall agree to install proper site separation and identification to maintain "Time and Space" at all times throughout the life of the project. When building operations staff, building staff or private sector maintenance personnel require access to operational equipment located in the construction area to operate the building, access shall be granted and proper coordination and communication must exist between all parties involved.

1.6 COMMON PRODUCT REQUIREMENTS

- .1 Quality of Work.
 - .1 Carry out work using qualified licensed workers or apprentices in accordance with Provincial Act respecting manpower vocational training and qualification.
 - .2 Permit employees registered in Provincial apprenticeship program to perform specific tasks only if under direct supervision of qualified licensed workers.
 - .3 Determine permitted activities and tasks by apprentices, based on level of training attended and demonstration of ability to perform specific duties.
- .2 Storage, Handling and Protection.
 - .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions.
 - .2 Store packaged or bundled products in original and un-damaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Manufacturer's Instructions.
 - .1 Unless otherwise indicated in the Specifications, install or erect products in accordance with manufacturer's instructions.
 - .2 Do not rely on labels or enclosure provided with products.
 - .3 Obtain written instructions directly from manufacturers.

1.7 ADMINISTRATIVE REQUIREMENTS

- .1 Start-up Meeting.
 - .1 The Departmental Representative will convene a start-up meeting within two (2) weeks of contract award to confirm project requirements. Agenda to include:
 - .1 Schedule of Work: in accordance with Article 1.3 Schedule.
 - .2 Examination and preparation required before beginning work in accordance with Article 1.10 below
 - .3 Schedule of submission of shop drawings, technical data sheets. Submit submittals in accordance with Section 01 33 00 Submittal Procedures.
 - .4 Site security in accordance with Article 1.13 Building Security below.
 - .5 Proposed changes, procedures, approvals required, administrative requirements.
- .2 Attend all project meetings convened by the Departmental Representative.

1.9 OPERATIONAL REQUIREMENTS

- .1 Maintain existing services to building and provide for occupant, visitor and vehicle access.
- .2 Premises must remain in operational condition for the entire duration of the Work.
- .3 Refer to the Specifications and the electrical diagrams for the preparatory work to be performed before disconnection of the existing equipment of the uninterruptible power source begins. The entire process must also be coordinated with and approved by the Departmental Representative.
- .4 Any necessary closure of the building's existing services can only occur after the prescribed warning notice is submitted to and approved by the Departmental Representative.

1.10 EXAMINATION AND PREPARATION

- .1 The Contractor must verify field measurements, and confirm compliance with code requirements and on-site restrictions.
- .2 The Contractor is responsible for the pre-construction engineering work and installation work and must ensure that the materials and / or equipment provided are fully compatible with the existing conditions on site.
 - .1 Examine site and conditions likely to affect the Work and be familiar and conversant with existing conditions.
 - .2 Submit photographs of surrounding properties, objects and structure liable to be damaged or be the subject of subsequent claims to Departmental Representative before commencement of Work in any location.
 - .3 Before commencement of Work, establish location and extent of service lines in Work Area and notify Departmental Representative of findings.

1.11 ACCESS AND EGRESS

- .1 If necessary, design, construct and maintain temporary "access to" and "egress from" Work Areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.
 - .1 Submit proposed temporary means to Departmental Representative for review and approval a minimum of five (5) days before undertaking respective work.

1.12 USE OF SITE AND FACILITIES

- .1 Schedule and execute work with least possible interference or disturbance to the normal use of premises. Make arrangements with Departmental Representative to facilitate Work as stated.
- .2 The Departmental Representative will assign on-site sanitary facilities for use by Contractor's personnel.
 - .1 Keep facilities clean.
- .3 If necessary, use only existing elevators in the building for moving workers and material to and from Work Area.
 - .1 Protect walls of passenger elevators, to approval of Departmental Representative prior to use.
 - .2 Accept liability for damage, safety of equipment and overloading of existing equipment.
- .4 Keep within limits of Work Areas and avenues of ingress and egress as designated by the Departmental Representative.
- .5 Parking.
 - .1 Contain deliveries and temporary parking as designated by the Departmental Representative.
 - .2 Temporary parking permitted for Contractor employees in company-marked vehicles only.
 - .1 Contractor vehicles at site is limited to equipment delivery.
 - .3 No parking permitted outside of designated parking spots.
- .6 Deliveries.
 - .1 Delivery of any material and/or equipment in preparation for the Work shall be done outside regular business hours. Deliveries shall be planned in the following timeframes unless otherwise specified by the Departmental Representative:
 - .1 From Monday to Thursday, between 9PM and 6AM, and on weekends from Friday 6PM until 6AM on the following Monday morning.
- .7 Signage.
 - .1 Provide common use signs related to traffic control, information, instruction, use of equipment, public safety devices, etc. in both official languages or by the use of commonly understood graphic symbols to the Departmental Representative's approval.

- .2 No advertising will be permitted on this project.
- .8 Access equipment and materials.
 - .1 Provide access equipment and materials required to carry out the Work in accordance with IHSA recommendations and the Occupational Health and Safety Act.
- .9 Protection.
 - .1 Protect all finished Work against damages and/or deterioration until the time of final handover.
 - .2 Effectively protect adjacent work against the spread of dust and dirt beyond the Work areas.
 - .3 Protect all personnel and other users of site from all hazards.
- .10 Site Storage / Loading.
 - .1 Do not unreasonably encumber premises with products, tools or equipment.
 - .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.
 - .3 Storage of materials, tools or equipment on site is not permitted.

1.13 BUILDING SECURITY

- .1 The Contractor shall provide to the Departmental Representative a list of all personnel that will be employed on site to execute the Work at least five (5) business days prior to commencement of any Work for building security clearance.
 - .1 Information shall include: name of the company for each person, their full name, and their security clearance certificate number (or date of birth).
- .2 The Contractor is responsible for security of Work Area.
- .3 Where security is reduced by work.
 - .1 Provide temporary means to maintain security.
 - .2 Submit proposed temporary means to Departmental Representative for review and approval a minimum of five (5) days before undertaking respective work.
- .4 Security escorts.
 - .1 All personnel employed on this project must be escorted when executing Work in non-public areas during normal working hours. Personnel must be escorted in all areas after normal working hours.
 - .2 The Departmental Representative will coordinate for security escorts.

1.14 CUT, PATCH AND MAKE GOOD

- .1 The Contractor is responsible for all cutting and repair work required to perform the Work. The electrical contractor must identify the locations for all necessary openings, in particular conduits, ducts, electrical outlets, cable trays, etc., and must co-ordinate all openings with the other trades.
- .2 Cut existing surfaces as required to accommodate new Work.

- .3 Remove all items so shown or specified.
- .4 Patch and make good surfaces cut, damaged or disturbed, to Departmental Representative's approval. Match existing material, colour, finish and texture.
- .5 Before proceeding with core drilling of concrete wall or floor, perform a Ground Penetrations Radar (GPR) type scanning in the area of penetration to ensure that it will not interfere with concealed conduits, ducts or piping. Make use of a cable locator to distinguish reinforced bars from electrical conduits.
- .6 Obtain Departmental Representative's approval before making any opening. Clean floors/walls immediately and after core drilling is complete.
- .7 Core drilling through floors and walls shall be done with diamond drills only. The use of pneumatic hammers will not be permitted.

1.15 SLEEVES, SUSPENSION MECHANISMS AND ANCHORS

- .1 Match sleeve installation and stuffing with supply and installation of suspension rods and embedded parts.
- .2 Co-ordinate setting and packing of sleeves and supply and installation of hangers and inserts. Obtain Departmental Representative's approval before cutting into structure.

1.16 CLEANING

- .1 Site cleanliness.
 - .1 Maintain site in tidy condition, free from accumulation of waste and debris.
 - .2 Make arrangements with and obtain permits from the competent authorities for the disposal of waste and debris.
 - .3 Provide on-site dump containers for collection of waste materials and debris.
 - .4 Dispose of waste materials and debris off site.
 - .5 Provide adequate ventilation during use of volatile or noxious substances. Use of the building ventilation system for this purpose is prohibited.
 - .6 Only use cleaning products recommended by the manufacturer of the surface to be cleaned and use them as recommended by the cleaning product manufacturer.
- .2 Final cleanup.
 - .1 When Work is substantially completed, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
 - .2 Remove waste products and debris, and leave premises clean and suitable for occupancy.
 - .3 Prior to final inspection, remove surplus products, tools, construction machinery and equipment.
 - .4 Make arrangements with and obtain permits from the competent authorities for the disposal of waste and debris.
 - .5 Clean lighting reflectors, lenses and other lighting surfaces.

- .6 Remove dirt and other disfigurations from exterior surfaces.
- .7 Clean materials and equipment in perfectly sanitary manner.

1.17 WASTE MANAGEMENT

- .1 Comply with Environmental Protection Act, Ontario Regulations: O. Reg. 102/94 – Waste Audits and Waste Reduction Work Plans; and O. Reg. 103/94 – Industrial, Commercial and Institutional Source Separation Programs; for waste management on construction and demolition projects.
- .2 Recycling and waste bins are NOT provided by the Departmental Representative. The Contractor is required to provide such bins and to remove them from the site on a daily basis.

1.18 REMOVED MATERIALS

- .1 Unless otherwise specified, all materials and/or equipment designated for dismantling will become the property of the Contractor, who will be responsible for removing these from site.

Part 2 Products

2.1 NOT APPLICABLE

- .1 Not applicable.

Part 3 Execution

3.1 NOT APPLICABLE

- .1 Not applicable

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 00 10 – General Instructions
- .2 Section 01 33 00 – Submittal Procedures
- .3 02 82 00.01 – Asbestos Abatement: Minimum Precautions
- .4 02 82 00.02 – Asbestos Abatement: Intermediate Precautions
- .5 02 89 00 – Silica Precautionary Measures

1.2 REFERENCE STANDARDS

- .1 Federal Legislation
 - .1 *Canada Labour Code*
 - .1 *Canada Occupational Health and Safety Regulations.*
 - .2 *Transportation of Dangerous Goods Act, 1992 (TDGA).*
 - .3 *Canada Consumer Product Safety Act*
 - .1 *Surface Coating Materials Regulations SOR/2005-109.*
- .2 Provincial Legislation
 - .1 *Ontario Occupational Health and Safety Act, R.S.O. 1990, 2010 edition.*
 - .1 *Ontario Regulation 490/09 – Designated Substances (O.Reg. 490/09).*
 - .2 *Ontario Regulation 278/05 – Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations, (O.Reg. 278/05).*
 - .3 *Ontario Regulation 213/91 for Construction Projects (O.Reg. 213/91).*
 - .2 *Ontario Environmental Protection Act, R.R.O. 1990*
 - .1 *Ontario Regulation 347/09, General – Waste Management (O.Reg. 347/09).*
 - .3 *Ontario Dangerous Goods Transportation Act.*
- .3 *PSPC Asbestos Management Directive.*
- .4 *PSPC Asbestos Management Standard.*
- .5 *Canadian General Standards Board (CGSB).*
- .6 *Canadian Standards Association (CSA International). CAN/CSA-Z94.4-11 Respiratory Protection.*

1.3 DEFINITIONS

- .1 Asbestos Containing Materials (ACMs): materials that contain 0.5 percent or more asbestos by dry weight, including fallen materials and settled dust.
- .2 Time-weighted average exposure limit (TWael): the time-weighted average airborne concentration of a biological or chemical agent to which a worker may be exposed in a work day or work week as prescribed by O.Reg. 490/09 Designated Substances, as amended.

1.4 DESIGNATED SUBSTANCES

- .1 Confirm with the Departmental Representative that no additional designated substances have been brought to the project area prior to beginning Work.
- .2 Additional designated substances and hazardous materials may exist outside the accessible survey area but are beyond the scope of this project.
- .3 Should any additional material, suspected to be a designated substance, be encountered within the project area, any disturbance of such material must be stopped, precautionary measures taken, and the Departmental Representative must be notified immediately. Do not proceed until written instructions have been received.
 - .1 **ACRYLONITRILE:** Not Identified.
 - .2 **ARSENIC:** Not Identified.
 - .3 **ASBESTOS: Assumed.**
 - .1 The following asbestos-containing materials may be in the project area based on past reports:
 - a. Smooth and rough plaster finishes on walls and ceilings
 - b. Duct and pipe insulation
 - c. Mortar in the joints of concrete block walls
 - .4 **BENZENE:** Not Identified.
 - .5 **COKE OVEN EMISSIONS:** Not Identified.
 - .6 **ETHYLENE OXIDE:** Not Identified.
 - .7 **ISOCYANATES:** Not Identified.
 - .8 **LEAD: Assumed.**
 - .1 Lead has been confirmed present in various paint finishes in the building.
 - .2 Lead may be present in the solder or joint packings of pipes.
 - .9 **MERCURY: Assumed.**
 - .1 Mercury is suspected to be present in the following materials:
 - a. Fluorescent light tubes
 - .10 **SILICA: Assumed.**
 - .1 Silica is present in the following building materials within the project area:
 - a. Plaster;
 - b. Drywall;
 - c. Mortar; and
 - d. Concrete blocks.
 - .11 **VINYL CHLORIDE MONOMER:** Not Identified.

1.5 RECOMMENDATIONS

.1 ASBESTOS

- .1 The disturbance of asbestos-containing materials on construction and renovation projects is governed by the *Canada Occupational Health and Safety Regulations*, *PSPC Asbestos Management Directive*, and in the province of Ontario by *O.Reg. 278/05*, as amended. These regulations classify all asbestos disturbances as Low Risk (Type 1), Moderate Risk (Type 2), or High Risk (Type 3), each of which has defined precautionary measures. All asbestos materials are subject to specific handling and disposal precautions. The Ontario Ministry of Labour (MoL) must be notified of any project involving removal of more than a minor amount (e.g. Typically 1 square metre of friable asbestos material). In the event of conflict between regulations, the more stringent procedures apply.

.2 LEAD

- .1 The Occupational Health and Safety Branch of the Ontario Ministry of Labour have published the document entitled “*Guideline: Lead on Construction Projects*”. This document classifies all disturbances of lead-containing materials as Type 1, Type 2a, Type 2b, Type 3a or Type 3b work, based on presumed air-borne concentrations of lead generated during the Work, each of which will have defined work practices. Although this document is not a regulation, Ministry of Labour Inspectors use it as guidance during site inspections. These procedures should be followed when performing Work involving the disturbance of lead- containing materials.
- .2 Disposal of construction waste containing lead must be done in accordance with *O.Reg. 347/90*, the *Ontario Dangerous Good Transportation Act*, and the federal TDGA. The classification of the waste is dependent upon the results of leachate tests. The waste can be classified as “hazardous,” “non-hazardous” or “registerable solid waste” depending on the results of the leachate test.

.3 SILICA

- .1 Comply with Ontario Regulations *O.Reg. 490/09* when performing works that may disturb silica-containing materials.
- .2 Follow recommendations provided in the Ontario Ministry of Labour Guideline entitled “*Guideline: Silica on Construction Projects*”. This document classifies all silica disturbances as Type 1, Type 2 or Type 3 work, and assigns different levels of respiratory protection and work procedures for each classification.

Part 2 Products

2.1 NOT APPLICABLE

- .1 Not applicable.

Part 3 Execution

3.1 NOT APPLICABLE

.1 Not applicable

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 00 10 – General Instructions
- .2 Section 01 78 00 – Closeout Submittals
- .3 Section 01 91 13 – General commissioning requirements
- .4 Section 02 82 00.01 – Asbestos Abatement: Minimum Precautions
- .5 Section 02 82 00.02 – Asbestos Abatement: Intermediate Precautions
- .6 Section 02 89 00 – Silica Precautionary Measures
- .7 Section 26 05 00 – Common Work Results for Electrical
- .8 Section 26 33 53 – Uninterruptible Power Systems static (UPS)

1.2 ADMINISTRATIVE DETAILS

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
- .2 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .3 Do not proceed with Work affected by submittal until review is complete.
- .4 Present all submittals in SI Metric units as far as possible.
- .5 Where item or information is not produced in SI Metric units converted values are acceptable.
- .6 Review submittals prior to submission to Departmental Representative. Such preliminary review and examination constitute confirmation by the Contractor that the requirements applicable to the Work have been or will be determined and verified and that every document a submitted has been reviewed or examined and found to conform to the work requirements and Contract Documents. Documents that are not stamped, signed, dated and identified as pertaining to the specific project will be returned without being examined and will be deemed to have been rejected.
- .7 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .8 Verify the accuracy of field measurements in relation to affected adjacent works.
- .9 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .10 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .11 Keep one reviewed copy of each submittal on site.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 “Shop drawings” means drawings, diagrams, illustrations, tables, performance charts, brochures and other documentation the Contractor is required to provide to show in detail any part of the structure.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in the province of Ontario, Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work in shop drawings. Where items or equipment attach or connect to other items or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and Specifications.
- .4 If any changes or adjustments made to the shop drawings by the Departmental Representative affect the value of the work, state such in writing to Departmental Representative prior to proceeding with Work.
- .5 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .6 Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project name and number.
 - .3 Name and address of the Contractor.
 - .4 Identification and quantity of each shop drawing, product data.
 - .5 Other pertinent data.
- .7 Submittals include:
 - .1 Date of production and dates of revisions.
 - .2 Project name and number.
 - .3 Name and address of:
 - .1 subcontractor;
 - .2 supplier; and
 - .3 manufacturer.
 - .4 Contractor’s stamp signed by the Contractor’s designated representative certifying that the documents submitted are approved, that the measurements taken on site have been verified and that everything meets the requirements set out in the Contract Documents;
 - .5 pertinent details of the portions of Work concerned:
 - .1 fabrication details and materials;
 - .2 layout or configuration, with dimensions, including dimensions measured on site, as well as leeway and clearances;

- .3 assembly and adjustment details;
 - .4 capacities, such as power, flow or loading capacity;
 - .5 performance characteristics;
 - .6 reference standards;
 - .7 operating weight;
 - .8 wiring diagrams;
 - .9 single line and schematic diagrams;
 - .10 relationship to adjacent works.
- .8 Distribute copies of the shop drawings and product data sheets after the Departmental Representative's review.
- .9 Submit one (1) electronic copy of shop drawing for each requirement requested in Specifications Sections and Departmental Representative may reasonably request.
- .10 Where shop drawings are not required due to the use of a standard manufactured product, submit electronic copy of the product data sheets or documentation produced by the manufacturer, as prescribed in the technical sections of the Specifications and required by the Departmental Representative.
- .11 Submit electronic copy of the certified required in the technical sections of the Specifications and as required by the Departmental Representative.
- .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets Specifications requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .12 Submit electronic copy of manufacturer's instructions, as prescribed in the technical sections of the Specifications and required by the Departmental representative.
- .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .13 Submit electronic copy of manufacturer's field testing reports, as prescribed in the technical sections of the Specifications and required by the Departmental Representative.
- .14 Documentation of the testing and verification actions taken by the manufacturer's representative to confirm compliance of installed products, materials, equipment or systems with the manufacturer's instructions.
- .15 Submit electronic copy of the operation and maintenance data, as prescribed in the technical sections of the Specifications and required by the Departmental Representative.
- .16 Delete information not applicable to project.
- .17 Supplement standard information to provide details applicable to project.
- .18 If upon review by the Departmental Representative no errors or omissions are discovered in the shop drawings, or if only minor corrections are made, the printed copies will be returned and fabrication and installation work may then proceed. If shop drawings are rejected, noted

copy to be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

- .19 The review of shop drawings by Public Services and Procurement Canada (PSPC) is for sole purpose of ascertaining conformance with general concept.
 - .1 This review does not mean that the Department approves detail design inherent in shop drawings, responsibility for which will remain with Contractor submitting same, and such review does not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of construction and Contract Documents.
 - .2 Without restricting generality of foregoing, Contractor is 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 all sub-trades.
- .20 Shops drawings are required for:
 - .1 UPS;
 - .2 Wiring devices;
 - .3 Distribution panels; and
 - .4 Transformers.

Part 2 Products

2.1 NOT APPLICABLE

- .1 Not applicable.

Part 3 Execution

3.1 NOT APPLICABLE

- .1 Not applicable

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 00 10 – General Instructions
- .2 Section 01 14 25 – Designated Substances
- .3 Section 01 33 00 – Submittal Procedures
- .4 Section 01 91 13 – General commissioning requirements
- .5 Section 02 82 00.01 – Asbestos Abatement: Minimum Precautions
- .6 Section 02 82 00.02 – Asbestos Abatement: Intermediate Precautions
- .7 Section 02 89 00 – Silica Precautionary Measures
- .8 Section 26 05 00 – Common Work Results for Electrical
- .9 Section 26 33 53 – Uninterruptible Power Systems static (UPS)

1.2 REFERENCE STANDARDS

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .3 Material Safety Data Sheets (MSDSs).
- .4 Province of Ontario.
 - .1 *Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O., as amended and O.Reg. 213/91 as amended* - in its most recent version.

1.3 SUBMITTALS FOR APPROVAL/INFORMATION

- .1 Submittals in accordance with Section 01 33 00.
- .2 Submit site-specific Health and Safety Plan: Within seven (7) days after date of Contract Award and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of the site-specific safety risk/hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Submit copies of reports or directions issued by federal, provincial and territorial health and safety inspectors.
- .4 The Contractor must notify the Departmental Representative of any accident, injury, near miss, fire, explosion or chemical spill that occurs at the worksite or during any site visit by a government execution officer. The Contractor must provide a written report within 24 hours of an accident, injury, near miss, fire, explosion or chemical spill.
- .5 Submit for review by the Departmental Representative a comprehensive Hazard Assessment Site Specific Safety Plan (HASSSP) in an indexed format inserted in a three-ring binder. Once the Departmental Representative has reviewed and approved the HASSSP binder, the Departmental Representative will return it to the Contractor for use at the site.

- .6 The Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to the Contractor.
- .7 The Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .8 Medical surveillance: Where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work. Request from the Departmental Representative an additional certification for any new employee working at the job site.
- .9 On-site Contingency and Emergency Response Plan: Address standard operating procedures to be implemented during emergency situations.

1.4 FILING OF NOTICE

- .1 Before Work begins, send the project notice to the Provincial Authorities having jurisdiction.
- .2 Work area locations include:
 - .1 The UPS Room located inside the large Mechanical Room in the basement, and the large room right next to the UPS Room.
- .3 Contractor must agree to install proper site separation and identification in order to maintain time and space at all times for the duration of the project.

1.5 RISK/HAZARD ASSESSMENT

- .1 Conduct an assessment of safety risks/hazards related to Work performed on the site.

1.6 MEETINGS

- .1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

1.7 REGULATORY REQUIREMENTS

- .1 Perform Work in accordance with Section 01 00 10.

1.8 PROJECT/SITE CONDITIONS

- .1 Refer to the site condition and to the assessment reports for all hazardous or contaminated materials or substances at the project site.

1.9 GENERAL REQUIREMENTS

- .1 Draft a site-specific health and safety plan based on the risk/hazard assessment before the start of Work. Implement and ensure full compliance with the plan until all employees have cleared the site. Health and Safety Plan must address project Specifications.
- .2 The Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.10 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for

protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

- .2 Contractor will be responsible and assume the role Constructor as described in the Ontario Occupational Health and Safety Act and Regulations for Construction Projects.
- .3 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.
- .4 The Contractor must ensure that the worksite supervisor is present and available at all times for the duration of the project and that he or she is an employee of the Contractor.

1.11 COMPLIANCE REQUIREMENTS

- .1 The Contractor must comply with the Canada Labour Code, Part II, Canada Occupational Health and Safety Regulations.
- .2 Comply with the occupational health and safety requirements set out in CSA Z462 Workplace Electrical Safety.
- .3 Comply with the occupational health and safety requirements set out in CSA Z460 Control of Hazardous Energy.

1.12 UNFORSEEN HAZARDS

- .1 When unforeseen or specific safety-related factors, hazards, or conditions occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with provincial statutes and regulations and notify Departmental Representative verbally and in writing.

1.13 POSTING OF DOCUMENTS

- .1 Ensure applicable documents, articles, notices and orders are posted in conspicuous location on site in accordance with provincial statutes and regulations and in consultation with Departmental Representative.

1.14 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance with health and safety regulations.
- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.15 POWDER ACTUATED DEVICES

- .1 Use powder actuated devices only after receipt of written permission from Departmental Representative.

1.16 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of

environment over cost and schedule considerations for Work.

Part 2 Products

2.1 NOT APPLICABLE

.1 Not applicable.

Part 3 Execution

3.1 NOT APPLICABLE

.1 Not applicable

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 00 10 – General Instructions
- .2 Section 01 91 13 – General commissioning requirements
- .3 Section 02 82 00.01 – Asbestos Abatement: Minimum Precautions
- .4 Section 02 82 00.02 – Asbestos Abatement: Intermediate Precautions
- .5 Section 02 89 00 – Silica Precautionary Measures
- .6 Section 26 05 00 – Common Work Results for Electrical
- .7 Section 26 33 53 – Uninterruptible Power Systems static (UPS)

1.2 REFERENCES AND CODES

- .1 Materials shall be new and Work shall conform to the minimum applicable standards of the “References” indicated in the Specification sections, the National Building Code of Canada 2015 (NBC) and all applicable Provincial and Municipal codes. In the case of conflict or discrepancy the most stringent requirement shall apply.
- .2 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.3 HAZARDOUS MATERIAL DISCOVERY

- .1 Hazardous Material: Product, substance, or organism that may cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into environment.
- .2 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Departmental Representative. Refer to Section 02 82 00.02 - Asbestos Abatement - Intermediate Precautions.
- .3 PCB: Polychlorinated Biphenyl: stop work immediately when material resembling Polychlorinated Biphenyl is encountered during demolition work. Notify Departmental Representative.
- .4 Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify Departmental Representative.
- .5 For Work in occupied buildings, give the Department Representative 72 hour’s notice for work involving designated substances (Ontario Bill 208), hazardous substances (Canada Labour Code Part II Section 10), and before painting, caulking, installing carpet or using adhesives and other materials, that cause off gassing.

1.4 APPLICABLE REGULATIONS

- .1 Comply with specified standards and regulations to ensure safe operations at site containing hazardous or toxic materials.
- .2 Obtain necessary permits and approvals.
 - .1 Provide copies to Departmental Representative prior to start of Work on site.
- .3 Federal:
 - .1 Canadian Environmental Protection Act.
 - .2 Transportation of Dangerous Goods Act and Regulations.
 - .3 Canada Safety Code Part II.
 - .4 National Building Code of Canada, 2015 Edition.
- .4 Province of Ontario:
 - .1 Ontario Building Code, latest edition.
 - .2 Occupational Health and Safety Act, R.S.O., 2004.
 - .1 O.Reg. 278/05- Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations.
 - .2 O.Reg. 213/91 – Construction Projects.
 - .3 O.Reg. 490/09 – Designated Substances.
 - .4 Guideline - Silica on Construction Projects.
 - .5 Guideline – Lead on Construction Projects.
 - .3 Environmental Protection Act.
 - .1 O.Reg 102/94 – Waste Audits and Waste Reduction Work Plans.
 - .2 O.Reg. 347 – General Waste Management.
 - .3 O.Reg. 360 – Spills.
 - .4 Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and the provision of Material Safety Data Sheets (MSDS) acceptable to Ontario's Bill 208, Reg. 490/09 from Ontario.
- .5 City of Ottawa applicable municipal building codes and bylaws.

1.5 SITE SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions and municipal by-laws.
 - .1 Smoking is not permitted in the Building and within the borders of the construction site. Obey smoking restrictions on building property.

Part 2 Products

2.1 NOT APPLICABLE

.1 Not applicable.

Part 3 Execution

3.1 NOT APPLICABLE

.1 Not applicable

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 00 10 – General Instructions
- .2 Section 01 33 00 – Submittal Procedures
- .3 Section 01 91 13 – General commissioning requirements
- .4 Section 26 05 00 – Common Work Results for Electrical
- .5 Section 26 33 53 – Uninterruptible Power Systems static (UPS)

1.2 ADMINISTRATIVE DETAILS

- .1 Meeting before completion of Work:
 - .1 Convene meeting one week prior to Contract completion with the Contractor's representative and the Departmental Representative to review:
 - .1 Work requirements.
 - .2 Manufacturer's installation instructions
- .2 Departmental Representative to establish communication procedures for:
 - .1 Giving notice of construction warranty defects.
 - .2 Determining priorities for type of defects.
 - .3 Determining reasonable response time.
- .3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
- .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to enquiries for warranty work action.

1.3 SUBMITTALS FOR APPROVAL/INFORMATION

- .1 Submittals in accordance with Section 01 33 00.
- .2 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .3 Provide evidence, if requested, for type, source and quality of products supplied.

1.4 FORMAT

- .1 Organize data as an instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are required, correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.

- .4 Cover: identify each binder with typed or printed title "Project Record Documents"; list the title of the Project and identify subject matter of contents.
- .5 Arrange content by systems, under section numbers and sequence of Table of Contents.
- .6 For each product and system, a tab divider on which must be typed a description of the product and a list of the main pieces of equipment.
- .7 Text: Manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.
 - .1 The flags must be placed in the binder and large drawings must be folded to the size of the text pages.
- .9 Provide 1:1 scaled CAD files in dwg format on CD and USB key.

1.5 CONTENTS - PROJECT RECORD DOCUMENTS

- .1 Table of Contents for Each Volume: provide title of project;
 - .1 Date of submission.
 - .2 Name, address and telephone number of Contractor and names of Contractor representatives.
 - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies.
- .3 Product data: mark each sheet so as to clearly identify the specific products and parts, as well as installation data; remove all irrelevant information.
- .4 Drawings: drawings serve to complete product data and illustrate the connections between various material and system components; they consist of control design schematics and schematic diagrams.
- .5 Typewritten Text: as required to supplement product data.
 - .1 Provide a logical sequence of instructions for each procedure, incorporating the manufacturer's instructions.

1.6 AS-BUILTS

- .1 Maintain, in addition to requirements in General Conditions, at site for Departmental Representative one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to the Contract.
 - .5 Reviewed shop drawings, product data
 - .6 Field test records.

- .7 Inspection certificates.
- .8 Manufacturer's certificates.
- .2 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
 - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .3 Maintain record documents in clean, dry and legible condition.
 - .1 The documents in the project file are not to be used as working documents.
- .4 Keep record documents available for the Departmental Representative's inspection.

1.7 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of black line opaque drawings.
- .2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress.
 - .1 Do not conceal the Work until the required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 Reference standards for shop drawings and related changes.
- .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain records of on-site tests, inspection certificates, and manufacturer's certificates required by individual Specifications sections.
- .7 Provide digital photos for site records.

1.8 EQUIPMENT AND SYSTEMS

- .1 For each item of equipment and each system include description of unit or system, and component parts.
 - .1 Give function, normal operation characteristics, and limiting conditions.

- .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Provide the lists of power circuits (distribution panels), showing electrical characteristics, and control and telecommunications circuits.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
 - .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide maintenance and lubrication schedules and a list of lubricants required.
- .7 Provide written manufacturer's instructions for operating and maintaining components.
- .8 Provide descriptions of the sequence of operations prepared by the various manufacturers of control/adjustment devices and machines.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide control diagrams for installed control/adjustment devices, prepared by the various manufacturers.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .13 Include test and balancing reports.
- .14 Additional Requirements: as specified in individual Specifications sections.

1.9 MATERIALS AND FINISHES

- .1 Construction materials, finishing products, and other products to apply: provide technical sheets showing the catalogue number, dimensions, composition and any colour and texture designations for products and materials.
 - .1 Provide information for re-ordering custom manufactured products.
- .2 Provide instructions regarding cleaning agents and methods as well as recommended cleaning and maintenance schedules, and indicate any precautions to be taken against harmful methods or products.
- .3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional Requirements: as specified in individual Specifications sections.

1.10 MAINTENANCE MATERIALS

- .1 Spare Parts:
 - .1 Provide spare parts, in quantities specified in individual Specifications sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site as directed; place and store.
 - .4 Receive and catalogue all items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .2 Extra Materials:
 - .1 Provide spare parts, in quantities specified in individual Specifications sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site as directed; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 Special Tools:
 - .1 Supply special tools in the quantities prescribed in the different technical sections of the Specifications.
 - .2 Provide items with tags identifying their associated function and equipment.
 - .3 Deliver to site as directed; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.

1.11 TRANSPORT, STORAGE AND HANDLING

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review by Departmental Representative.

Part 2 Products

2.1 NOT APPLICABLE

.1 Not applicable.

Part 3 Execution

3.1 NOT APPLICABLE

.1 Not applicable

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 00 10 – General Instructions
- .2 Section 01 33 00 – Submittal Procedures
- .3 Section 26 05 00 – Common Work Results for Electrical
- .4 Section 26 33 53 – Uninterruptible Power Systems static (UPS)

1.2 REFERENCES

- .1 Perform commissioning as per CSA-Z320-11(R2016).

1.3 TESTING

- .1 Test all system equipment and devices as required by these specifications or Governing Authorities. Coordinate time for testing with Departmental representative. Notice is required to be given, in writing, in advance of any testing, to all parties concerned. Allow for fire alarm testing to be completed outside of normal working hours.
- .2 Provide all testing equipment, meters, etc., and personnel as required to complete testing. Turn over test results at the end of the project.
- .3 Systems requiring testing for proper operation include:
 - .1 Power systems - phasing voltage, load balancing, bonding.
 - .2 Lighting systems - fixtures and related controls.
 - .3 Electric heaters and controls.
- .4 Motor and motor control and sequence of operation where applicable. Correct overload settings at motor starters.
- .5 Measure phase current to panelboards with normal loads, i.e., lighting, etc., operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes. Measure phase voltages at loads and adjust transformer taps to within 2% of the rated voltage of equipment. At completion of work, submit report listing phase and neutral currents on panelboards and dry-core transformers operating under normal load. State hour and date that each load was measured and voltage at time of test.
- .6 Provide insulation resistance test for all feeders and equipment to ensure they are continuous and free from short circuits and grounds. Indicate in report result of each test.

1.4 COMMISSIONING

- .1 Plan, organize and implement a commissioning plan (including a commissioning schedule) for all electrical and related mechanical systems. Plan shall include as a minimum the following:
 - .1 Installation checklist.
 - .2 Start-up checklist.
 - .3 Verification sheets.

- .4 Integrated testing sheets.
- .2 Upon completion and acceptance of certification of the Work, hand over to Departmental Representative complete instructions and information relating to operations and maintenance of all equipment and systems.
 - .1 Departmental Representative shall be present for all commissioning activities. Submit proposed commissioning plan to Departmental Representative two (2) weeks prior to commencing any Work.
 - .2 Submit the following documentations to the Departmental Representative for their approval prior to closing of the project:
 - .1 Copy of electrical safety authority's final inspection certificate.
 - .2 Certification of design of electrical system support anchorage and restraint by a structural engineer as per (2.7).
 - .3 Submit signed documents to Departmental Representative for the following items:
 - .1 All maintenance materials.
 - .2 Tagged keys for all equipment supplied with locks.
 - .3 Any unused material as a result of site conditions, deletions, etc. And any items under demolition drawings where noted.
 - .4 Record drawings for review by Departmental representative
 - .5 For each of the following systems, submit a letter or certificate from manufacturer indicating system has been installed to their satisfaction and where applicable, indicate that owner's personnel has been trained in its operation and maintenance.
 - .1 Uninterruptible power supply (UPS).
 - .6 Submit to Departmental Representative written report containing all phase and neutral currents and voltages for panelboards, primary and secondary of transformers, and motor control centers operating under normal load. State hour and date when each load was measured.
 - .7 Submit Insulation resistance test reports for all feeders and equipment indicating that they are continuous and free from short circuits and grounds. Indicate in report result of each test.
 - .8 On completion of work and prior to final inspection, submit record drawings to departmental representative.

Part 2 Products

2.1 NOT APPLICABLE

- .1 Not applicable.

Part 3 Execution

3.1 NOT APPLICABLE

.1 Not applicable

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Comply with requirements of this Section when performing following work:
 - .1 The removal of less than one square meter of drywall in which the joint filler is asbestos-containing.
 - .2 Removal of non-friable asbestos-containing material, if the material is removed without being broken, cut, drilled, abraded, ground, sanded or vibrated.
 - .3 Removal of non-friable asbestos-containing materials if the material is removed by breaking, cutting, drilling, abrading, grinding or vibrating, if the material is wetted to control the spread of dust and fibers, and the work is only done by non-powered hand-held tools.
- .2 Refer to Specification Section 01 14 25 – Designated Substances for details on asbestos-containing materials.

1.2 RELATED SECTIONS

- .1 Section 01 00 10 – General Instructions
- .2 Section 01 33 00 – Submittal Procedures
- .3 Section 01 14 25 – Designated Substances
- .4 Section 02 82 00.02 - Asbestos Abatement: Intermediate Precautions
- .5 Section 02 89 00 - Silica Precautionary Measures

1.3 REFERENCES

- .1 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-1.205-03, Sealer for Application of Asbestos-Fibre Releasing Materials.
- .2 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .4 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
- .5 Ontario Environmental Protection Act, R.R.O 1990.
 - .1 General – Waste Management, O. Reg. 347/90, as amended.
- .6 Underwriters' Laboratories of Canada (ULC).
- .7 National Joint Council (NJC).
 - .1 Part XI – Hazardous Substances.
- .8 Ontario Ministry of Labour (MoL).

- .9 Occupational Health and Safety Act, R.S.O 1990, c. O1 (OSHA).
 - .1 O.Reg. 278/05 – Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations, as amended.
 - .2 Ontario Occupational Health and Safety Act, R.S.O. 1990, Regulation 490/09 “Designated Substances”, as amended.
 - .3 O.Reg 213/91 - “Construction Projects”, as amended.

1.4 DEFINITIONS

- .1 HEPA vacuum: DOP tested High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibers greater than 0.3 microns in any direction at 99.97% efficiency.
- .2 Amended Water: water with non-ionic surfactant wetting agent added to reduce surface tension of water to allow wetting of fibers.
- .3 Asbestos-Containing Materials (ACMs): materials that contain 0.5 percent or more asbestos by dry weight, identified under Existing Conditions Article, including fallen materials and settled dust.
- .4 Asbestos Work Area: area where work takes place which will, or may disturb ACMs.
- .5 Authorized Visitors: Departmental Representative, and representative(s) of regulatory agencies.
- .6 Competent worker: in relation to specific work, means a worker who:
 - .1 Is qualified because of knowledge, training and experience to perform the work.
 - .2 Is familiar with the provincial laws and with the provisions of the regulations that apply to the work.
 - .3 Has knowledge of all potential or actual danger to health or safety in the work.
- .7 DOP Test: testing method used to determine integrity of Negative Pressure unit using Dispersed Oil Particulate (DOP) HEPA-filter leak test.
- .8 Friable Material: material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.
- .9 Hazardous Material Workplan: A brief report identifying the location and quantities of hazardous materials and the methods that will be used to remove, store, transport and dispose of them.
- .10 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .11 Polyethylene: rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.
- .12 Occupied Area: any area of building or work site that is outside Asbestos Work Area.
- .13 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for scope of work.

1.5 ACTION AND INFORMATION SUBMITTALS

- .1 Submit proof satisfactory to the Departmental Representative that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of authority having jurisdiction.
- .2 Submit Provincial/Territorial and/or local requirements for Notice of Project Form.
- .3 Submit proof of Contractor's Asbestos Liability Insurance.
- .4 Submit to the Departmental Representative necessary permits for transportation and disposal of asbestos-containing waste and proof that asbestos-containing waste has been received and properly disposed.
- .5 Submit proof that all asbestos workers and/or supervisor have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene and work practices while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.
- .6 Submit proof satisfactory to Departmental Representative that employees have appropriate respirator fitting and testing (fit test certificates). Workers must be fit tested (qualitative as a minimum for Half-face respirator, quantitative for Full-face respirator) with respirator that is personally issued.
- .7 Asbestos abatement section within Hazardous Material Work Plan.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: comply with Federal, Provincial/Territorial and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at the time work is performed.
- .2 Health and Safety:
 - Safety Requirements: worker and visitor protection.
 - .1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:
 - .1 As a minimum, air purifying respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation

while using the respirator.

- .2 Disposable-type protective clothing (high-density polyethylene protective clothing (Tyvek or similar, as approved by the Departmental Representative) that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing shall consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing to include suitable footwear, and to be repaired or replaced if torn.
- .2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.
- .3 Before leaving Asbestos Work Area, the worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.
- .4 Facilities for washing hands and face shall be provided within or close to the Asbestos Work Area.
- .5 Ensure workers wash hands and face when leaving Asbestos Work Area
- .6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Separate for reuse, and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.
- .4 Place materials defined as hazardous or toxic in designated containers.
- .5 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .6 Fold up metal banding, flatten and place in designated area for recycling.
- .7 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 0.15 mm thick bags or leak proof drums. Label containers with appropriate warning labels.
- .8 Provide manifests describing and listing waste created. Transport containers by approved means to licenced landfill for burial.

1.8 EXISTING CONDITIONS

- .1 Refer to the Specification Section 01 14 25 – Designated Substances for details on asbestos-containing materials.
- .2 Notify Departmental Representative of asbestos-containing material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material pending instructions from Departmental Representative.

1.9 SCHEDULING

- .1 Hours of Work: perform work involving asbestos abatement located at the Building during hours specified by Departmental Representative.

1.10 PERSONNEL TRAINING

- .1 Before beginning Work, provide Departmental Representative satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, and in use, cleaning, and disposal of respirators and protective clothing.
- .2 Instruction and training related to respirators includes, at minimum:
 - .1 Fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
- .3 Instruction and training must be provided by competent, qualified person.

Part 2 Products

2.1 MATERIALS

- .1 Drop and Enclosure Sheets.
 - .1 Polyethylene: 0.15 mm thick.
 - .2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.
- .2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in concentration to provide thorough wetting of asbestos-containing material.
- .3 Waste Containers: contain waste in two separate containers:
 - .1 Inner container: 0.15 mm thick sealable polyethylene waste bag.
 - .2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
 - .3 Label containers in accordance with applicable Regulations. Label in both official languages.

Part 3 Execution

3.1 SUPERVISION

- .1 Minimum of one Supervisor for every ten workers is required.
- .2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos-containing materials.

3.2 PROCEDURES

- .1 Before beginning Work, isolate Asbestos Work Area using, at a minimum, preprinted cautionary asbestos warning signs in both official languages that are visible at access routes to Asbestos Work Area.
 - .1 Remove visible dust from surfaces in the work area where dust is likely to be disturbed during course of work.
 - .2 Use I-EPA vacuum, or damp cloths where damp cleaning does not create a hazard and is otherwise appropriate.
 - .3 Do not use compressed air to clean up or remove dust from any surface.
- .2 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.
 - .1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in work areas where dust or contamination cannot otherwise be safely contained.
- .3 Wet materials containing asbestos to be cut, ground, abraded, scraped, drilled, or otherwise disturbed unless wetting creates hazard or causes damage.
 - .1 Use garden reservoir type low - velocity fine - mist sprayer.
 - .2 Perform Work to reduce dust creation to lowest levels practicable.
 - .3 Work will be subject to visual inspection.
 - .4 Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas.
- .4 Cutting, shaping, grinding, drilling, abrading or otherwise disturbing non-friable asbestos-containing materials shall be executed using non-powered hand-tools only.
- .5 Clean-Up:
 - .1 Frequently during Work and immediately after completion of Work, clean up dust and asbestos-containing waste using HEPA vacuum or by damp mopping.
 - .2 Place dust and asbestos-containing waste in sealed dust-tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste: wet and fold these items to contain dust, then place in plastic bags.
 - .3 Clean exterior of each waste-filled bag using damp cloths or HEPA vacuum and place in second clean waste bag immediately prior to removal from Asbestos Work Area.

- .4 Seal waste bags and remove from site. Dispose of in accordance with requirements of Provincial and Federal Authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.
- .5 Perform final thorough clean-up of Work areas and adjacent areas affected by Work using HEPA vacuum.

3.3 INSPECTION

- .1 Perform inspection of Asbestos Work Area to confirm compliance with specification and governing authority requirements. Deviation(s) from these requirements that have not been approved in writing by Departmental Representative may result in Work stoppage, at no cost to Owner.
- .2 Departmental Representative may inspect Work at any time during the project for:
 - .1 Adherence to specific procedures and materials.
 - .2 Final cleanliness and completion.
 - .3 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.
- .3 When asbestos leakage from Asbestos Work Area has occurred or is likely to occur Departmental Representative may order Work shutdown.
- .4 No additional costs will be allowed by the Contractor for additional labour or materials required to provide specified performance level.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Comply with requirements of this Section when performing the following Work:
 - .1 The removal or disturbance of one square metre or less of friable asbestos-containing material.
 - .2 Glove bag and removal of good condition, friable, asbestos-containing materials.
- .2 Refer to Specification Section 01 14 25 – Designated Substances for details on asbestos-containing materials.

1.2 RELATED SECTIONS

- .1 Section 01 00 10 – General Instructions
- .2 Section 01 33 00 – Submittal Procedures
- .3 Section 01 14 25 – Designated Substances

1.3 REFERENCES

- .1 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-1.205-03, Sealer for Application of Asbestos-Fibre Releasing Materials.
- .2 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .4 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
- .5 Ontario Environmental Protection Act, R.R.O 1990.
 - .1 General – Waste Management, O. Reg. 347/90, as amended.
- .6 Underwriters' Laboratories of Canada (ULC).
- .7 National Joint Council (NJC).
 - .1 Part XI – Hazardous Substances.
- .8 Ontario Ministry of Labour (MoL).
 - .1 Occupational Health and Safety Act, R.S.O 1990, c. O1 (OSHA).
 - .1 O.Reg. 278/05 – Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations, as amended.
 - .2 Ontario Occupational Health and Safety Act, R.S.O. 1990, Regulation 490/09 “Designated Substances”, as amended.
 - .3 O.Reg 213/91 - “Construction Projects”, as amended.

1.4 DEFINITIONS

- .1 Amended Water: water with non-ionic surfactant wetting agent added to reduce surface tension of water to allow wetting of fibres.
- .2 Asbestos-Containing Materials (ACMs): materials that contain 0.5 percent or more asbestos by dry weight, identified under Existing Conditions Article, including fallen materials and settled dust.
- .3 Asbestos Work Area: area where work takes place which will, or may disturb ACMs.
- .4 Authorized Visitors: Departmental Representative, and representative(s) of regulatory agencies.
- .5 Competent worker: in relation to specific work, means a worker who:
 - .1 Is qualified because of knowledge, training and experience to perform the work.
 - .2 Is familiar with the provincial laws and with the provisions of the regulations that apply to the work.
 - .3 Has knowledge of all potential or actual danger to health or safety in the work.
- .6 Curtained doorway: arrangement of closures to allow ingress or egress from one room to another while permitting minimal air movement between rooms, typically constructed as follows:
 - .1 Place two overlapping sheets of polyethylene over existing or temporarily framed doorway, secure each along top of doorway, secure vertical edge of one sheet along one vertical side of doorway, and secure vertical edge of other sheet along opposite vertical side of doorway.
 - .2 Reinforce free edges of polyethylene with duct tape and weight bottom edge to ensure proper closing.
 - .3 Overlap each polyethylene sheet at openings not less than 1.5 metres on each side.
- .7 DOP Test: testing method used to determine integrity of Negative Pressure unit using Dispersed Oil Particulate (DOP) HEPA-filter leak test.
- .8 Friable Material: material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.
- .9 Glove Bag: prefabricated glove bag as follows:
 - .1 Minimum thickness 0.25 mm (10 mil) polyvinyl-chloride bag.
 - .2 Integral 0.25 mm (10 mil) thick polyvinyl-chloride gloves and elastic ports.
 - .3 Equipped with reversible, double-pull, double throw zipper on top and at approximately mid-section of the bag.
 - .4 Straps for sealing ends around pipe.
 - .5 Must incorporate internal closure strip if it is to be moved or used in more than one specific location.
- .10 Hazardous Material Workplan: A brief report identifying the location and quantities of hazardous materials and the methods that will be used to remove, store, transport and dispose of them.

- .11 HEPA vacuum: DOP tested, High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any dimension at 99.97% efficiency.
- .12 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .13 Polyethylene: polyethylene sheeting or rip proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.
- .14 Occupied Area: any area of building or work site that is outside Asbestos Work Area.
- .15 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for scope of work.

1.5 ACTION AND INFORMATION SUBMITTALS

- .1 Submit proof satisfactory to the Departmental Representative that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of authority having jurisdiction.
- .2 Submit Provincial/Territorial and/or local requirements for Notice of Project Form.
- .3 Submit proof of Contractor's Asbestos Liability Insurance.
- .4 Submit to the Departmental Representative necessary permits for transportation and disposal of asbestos-containing waste and proof that asbestos-containing waste has been received and properly disposed.
- .5 Submit proof that all asbestos workers and/or supervisor have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene and work practices while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.
- .6 Submit proof that supervisory personnel have attended asbestos abatement course, of not less than two days duration, approved by Departmental Representative. Minimum of one supervisor for every ten workers.
- .7 Submit Worker's Compensation Board status and transcription of insurance.
- .8 Submit documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including:
 - .1 encapsulants;
 - .2 amended water;
 - .3 slow-drying sealer.
- .9 Submit proof satisfactory to Departmental Representative that employees have appropriate respirator fitting and testing (fit test certificates). Workers must be fit tested (qualitative as a minimum for Half-face respirator, quantitative for Full-face respirator) with respirator that is personally issued.
- .10 Asbestos abatement section within Hazardous Material Work Plan.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: comply with Federal, Provincial/Territorial and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at the time work is performed.
- .2 Health and Safety:
 - .1 Safety Requirements: worker and visitor protection.
 - .1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:
 - .1 As a minimum, air purifying respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.
 - .2 Disposable-type protective clothing (high-density polyethylene protective clothing (Tyvek or similar, as approved by the Departmental Representative) that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing shall consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing to include suitable footwear, and to be repaired or replaced if torn.
 - .3 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.
 - .4 Before leaving Asbestos Work Area, the worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container to be
 - .5 dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.
 - .6 Ensure workers wash hands and face when leaving Asbestos Work Area. Facilities for

washing hands and face shall be provided within or close to the Asbestos Work Area.

- .7 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

.1 Visitor Protection:

- .1 Provide protective clothing and approved respirators to Authorized Visitors to work areas.
- .2 Instruct Authorized Visitors in the use of protective clothing, respirators and procedures.
- .3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Asbestos Work Area.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Separate for reuse, and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.
- .4 Place materials defined as hazardous or toxic in designated containers.
- .5 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .6 Fold up metal banding, flatten and place in designated area for recycling.
- .7 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 0.15 mm thick bags or leak proof drums. Label containers with appropriate warning labels.
- .8 Provide manifests describing and listing waste created. Transport containers by approved means to licenced landfill for burial.

1.8 EXISTING CONDITIONS

- .1 Refer to the Specification Section 01 14 25 – Designated Substances for details on asbestos-containing materials.
- .2 Notify Departmental Representative of asbestos-containing material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material pending instructions from Departmental Representative.

1.9 SCHEDULING

- .1 Hours of Work: perform work involving asbestos abatement located at the Building during hours specified by Departmental Representative.

1.10 PERSONNEL TRAINING

- .1 Before beginning Work, provide Departmental Representative satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, and in use, cleaning, and disposal of respirators and protective clothing.
- .2 Instruction and training related to respirators includes, at minimum:
 - .1 Fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
- .3 Instruction and training must be provided by competent, qualified person.

Part 2 Products

2.1 MATERIALS

- .1 Drop and Enclosure Sheets.
 - .1 Polyethylene: 0.15 mm thick.
 - .2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.
- .2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in concentration to provide thorough wetting of asbestos-containing material.
- .3 Asbestos waste containers: Metal or fibre - type acceptable to dump operator with tightly fitting covers and 0.15 mm minimum thickness sealable polyethylene liners.
 - .1 Inner container: 0.15 mm thick sealable polyethylene waste bag.
 - .2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
 - .3 Label containers in accordance with applicable Regulations. Label in both official languages.
- .4 Glove Bag: prefabricated glove bag as follows:
 - .1 Minimum thickness 0.25 mm (10 mil) polyvinyl-chloride bag.
 - .2 Integral 0.25 mm (10 mil) thick polyvinyl-chloride gloves and elastic ports.
 - .3 Equipped with reversible, double-pull, double throw zipper on top and at approximately mid-section of the bag.
 - .4 Straps for sealing ends around pipe.
 - .5 Must incorporate internal closure strip if it is to be moved or used in more than one specific location.
- .5 Tape: tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using amended water.

- .6 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.
 - .1 Sealer: flame spread and smoke developed rating less than 50.
- .7 Encapsulant: penetrating type conforming to CAN/CGSB-1.205.

Part 3 Execution

3.1 SUPERVISION

- .1 Minimum of one Supervisor for every ten workers is required.
- .2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos-containing materials.

3.2 PROCEDURES

- .1 Before beginning Work, at each access to Asbestos Work Area, install warning signs in both official languages in upper case 'Helvetica Medium' letters reading as follows, where number in parentheses indicates font size to be used: 'CAUTION ASBESTOS HAZARD AREA (25 mm) / NO UNAUTHORIZED ENTRY (19 mm) / WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) / BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm)'.
 - .2 Before beginning Work remove visible dust from surfaces in work area where dust is likely to be disturbed during course of work.
 - .1 Use HEPA vacuum, or damp cloths where damp cleaning does not create hazard and is otherwise appropriate.
 - .2 Do not use compressed air to clean up or remove dust from any surface.
- .3 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.
 - .1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in work areas where dust or contamination cannot otherwise be safely contained.
 - .2 Erect enclosure of polyethylene sheeting around indoor Type 2 work areas, shut off mechanical ventilation system serving work area, and seal ventilation ducts to and from work area.
- .4 Remove loose material by HEPA vacuum; thoroughly wet friable material containing asbestos to be removed or disturbed before and during Work unless wetting creates hazard or causes damage.
 - .1 Use garden reservoir type low - velocity sprayer or airless spray equipment capable of producing mist or fine spray.
 - .2 Perform Work in a manner to reduce dust creation to lowest levels practicable.
- .5 Pipe Insulation Removal Using Glove Bag:
 - .1 A glove bag not to be used to remove insulation from a pipe, duct or similar structure

- if:
 - .1 It may not be possible to maintain a proper seal for any reason including, without limitation.
 - .2 The condition of the insulation.
 - .2 The bag could become damaged for any reason including:
 - .1 The type of jacketing.
 - .2 The temperature of the pipe, duct or similar element
 - .3 Upon installation of the glove bag, inspect bag for any damage or defects. If any damage or defects are found, the glove bag is to be repaired or replaced. The glove bag to be inspected at regular intervals for damage and defects, and repair or replaced, as appropriately. The asbestos containing contents of the damaged or defective glove bag found during removal are to be wetted and the glove bag and its contents are to be removed and disposed of in an appropriate waste disposal container. Any damaged or defective glove bags are not be re-used.
 - .4 Place tools necessary to remove insulation in tool pouch. Wrap bag around pipe and close zippers. Seal bag to pipe with cloth straps.
 - .5 Place hands in gloves and use necessary tools to remove insulation. Arrange insulation in bag to obtain full capacity of bag.
 - .6 Insert nozzle of garden reservoir type sprayer into bag through valve and wash down pipe and interior of bag thoroughly. Wet surface of insulation in lower section of bag.
 - .7 To remove bag after completion of stripping, wash top section and tools thoroughly. Remove air from top section through elasticized valve using a HEPA vacuum. Pull polyethylene waste container over glove bag before removing from pipe. Release one strap and remove freshly washed tools. Place tools in water. Remove second strap and zipper. Fold over into waste container and seal.
 - .8 After removal of bag ensure that pipe is free of residue. Remove residue using HEPA vacuum or wet cloths. Ensure that surfaces are free of sludge which after drying could release asbestos dust into atmosphere. Seal exposed surfaces of pipe and ends of insulation with slow drying sealer to seal in any residual fibres.
 - .9 Upon completion of Work shift, cover exposed ends of remaining pipe insulation with polyethylene taped in place.
- .6 Work is subject to visual inspection and air monitoring. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas at no additional costs to owners.
- .7 Clean-up:
- .1 Frequently during Work and immediately after completion of work, clean up dust and asbestos-containing waste using HEPA vacuum or by damp mopping.
 - .2 Place dust and asbestos-containing waste in sealed dust-tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste and wet and fold to contain dust and then place in waste bags.
 - .3 Immediately before their removal from Asbestos Work Area and disposal, clean each

filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.

- .4 Seal and remove double-bagged waste from site. Dispose of in accordance with requirements of Provincial/Territorial and Federal authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.
- .5 Perform final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

3.3 AIR MONITORING

- .1 From beginning of Work until completion of cleaning operations, the Departmental representative may collect air samples on a daily basis outside of Asbestos Work Area enclosures.
- .2 If air monitoring shows that areas outside work area enclosures are contaminated, enclose, maintain, and clean these areas in same manner as that applicable to Asbestos Work Areas
 - .1 Stop work and clean areas outside of Asbestos Work Areas when Phased Contrast Microscopy measurements exceed 0.05 fibres per cubic centimetre (f/cc) and correct procedures.
 - .2 All required cleaning, re-cleaning, additional air testing and/or inspections will be performed at no extra charge to the Departmental Representative.
- .3 Ensure that respiratory safety factors for Workers are not exceeded.
- .4 The Departmental Representative may collect clearance/post-abatement air samples following a final visual inspection of the Asbestos Work Area by the Departmental Representative. Samples will be analyzed and compared to applicable regulations.
 - .1 Final air monitoring results must show fibre levels of less than 0.05 fibres per cubic centimetre (f/cc).
 - .2 If air monitoring shows that areas inside the Asbestos Work Area enclosures are contaminated; enclose, maintain and clean these areas in same manner as that applicable to Asbestos Work Area at no additional cost to the Departmental Representative.
 - .3 Repeat as necessary until fibre levels are less than 0.05 f/cc
 - .4 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This section specifies requirements and procedures for silica precautionary measures. This section conforms to the requirements of the Ontario Occupational Health and Safety Act, R.S.O. 1990, Regulation 490/09 “Designated Substances”.
- .2 Comply with the requirements of this Section when performing the following work:
 - .1 Work at site which may involve contact with silica dust generated through such processes as sawing, cutting, grinding, blasting and/or breaking of the silica containing material.
 - .2 Refer to the following documentation for details on silica-containing materials:
 - .1 Specification Section 01 14 25 – Designated Substances.

1.2 RELATED SECTIONS

- .1 Section 01 00 10 – General Instructions
- .2 Section 01 33 00 – Submittal Procedures
- .3 Section 01 14 25 – Designated Substances

1.3 REFERENCES

- .1 Comply with current Federal, Provincial, and local requirements pertaining to silica, provided that in case of conflict among these requirements or with these specifications the more stringent requirement applies. Comply with regulations in effect at time work is performed.
- .2 Federal Legislation
 - .1 Canada Labour Code and associated regulations.
- .3 Provincial legislation
 - .1 Ontario Occupational Health and Safety Act, R.S.O. 1990, Regulation 490/09 “Designated Substances”.

1.4 DEFINITIONS

- .1 **Dangerous Goods:** product, substance, or organism that is specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.
- .2 **Hazardous Material:** product, substance, or organism that is used for its original purpose; and that is either dangerous goods or a material that may cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.
- .3 **Hazardous Material Workplan:** A brief report identifying the location and quantities of hazardous materials and the methods that will be used to remove, store, transport and dispose of them.
- .4 **Workplace Hazardous Materials Information System (WHMIS):** Canada-wide system designed to give employers and workers information about hazardous materials used in

workplace. Under WHMIS, information on hazardous materials is provided on container labels, material safety data sheets (MSDS), and worker education programs. WHMIS is put into effect by combination of federal and provincial laws.

1.5 SUBMITTALS

- .1 Silica abatement section within Hazardous Material Work Plan.

1.6 PRECAUTIONARY MEASURES AND PROCEDURES

- .1 Execute work by methods to minimize raising silica dust from demolition operations. Where practical, wet methods or a dust collection system should be used to reduce dust.
- .2 Adequate ventilation, including local exhaust ventilation, should be maintained to prevent the accumulation and recirculation of harmful concentrations of free crystalline silica in the work area.
- .3 As practical, processes that generate silica dust should be completed in enclosed areas wherever possible to prevent the spread of silica dust outside of the work area.
- .4 Implement and maintain silica dust control measures during work to ensure that silica levels do not exceed allowable limits.
- .5 Departmental Representative may stop work at any time when release of silica dust to adjacent area is suspected. Contractor must discuss procedures that Contractor proposes to resolve problem. Make all necessary changes to operations prior to resuming any demolition activities that may cause release of silica dust at no extra cost to the Departmental Representative.
- .6 Silica dust should be cleaned from machinery and work surfaces by wet sweeping, the use of sweeping compounds or vacuum cleaners fitted with a HEPA filter to prevent the recirculation of dusty air. Cleaning methods such as blowing with compressed air or dry sweeping should be avoided. Where exposure to free crystalline silica occurs, protective work clothing should be vacuumed before removal.
- .7 Store material containing silica dust in closed containers or use other appropriate means to prevent dust from becoming airborne.

1.7 PERSONAL PROTECTIVE EQUIPMENT

- .1 Anticipated minimum levels of personal protection based on work activity involving silica dust are listed below and are in addition to the personal protective Equipment (PPE) required for the completion of the demolition activities. Personal Protection are dependent on the work practices and associated silica exposure risks.
 - .1 Air purifying half-mask respirator equipped with HEPA filter cartridges or supplied-air type, personally issued to the worker and marked as to efficiency and purpose, and acceptable to the Provincial Authority having jurisdiction as suitable for silica and the level of silica exposure in the Work Area. If disposable type filters are used, provide sufficient filters so that workers can install new filters following disposal of used filters and before re-entering contaminated areas.
 - .2 Eye Protection: Goggles, Safety glasses with side shields, or Face shield.
 - .3 If requested by a worker:

- .1 Hand Protection: Gloves
- .2 Clothing: Full body protective clothing

1.8 AIR MONITORING

- .1 If air monitoring shows that work areas contain crystalline silica above the specified action levels, these areas shall be cleaned by previously outlined methods at no additional cost to the Departmental Representative.

1.9 PERMITS

- .2 Contractor is responsible to obtain all necessary permits, licenses and approvals to conduct the abatement (e.g. Ontario Ministry of the Environment (MOE) waste generating number, etc.).

Part 2 Products

2.1 NOT APPLICABLE

- .1 Not applicable.

Part 3 Execution

3.1 NOT APPLICABLE

- .1 Not applicable

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 00 10 – General Instructions
- .2 Section 01 14 25 – Designated Substance
- .3 Section 01 33 00 – Submittal Procedures
- .4 Section 01 35 30 – Health and Safety
- .1 Section 01 41 00 – Regulatory Requirements
- .2 Section 01 78 00 – Closeout Submittals
- .3 Section 01 91 13 – General commissioning requirements
- .4 Section 26 33 53 – Uninterruptible Power Systems (UPS)

1.2 REFERENCE STANDARDS

- .1 Reference Standards:
 - .1 CSA Group
 - .1 Ontario Electrical Safety Code (25nd Edition) consisting of CSA C22.1- 12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations and Ontario Amendments to CSA C22.1-12, Canadian Electrical Code, Part I.
 - .2 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000V.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, the Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates:
 - .1 Provide CSA certified material.
 - .2 Where CSA certified material is not available, submit such material to authority

having jurisdiction for approval before delivery to site.

- .3 Submit test results of installed electrical systems and instrumentation.
- .4 Permits and fees: in accordance with General Conditions of contract.
- .5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect all electrical equipment, devices and accessories from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Waste Management Plan related to Work of this Section and in accordance with Section 01 00 10 – General Instructions.
- .5 Packaging Waste Management: remove for reuse of padding, crates, pallets, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 00 10 – General Instructions.

1.7 PANELBOARD DIRECTORY REQUIREMENTS

- .1 For new or modified panelboards, provide updated panel directory (IES) upon completion of contract printed in panelboard. All panelboards modified and/or added to under this contract are to be updated and provided with new and/or revised panel directories.

1.8 FIREPROOFING

- .1 Where cables or conduits pass through floors and fire rated walls, pack space between cables or conduits and sleeve or opening with T&B flame-safe firestop material or 3M CP25 OR 303.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

- .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification labels for control items in English and French.
- .4 Use one label for both languages.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide material in accordance with Common Product Requirements in Section 01 00 10 – General Instructions.
- .2 Equipment to be CSA certified.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of Departmental Representative.
- .2 Decal signs, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION• USING LAMACOID PLATES

- .1 All terminal cabinets, panelboards, disconnect switches, magnetic motor starters, contactors and transformers, or other similar equipment furnished in this specification, to be provided with engraved lamacoid nameplates identifying equipment name and panel circuit(s), and in some cases, the voltage.
- .2 Lamacoids to be 3 mm thick plastic engraving sheets, mechanically attached with self-tapping screws, size as indicated, or industrial adhesive, do not use screws on exterior electrical components, use black lettering on white background for normal power, black lettering on yellow background for emergency power and white lettering on blue background for UPS power
- .3 Nameplates sizes:

<u>LETTER HEIGHT</u>	<u>LINE 1</u>	<u>LINE 2</u>	<u>LINE 3</u>
SIZE 1	20 X 50 MM	3 MM	3 MM
SIZE 2	20 X 75 MM	5 MM	5 MM
SIZE 3	50 X 75 MM	10 MM	10 MM
SIZE 4	50 X 100 MM	10 MM	5 MM
- .4 Distribution panels, panelboards, terminal cabinets and motor control centers: the main identification tag to indicate• equipment name (10 mm high), voltage (5 mm) and where fed from (5 mm), use size nameplate.

- .5 Breakers in distribution panels: install a lamacoid plate beside each breaker to indicate equipment or panel controlled, use size 2 nameplate.
- .6 Each motor control center compartment: indicate equipment name and horsepower. Use size nameplate.
- .7 Disconnect switches, magnetic motor starters and contactors: indicate equipment name (10 mm high), voltage (5 mm) and panel circuits (5 mm), use size 3 nameplate.
- .8 Manual motor starters: indicate equipment name and panel circuit, use size 1 nameplate.
- .9 Transformers: indicate equipment name (10 mm high), capacity, primary and secondary voltages and where fed from (5 mm high), use size 4 nameplate.
- .10 Lamacoids for equipment related to fire alarm (life safety) to be red.

2.7 EQUIPMENT IDENTIFICATION

- .1 All junction boxes, pull boxes and outlet boxes, exit and lighting fixtures, and other similar devices furnished in this specification to be provided with 12 mm embossed plastic labels and 5 mm high lettering, as follows:
 - .1 Label will indicate panel and circuit number.
 - .2 Use black lettering on white background for normal power.
 - .3 Use black lettering on yellow background for emergency power.
 - .4 Use black on blue background for UPS power.
 - .5 Use red lettering on white background for fire alarm.
 - .6 If a receptacle is a dedicated outlet, indicate dedicated at device.

2.8 WIRE AND CABLE

- .1 All wiring to be copper, minimum size #12 AWG conductors, stranded, except where noted otherwise. Insulation of chemically cross- linked thermosetting polyethylene material rated RW90.
- .2 Size #12 AWG is acceptable for armored cable (AC90) within partitions from branch circuit junction box to local device (receptacles and switches).
- .3 Size #14 AWG RW90 is acceptable for control wiring.
- .4 Wiring to be sized for a maximum voltage drop not to exceed 3%.
- .5 Armored cable (ACSO) can be used in all T-bar ceilings and interior partitions. Maximum continuous length - 3000 mm. AC90 shall not be used for long branch wiring runs in the ceiling space above and beyond this length.
- .6 Type RWU90 for underground wiring.
- .7 Provide dedicated neutrals for all receptacle circuits. Neutrals to be identified at panel for related circuit(s).
- .8 Provide a green insulated bonding conductor in all installed conduit, minimum size #12 AWG. Size conductor as per the latest edition of the Ontario Electrical Safety Code.
- .9 TECK90 cable:
 - .1 Conductors: grounding conductor to be copper. Circuit conductors to be copper.

- .2 Insulation: 1000V cross-linked POLYETHYLENEXLPE.
- .3 Inner jacket to be polyvinyl chloride material.
- .4 Armor to be interlocking galvanized steel.
- .5 Fastening: one-hole steel straps to be used to secure surface cables 2" and smaller. Two-hole steel straps for cables larger than 2". Channel-type supports to be used for two or more cables at 5" centers or as recommended by the manufacturer. Threaded rods to be 1/2" diameter to support suspended channels.
- .6 Connectors to be watertight approved for TECK CAELE.

2.9 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring. Arrange uniform phase-to-main lug connection on all equipment, i.e. panelboards, starters, disconnect switches.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Provide numbered tape markings on all branch conductors, including neutrals. Where common neutrals are used, identify branch circuit numbers.
- .4 The following color coding of conductor insulation is to be strictly adhered to:

<u>120/208V SYSTEM</u>	PHASE A	RED	<u>347/600V SYSTEM</u>	PHASE A	YELLOW
	PHASE C	BLUE		PHASE B	ORANGE
	PHASE S	BLACK		PHASE C	BROWN
	NEUTRAL	WHITE		NEUTRAL	WHITE
	GROUND	GREEN		GROUND	GREEN

- .5 At all junction boxes, splitters, cabinets and outlet boxes, maintain identification system.

2.10 CONDUITS AND FITTINGS

- .1 Minimum size of all conduits to be 21 mm.
- .2 Use rigid galvanized steel conduit, size as indicated. Use where subject to mechanical injury.
- .3 Use EMT:
 - .1 For all work except where specified otherwise
 - .2 In all drywall ceilings and masonry walls.
 - .3 In ceiling to collect up to maximum of six (6) circuits for runs back to the panel.
- .4 Size conduit as indicated and/or as per electrical safety code, taking into consideration conduit fill and voltage drop of conductors.
- .5 Fittings to be set screw type, zinc-coated steel connectors and couplings. Die cast connectors and couplings will not be acceptable.
- .6 Use liquid tight, metal flexible conduit for final connection to equipment in damp, wet or corrosive locations, to all motors, transformers, kitchen equipment and any other vibrating

equipment.

- .7 Provide a pull cord, Polypropylene, in all empty conduits.
- .8 All empty conduits terminating outdoors shall be capped and identified at both ends.

2.11 CONDUIT IDENTIFICATION

- .1 Color code all conduits.
- .2 Coding to be located on all conduits and cable exposed after completion of building and in suspended removable ceilings.
- .3 Coding to be plastic tape or paint at all points where conduit or cable enters wall, ceiling or floor and at 15 m (50') intervals, unless otherwise noted.
- .4 Colors to be (21 mm) (3/4") wide prime color and (13 mm) (1/2") wide auxiliary color:

	<u>PRIME</u>	<u>AUXILIARY</u>
UP TO 250V	YELLOW	
UP TO 600V	YELLOW	GREEN
UP TO 5KV	YELLOW	BLUE
UP TO 15KV	YELLOW	RED
FIRE ALARM	RED (ALL RACEWAYS TO BE FACTORY PAINTED)	
EMERGENCY VOICE	RED	BLUE

2.12 ELECTRICAL SYSTEM SUPPORT ANCHORAGE AND SEISMIC RESTRAINT

- .1 Provide support, anchorage and restraint of electrical distribution systems and equipment, designed and constructed in accordance with the Latest Edition of the following standard:
 - .1 Ontario Building Code.
- .2 Provide certification regarding the design of the electrical system support, anchorage and restraint system by a structural engineer licensed in the Province of Ontario. The construction of the support, anchorage and restraint system is to be reviewed and certified by the structural engineer.
- .3 Coordinate electrical system support, anchorage and restraint system with the requirements and constraints of the structure, vibration isolation systems and the support, anchorage and restraint systems for electrical and architectural components of the building.

2.13 JUNCTION AND PULLBOXES

- .1 Provide junction and pull boxes to meet requirements of the Ontario Electrical Safety code for number of conductors and conduit sizes as a minimum or as indicated.
- .2 Provide pull boxes in conduit runs 30 meters or longer. Onebox required for every 30 meters of length minimum.

2.14 OUTLET BOXES

- .3 Surface mount;
 - .1 Cast (FS or FD) ferrous alloy boxes with factory threaded hubs and mounting feet, complete with appropriate cover plate to suit box.
- .4 Flush mount:

- .1 100 mm square deep outlet boxes with extension and plaster rings for flush mounting devices in finished walls. Plaster ring to suit finish; or 2. Deep device box, sectional, complete with wraparound bracket for steel studs and with integral support bracket. Box size (capacity) to suit number of conductors to meet electrical safety code.
- .5 Use electrogalvanized steel masonry single and multi-gang boxes FDR devices flush-mounted in exposed block walls.
- .6 All boxes to be identified for panel and circuit(s).

2.15 COVER PLATES

- .1 Provide cover plates for all wiring devices.
- .2 Sheet steel utility box cover for wiring devices installed in surface mounted utility boxes.
- .3 (Sheet Metal) (Cast) cover plates for wiring devices mounted in surface mounted (FS or FD) type conduit boxes.
- .4 Stainless steel 1 mm thick cover plates, for all wiring devices mounted in a flush mounted outlet box.
- .5 Colours to match local devices specified.
- .6 Weatherproof cover plates for GFI receptacles to be P&S 1591-WP.
- .7 Blank plates - finish to match other plates in area for boxes without wiring devices.
- .8 Use PVC cover plates for PVC outlet boxes.

2.16 LOCAL DEVICES

- .1 Duplex GFCI receptacle to be 20 A, 120 V, T-SLOT, heavy duty industrial grade. Colour to be white and fed with a 20 A breaker.
- .2 Special receptacles: refer to nema rating on drawings.
- .3 Provide new cover plates as required to replace missing or damaged existing cover plates. Cover plates to match existing.
- .4 At end of construction, provide blank cover plates for all open back boxes. Covers to be sized as required. Cover plates to match existing.
- .5 Provide p-touch label on cover plates for all circuits identifying panel and circuit number(s). If dedicated circuit, identify as "dedicated" and panel and circuit.
- .6 All outlet boxes penetrating vapor barriers will be PVC type, complete with neoprene gaskets approved to maintain integrity of vapor barrier. Provide shop drawing of product. Where necessary, pre-drill outlet box to accept conduit and seal with silicone.

2.17 COMMUNICATION OUTLETS

- .1 All communication system cabling to be CAT-6; provide cable quantities as indicated on drawings.
- .2 Provide blank cover plates for unused boxes.

2.18 DISTRIBUTION

- .1 Panelboards:
 - .1 Existing panelboard(s) to remain unless noted otherwise.
 - .2 Provide new (service entrance rated) panelboards (to replace existing) (as shown on drawings) and (reuse existing) (provide new) feeders.
 - .3 New panelboard to be sub-fed from existing panelboard.
 - .4 New panelboards to be installed (after hours and on weekends). Coordinate exact date and time with Departmental Representative.
 - .5 New panelboards up to 240 V to have breakers rated for 10000 A RMS symmetrical interrupting capacity, unless otherwise noted.
 - .6 New 600 V panelboard to have breakers rated for 14000 A RMS symmetrical interrupting capacity, unless otherwise noted.
 - .7 Panelboard mains suitable for (plug-in or bolt-on) breakers.
 - .8 Provide main breaker in panel as indicated.
 - .9 Provide new breakers in existing panelboards as (required) (detailed in panel schedule(s)). Breakers to have same interrupting capacity as existing.
 - .10 Where changes are made to existing panelboard circuits, update legend to suit. Provide typed directory for panelboard legend.
 - .11 Provide lamacoid panelboard labels, size 7 black with white letters, for all affected panelboards.
 - .12 Where possible, reuse existing circuits from panel. New circuits to be fed from panel.
 - .13 All circuits shown on drawings are for quantity purposes only. Verify circuit availability on-site.
 - .14 Sprinkler proof.
 - .15 Panelboards to have hinged trim, complete with door. Door-in-door construction.
 - .16 Provide two (2) keys for each panel and all new panels to be keyed alike.
 - .17 Provide lock-on devices for breakers for all circuits, exit lighting, night lighting, stairway lighting, refrigerators, freezers, fire alarm, door supervisory and intercom.

2.19 TRANSFORMERS

- .1 Three-phase 0-75 KVA, TYPE 1 enclosure:
 - .1 Class 220.
 - .2 150 DEG.C temperature rise insulation system.
 - .3 Four (4) 2.5% TAPS, 2-FCAN, 2-FCBN.
 - .4 Enclosed in ventilated enclosure, CSA TYPE 1, with removable metal front panels. Finish to be Standard ASA 61 GREY.
 - .5 Sprinkler proof to requirements of Electrical Safety Authority.

- .6 Will conform to CSA C602 Energy Star.
- .7 Provide nameplate for each Transformer, Size 7.

2.20 CABLE/BASKET TRAY

- .1 Metallic cable trough: Ladder Type.
 - .1 Metallic cable tray as per CSA C222 NO.126.1.
 - .2 Type: ladder.
 - .3 Rung spacing: [300 MM] [12 INCH].
 - .4 Material: aluminum.
 - .5 Class Type: [A] [C1] [D1] [E].
 - .6 Width: [150] [300] [450] [600] [750] MM.
 - .7 Depth: [40] [75] [100] [150] MM.
 - .8 Width: [6] [12] [18] [24] [30] INCH.
 - .9 Depth: [1.5] [3] [4] [6] INCH.
- .2 Type: Ladder.
- .3 Rung spacing: [300 MM] [12 INCH].
- .4 Cable trough fittings and components
 - .1 Cable troughs and fittings to CSA and other Reference Standards.
- .5 Fittings:
 - .1 provide horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, as the manufacturer's manufactured accessories for the cable trough system supplied:
 - .1 RADII on fittings: [300] [600] [900] MM MINIMUM.
 - .2 RADII on fittings: [12] [24] [36] INCH MINIMUM.
- .6 Covers:
 - .1 Provide solid (hinged) (bolted) covers for complete cable trough system including fittings (as indicated on contract drawings) (for the following tray types).
- .7 Barriers:
 - .1 Provide barriers where different voltage systems are in same cable trough.
- .8 Fire barriers:
 - .1 Provide fire stop material at firewall penetrations.
- .9 Supports:
 - .1 Provide splices, supports as required to maintain CSA, as well as manufacturer's class and type rating of the cable trough assembly.

- .10 Installation:
 - .1 Install complete cable trough system in accordance with referenced standards and code requirements.
 - .2 Keep number of elbows, offsets and connections to a minimum.
 - .3 Route cable trough systems level and parallel to building lines.
 - .4 Cable trough ground conductor to be grounded to each tray section, using CSA approved ground clamps, in accordance with manufacturer and electrical code requirements. Grounding points shall not exceed [6 M] [20 FT.] Center under any circumstance. Ground cable trough to building steel at [15 M] [50 FT.] Centres.
 - .5 Remove sharp burrs or projections from bolts or other devices to prevent damage to cables or injury to personnel.
- .11 Cables in cable trough:
 - .1 Install cables individually.
 - .2 Lay cables into cable trough. Use rollers when necessary to pull cables. Do not pull or adjust cables over the length of the cable run without rollers.
 - .3 Secure cables in cable trough at [6 M] [20 FT.] Centres, as well as at entry points, exit points and changes in direction with [weatherproof] [UV stabilized] nylon ties for power feeders, VELCRO for communications cables. Provide p-clips on vertical installations at [1.5 M] [5 FT.] Centres.
 - .4 Identify cables every [10 M] [30 FT.] With size 2 nameplates.
- .12 Fire barriers:
 - .1 Arrange for opening in fire rated wall or floor. Width and height of cable trough to run continuously through provided opening.
 - .2 Provide specialized fire barrier on completed cable trough assembly to ensure fire rating of spaces through which cable trough is both entering and leaving, is maintained at all times.

Part 3 Execution

3.1 CONDUIT INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations with minimum interference in spaces through which conduits pass. Conceal conduits and wiring except in mechanical and electrical service rooms and unfinished areas.
- .2 Run conduits parallel or perpendicular to building lines.
- .3 Run two (2) 25 MM spare conduits up to ceiling space and two (2) 25 MM spare conduits down to ceiling space below from each flush mounted panel and terminate in a 150 MM X 150 MM X 100 MM junction box.

- .4 Locate conduits not less than 150 MM parallel to steam or hot water lines with a minimum of 50 MM at crossovers.
- .5 Locate conduits behind infrared or gas-fired heaters with 1500 MM clearance.
- .6 Conduits to run in flanged portion of structural steel.
- .7 Group conduits wherever possible on surface or, if necessary, on suspended channels.
- .8 Horizontal runs are not permitted in masonry walls or Terrazzo and concrete toppings.
- .9 PVC conduits in floor slab to have rigid galvanized steel elbows to exit from slab if not protected from damage.
- .10 Use one-hole steel straps to secure surface conduits 50 MM and smaller; and two-hole steel straps for conduits larger than 50 MM.
- .11 Use beam clamps to secure conduits to exposed steelwork and channel type supports for two or more conduits at 1828 MM on centres. Six (6) mm diameter threaded rods (minimum) to support suspended channels. All supports must comply with Ontario Building Code seismic restraint requirements.
- .12 Paint conduit to match wall colour in visible locations when surface mounted (i.e., corridors, offices, meeting room, etc.)

3.2 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Wall receptacles:
 - .1 General 400 MM.

3.3 TESTING AND COMMISSIONING

- .1 Complete in accordance with Section 01 91 13 – General commissioning requirements

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 00 10 – General Instructions
- .2 Section 01 33 00 – Submittal Procedures
- .3 Section 01 35 30 – Health and Safety
- .1 Section 01 41 00 – Regulatory Requirements
- .2 Section 01 78 00 – Closeout Submittals
- .4 Section 01 91 13 – General commissioning requirements
- .5 Section 26 05 00 – Common Work Results – Electrical

1.2 DESCRIPTION

- .1 **Scope:** Provide design and engineering, labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for a static uninterruptible power supply (UPS) as required for the complete performance of the work and as shown on the Drawings and as herein specified.
- .2 **The work:** The work includes, but shall not be limited to, a continuous duty, and three-phase, solid state, on-line double conversion static UPS.
 - .1 The UPS shall utilize a rack-mounted N+1 redundant, scalable array architecture. The UPS shall be ENERGY STAR qualified. The system power train shall be comprised of 10 kVA/10 kW power modules and shall be capable of being configured for N+1 redundant operation at the rated system load. UPS shall facilitate the replacement of swappable power modules in less than ten minutes. Each 10 kVA/10 kW power module shall contain a fully rated input rectifier/boost converter hereafter referred to as the input converter, a fully rated output inverter, and battery charging circuit. The system shall also be comprised of a continuous duty bypass static switch module that can be swapped by trained personnel, battery modules that can be swapped by trained personnel, redundant control modules, redundant logic power supplies, and LCD interface/display. All of the above system components shall be housed in standard 600 mm wide by 1070 mm deep by 2000 mm high cabinets.
 - .2 In addition, this Section describes the performance, functionality, and design of the power distribution unit, hereafter referred to as the PDU, and the battery system.
 - .3 The UPS and associated equipment shall operate in conjunction with a primary power supply and an output distribution system to provide quality uninterrupted power for mission critical, electronic equipment load.
 - .4 All programming and miscellaneous components for a fully operational system as described in this Section shall be available as part of the UPS.

1.3 REFERENCES

- .1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):

- .1 ANSI/IEEE 519, "Guide for Harmonic Control and Reactive Compensation of Static Power Converters" (copyrighted by IEEE, ANSI approved).
- .2 International Organization for Standardization (ISO):
 - .1 ISO 9001, "Quality Management Systems _Requirements."
 - .2 ISO 14001, "Environmental Management Systems _ Requirements with Guidance for Use."
- .3 Underwriters Laboratories, Inc. (UL):
 - .1 UL 1778 second Edition, "Standard for Uninterruptible Power Supply Equipment" (copyrighted by UL, ANSI approved).
 - .2 UL 60950-1, "Standard for Information Technology Equipment."
- .4 International Electro technical Commission (IEC)
 - .1 IEC 61000-4-2, "Electromagnetic Compatibility - Testing and Measurement - Techniques; Electrostatic Discharge Immunity Test."
 - .2 IEC 61000-4-3, "Electromagnetic Compatibility - Testing and Measurement - Techniques; Radiated, Radio Frequency, Electromagnetic Field Immunity Test."
 - .3 IEC 61000-4-4, "Electromagnetic Compatibility - Testing and Measurement - Techniques; Electrical Fast Transient/Burst Immunity Test."
 - .4 IEC 61000-4-5, "Electromagnetic Compatibility - Testing and Measurement - Techniques; Surge Immunity Test."
 - .5 IEC 62040-2, "Uninterruptible Power Systems - Electromagnetic Compatibility (EMC) Requirements,"
 - .6 IEC 62040-3, "Uninterruptible Power Systems - Method of Specifying the Performance and Test Requirements."
- .5 CSA:
 - .1 C22.2 no. 107.1-M95, "General Use Power Supplies."
 - .2 CAN/CSA-60950-1, "Information Technology Equipment - Safety - Part 1: General Requirements."
- .6 EMC:
 - .1 FCC part 15 Class A.

1.4 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 The UPS shall be sized for a 40 kW load with N+1 power module redundancy, to a maximum capacity of 100kW.
 - .2 The UPS battery shall be sized for 26 kW at a power factor of 1 for 71 minutes.
- .2 System Characteristics:
- .3 System Capacity: The system shall be rated for full kW output in the following frame sizes:

- .1 40 kW N+1 power module redundancy, can be configured with up to ten, 10 kW power modules for 100 kW or 90 kW N+1.
- .4 Input: The system input shall be configurable as single mains derived from a three phase wye source. Standard cable entry shall be through the top.
 - .1 AC Input Nominal Voltage: 600 V three-phase, 4-wires plus ground, 60 Hz.
 - .2 AC Input Voltage Window:
 - .1 $\pm 15\%$ for full performance (510 to 690 volts).
 - .3 Short Circuit Withstand Rating: 30,000 symmetrical amperes.
 - .4 Maximum Frequency Range: 40 to 70 hertz.
 - .5 Input Power Factor:
 - .1 Greater than 0.99 with load at 25%
 - .2 Greater than 0.95 with loads above 15%
 - .3 Greater than 0.90 with loads above 10%
 - .6 Input Current Distortion With No Additional Filters: Less than 5 percent at full load.
- .5 UPS Output:
 - .1 AC Output Nominal Output: 208 Y/120 V, 4-wires plus ground, 60 Hz.
 - .2 AC Output Voltage Distortion: Less than 2% at 100% linear load, less than 6.5% for non-linear load as defined by IEC/EN 62040_3
 - .3 AC Output Voltage Regulation: $\pm 1\%$ for 100% linear or nonlinear load.
 - .4 Voltage Transient Response: $\pm 5\%$ maximum RMS change in a half cycle at load step 0% to 100% or 100% to 0%.
 - .5 Voltage Transient Recovery: Within less than 50 milliseconds.
 - .6 Output Voltage Harmonic Distortion: Less than 2% THD maximum and 1% single harmonic for a 100% linear load.
 - .7 Overload Capabilities:
 - .1 Normal Operation:
 - .1 150% for 30 seconds before transfer to bypass.
 - .2 Battery Operation: 150% for 30 seconds.
 - .3 Bypass Operation:
 - .1 125% continuous at 208 V
 - .2 1000% for 100 milliseconds.
 - .8 UPS efficiency:
 - .1 ENERGY STAR qualified system efficiency in double conversion mode:
 - .1 100% load: 94.7% efficient
 - .2 75% load: 94.9% efficient
 - .3 50% load: 94.8% efficient

.4 25% load: 93.2% efficient

.9 Output Power Factor Rating: 0.5 leading to 0.5 lagging without any derating.

1.5 SUBMITTALS

- .1 Product Data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications. Product data shall include, but shall not be limited to, the following:
 - .1 As bid system bill of materials.
 - .2 Product catalog sheets or equipment brochures.
 - .3 Product guide specifications.
- .2 Shop Drawings: Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer's standard product data, including, but not limited to, the following:
 - .1 Installation information, including, but not limited to, weights and dimensions.
 - .2 Information about terminal locations for power and control connections.
 - .3 Drawings for requested optional accessories.
- .3 Wiring Diagrams: Submit wiring diagrams detailing power, signal, and control systems, clearly differentiating between manufacturer-installed wiring and field-installed wiring, and between components provided by the manufacturer and those provided by others.
 - .1 Submit system single-line operation diagram.
- .4 Operation and Maintenance Data: Submit operation and maintenance data to include in operation and maintenance manuals including, but not limited to, safe and correct operation of UPS functions.
 - .1 Submit an installation manual, which shall include, but shall not be limited to, instructions for storage, handling, examination, preparation, installation, and start-up of UPS.
 - .2 Submit an operation and maintenance manual, which shall include, but shall not be limited to, operating instructions.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, Provincial, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.
 - .1 Work shall also be designed in accordance with the following:
 - 1. UL 1778 4th edition.
 - 2. UL 60950-1.
 - .2 Where applicable, the UPS shall also be designed in accordance with publications from the following organizations and committees:
 - 1. National Fire Protection Association (NFPA).
 - 2. National Electrical Manufacturers Association (NEMA).

3. Occupational Safety and Health Administration (OSHA).
4. Institute of Electrical and Electronics Engineers, Inc. (IEEE); ANSI/IEEE 519.
5. ISO 9001.
6. ISO 14001.
7. FCC.
8. ENERGYSTAR.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials to the project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.
- .2 Store materials in their original, undamaged packages and containers, inside a well ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.8 PROJECT CONDITIONS

- .1 Environmental Requirements: Do not install the UPS until space is enclosed and weatherproof, wet work in space is completed and nominally dry, work above ceilings is complete and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.
 - .1 Environmental:
 - .1 Storage Ambient Temperature: 15°C to 40°C
 - .2 Operating Ambient Temperature: 0°C to 40 °C (25°C shall be ideal for most battery types).
 - .3 Relative Humidity: 0% to 95% non-condensing.
 - .4 Altitude: Maximum installation with no derating of the UPS output shall be 1000 m above sea level. The UPS capacity shall be derated for altitude as follows:
 - .1 1500 m, 95% load.
 - .2 2000 m, 91% load.
 - .3 2500 m, 86% load.
 - .4 3000 m, 82% load.
 - .5 Audible Noise (As Measured 3 Feet (914 mm) From Surface):
 - .1 60 dBA at 70% load. 67 dBA at 100% load.

Part 2 Products

2.1 MODES OF OPERATION

- .1 **Normal:** The Input converter and output inverter shall operate in an on-line manner to continuously regulate power to the critical load. The input and output converters shall be

capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.

- .2 **Battery:** Upon failure of the AC input source, the critical load shall continue being supplied by the output inverter, which shall derive its power from the battery system. There shall be no interruption in power to the critical load during both transfers to battery operation and retransfers from battery to normal operation.
- .3 **Recharge:** Upon restoration of utility power to the UPS input, the input converter and output inverter shall simultaneously recharge the battery and provide regulated power to the critical load.
- .4 **Static Bypass:** The static bypass shall be used to provide controller transfer of critical load from the inverter output to the bypass source. This transfer, along with its retransfer, shall take place with no power interruption to the critical load. In the event of an emergency, this transfer shall be an automatic function.
- .5 **Maintenance Bypass:** The system shall be equipped with an external make-before-break maintenance bypass cabinet (MBC) to electrically isolate the UPS during routine maintenance and service of the UPS. The MBC shall allow for the completely electrical isolation of the UPS.

2.2 INPUT CONVERTER

- .1 **General:** The Input converters of the system shall be housed within the removable power modules, and shall constantly control the power imported from the mains input of the system, to provide the necessary UPS power for precise regulation of the DC bus voltage, battery charging, and main inverter regulated output power.
- .2 **Input Current Total Harmonic Distortion:** The input current THD shall be held to less than 5% at full system load, while providing conditioned power to the critical load bus, and charging the batteries under steady-state operating conditions. This shall be true while supporting both a linear or non-linear load. This shall be accomplished without the requirement for additional filters, magnetic devices, or other components.
- .3 **Soft-Start Operation:** As a standard feature, the UPS shall contain a user-adjustable soft-start, capable of limiting the input current from 0% to 100% of the input over a default 10 second period, when returning to the AC utility source from battery operation. The change in current over the change in time shall take place in a linear manner throughout the entire operation.
- .4 **Magnetization Inrush Current:** The UPS shall exhibit zero inrush current as a standard product. If provided with an optional isolation transformer, inrush should be limited to 11 times the nominal input current of the transformer.
- .5 **Input Current Limit:**
 - .1 The Input converter shall control and limit the input current draw from utility to 130% of the rated UPS output. During conditions where input current limit is active, the UPS shall be able to support 100% load, charge batteries at 10% of the UPS output rating, and provide voltage regulation with mains deviation +15/-5%.
- .6 **Redundancy:** The UPS shall be capable of being configured with redundant Input converters, each with semiconductor fusing, and logic-controlled contactors to isolate a failed module from the input bus.
- .7 **Back feed Protection:** The above mentioned logic-controlled contactor shall also provide

the back feed protection required by UL 1778, CSA 22.2, and IEC/EN Standards.

.8 Charging:

- .1 The battery charging shall keep the DC bus float voltage of nominal ± 218 volts, $\pm 1\%$.
- .2 The battery charging circuit shall contain a temperature compensation circuit, which shall regulate the battery charging to optimize battery life.
- .3 The battery charging circuit shall remain active when in static bypass and in normal operation.
- .4 Maximum charging power: 10% of output power rating or a maximum charge current of 0.25CA.

2.3 OUTPUT INVERTER

- .1 **General:** The UPS output inverter shall constantly develop the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of semiconductor driven power converters. In both normal operation and battery operation, the output inverters shall create an output voltage independent of the mains input voltage. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages shall not affect the amplitude or sinusoidal nature of the output voltage sine wave of the inverters.
- .2 **Overload Capability:** Steady-state overload conditions, of up to 150% of system capacity shall be sustained by the inverter for 30 seconds in normal and battery operation. Should overloads persist past the outlined time limitation, the critical load shall be switched to the automatic static bypass output of the UPS.
- .3 **Output Contactor:** The output inverter shall be provided with an output mechanical contactor to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter shall be isolated from the critical bus.
- .4 **Battery Protection:** The inverter shall be provided with monitoring and control circuits to limit the level of discharge on the battery system.
- .5 **Redundancy:** The UPS shall be capable of being configured with redundant output inverters, each with semiconductor fusing, and logic-controlled contactors to remove a failed component from the input, DC, and output critical bus.

2.4 STATIC BYPASS

- .1 **General:** As part of the UPS, a system static bypass cabinet shall be provided. The system static bypass shall provide no break transfer of the critical load from the inverter output to the static bypass input source during times where maintenance is required, or the inverter cannot support the critical bus. Such times may be due to prolonged or severe overloads, or UPS failure. The UPS and static bypass switch shall constantly monitor the auxiliary contacts of their respective circuit breakers, as well as the bypass source voltage, and inhibit potentially unsuccessful transfers to static bypass from taking place.
- .2 **Design:** The design of the static switch power path shall consist of silicon-controlled rectifiers (SCR) with a continuous duty rating of 125% of the UPS output rating.
- .3 **Automatic Transfers:** An automatic transfer of load to static bypass shall take place whenever the load on the critical bus exceeds the overload rating of the UPS. Automatic transfers of the critical load from static bypass back to normal operation

shall take place when the overload condition is removed from the critical output bus of the system. Automatic transfers of load to static bypass shall also take place if for any reason the UPS cannot support the critical bus.

- .4 **Manual Transfers:** Manually initiated transfers to and from static bypass shall be initiated through the UPS display interface.
- .5 **Overloads:** The static bypass shall be capable of handling overloads equal to or less than 125% of the rated system output continuously. For instantaneous overloads caused by inrush current from magnetic devices, or short circuit conditions, the static bypass shall be capable of sustaining overloads of 1000% of system capacity for periods of up to 100 milliseconds.
- .6 **Modular:** The static bypass switch shall be of a modular design.
- .7 **System Protection:** As a requirement of UL 1778, back feed protection in the static bypass circuit shall also be incorporated in the system design. To achieve back feed protection, a mechanical contactor in series with the bypass SCR(s) shall be controlled by the UPS/static switch, to open immediately upon sensing a condition where back feeding of the static switch by any source connected to the critical output bus of the system is occurring. One such condition could be a result of a shorted SCR.

2.5

DISPLAY AND CONTROLS

- .1 **Control Logic:** The UPS shall be controlled by two fully redundant intelligence modules (IM) that can be swapped by trained personnel. These modules shall have separate, optically isolated, communication paths to the power and static switch modules. Logic power for the control modules shall be derived from redundant power supplies, each having a separate AC and DC input and output. The communication of the control modules shall be of controller area network (CAN Bus).
- .2 **Display unit:** A microprocessor-controlled display unit shall be located on a hinged door in front of the system. The display shall consist of an alphanumeric display with backlight, four LEDs for quick status overview, and a keypad consisting of pushbutton switches.
- .3 **Metered Data:** The following data shall be available on the alphanumeric display:
 - .1 Year, month, day, hour, minute, second of occurring events.
 - .2 Source input voltage.
 - .3 Output AC voltage.
 - .4 Output AC current.
 - .5 Input frequency.
 - .6 Battery voltage.
- .4 **Event Log:** The display unit shall allow trained personnel to display a time and date stamped log.
- .5 **Alarms:** The display unit shall allow the Departmental Representative to display a log of active alarms. The following minimum set of alarm conditions shall be available:
 - .1 Input frequency outside configured range.
 - .2 AC adequate for UPS but not for bypass.
 - .3 Low/no AC input, startup on battery.
 - .4 Intelligence module inserted.
 - .5 Intelligence module removed.

- .6 Redundant intelligence module inserted.
 - .7 Redundant intelligence module removed.
 - .8 Number of batteries changed since last on.
 - .9 Number of power modules changed since last on.
 - .10 Number of batteries increased.
 - .11 Number of batteries decreased.
 - .12 Number of power modules increased.
 - .13 Number of power modules decreased.
 - .14 Number of external battery cabinets increased.
 - .15 Number of external battery cabinets decreased.
 - .16 Redundancy restored.
 - .17 Need battery replacement.
 - .18 The redundant intelligence module is in control.
 - .19 UPS fault.
 - .20 On battery.
 - .21 Shutdown or unable to transfer to battery due to overload.
 - .22 Load shutdown from bypass, input frequency, volts outside limits.
 - .23 Fault, internal temperature exceeded system normal limits.
 - .24 Input circuit breaker open.
 - .25 System level fan failed.
 - .26 Bad battery module.
 - .27 Bad power module.
 - .28 Intelligence module installed and failed.
 - .29 Redundant intelligence module installed and failed.
 - .30 Redundancy lost.
 - .31 Redundancy below alarm threshold.
 - .32 Runtime below alarm threshold.
 - .33 Load above alarm threshold.
 - .34 Load no longer above alarm threshold.
 - .35 Minimum runtime restored.
 - .36 Bypass not in range (either frequency or voltage).
 - .37 Back feed contactor stuck in OFF position.
 - .38 Back feed contactor stuck in ON position.
 - .39 UPS in bypass due to internal fault.
 - .40 UPS in bypass due to overload.
 - .41 System in forced bypass.
 - .42 Fault, bypass relay malfunction.
 - .43 High DC warning.
 - .44 High DC shutdown.
 - .45 Low battery shutdown.
 - .46 Low battery warning.
- .6 **Controls:** The following controls or programming functions shall be accomplished by the use of the display unit. Pushbutton membrane switches shall facilitate these operations:
- .1 Silence audible alarm.
 - .2 Display or set the date and time.
 - .3 Transfer critical load to and from static bypass.
 - .4 Test battery condition on demand.
 - .5 Set intervals for automatic battery tests.

- .6 Adjust set points for different alarms.
- .7 Program the parameters for remote shutdown.
- .8 Enable or disable the automatic restart feature (field service engineer only).
- .7 **Potential Free (Dry) Contacts:** The following potential free contacts shall be available on an optional relay interface board:
 - .1 Normal operation.
 - .2 Battery operation.
 - .3 Bypass operation.
 - .4 Common fault.
 - .5 Low battery.
 - .6 UPS off.
- .8 **Communication Interface Board:** A communication interface board shall provide the following communication port:
 - .1 RS232 serial port: Enables local access to the UPS for management and monitoring, and provides UPS data and simple signaling support.

2.6 BATTERY

- .1 The UPS batteries shall be of a modular construction and shall be protected by a fuse. Trained personnel shall be capable of swapping the battery modules without the requirement to transfer to bypass. Each battery module shall be monitored for voltage and temperature for use by the UPS battery diagnostic and temperature compensated charger circuitry.
- .2 The battery jars housed within each removable battery module shall be of the valve regulated lead acid (VRLA) type.
- .3 The UPS shall incorporate a battery management system to continuously monitor the health of each removable battery module. This system shall notify the user in the event a failed or weak battery module is found.

2.7 ACCESSORIES

- .1 **Power Distribution Unit:** As a minimum, the PDU shall contain the following features and accessories:
 - .1 **Input voltage:** The PDU shall be available for a 600 VAC, 3-phase input.
 - .2 **Isolation transformer:** The 600:208 V PDU shall contain an isolation transformer. A 208 V Modular PDU without transformer shall also be available for purchase.
 - .3 **Maintenance Bypass:** The system shall be equipped with an integrated, bus connected external make-before-break MBwD to electrically isolate the UPS during routine maintenance and service of the UPS. The MBwD shall allow for the completely electrical isolation of the UPS.
 - .1 The Maintenance Bypass Panel shall provide power to the critical load bus from the bypass source, during times where maintenance or service of the UPS is required. The Maintenance Bypass Panel shall provide a mechanical means of complete isolation of the UPS from the electrical wiring of the installation. As a minimum, the Maintenance Bypass Panel shall contain the following features and accessories:

- .1 Circuit breakers of the appropriate size, withstand rating, and trip rating for the system.
 - .2 Minimum 1A/1B auxiliary contacts for the purpose of relaying status information of each circuit breaker/switch actuator to the UPS and static bypass.
 - .2 The following minimum options shall also be available for the Maintenance Bypass Panel:
 - .1 Mimic label with light indications for power flow.
 - .4 **Distribution Board:** Also included in the PDU shall be one 72 pole distribution board connected to the output bus of the PDU to serve as critical load distribution. The distribution panel shall be intrinsically finger safe, and shall be suitable for the installation of single or three phase modular circuit breaker assemblies without the need for hand tools.
 - .5 **Sub-feed Breaker:** Also included in the PDU shall be one adjustable sub-feed breaker connected to the output bus of the PDU to serve as auxiliary load distribution. The sub-feed breaker shall be 100% rated for the maximum output of the PDU.
 - .6 **Cabinet with locking mechanism:** The PDU shall also have a full-length hinged front door, with locking mechanism, to allow access to the panel board circuits. There shall also be a hinged rear door to allow access to the back of the unit.
 - .7 **Testing and quality assurance:** The transformer and all circuit breakers shall be 100% factory tested to ensure the highest quality for the PDU. In addition, the PDU shall be tested with 100% load and all panel circuit breakers shall be 100% tested. The PDU shall also be Hipot tested per UL 60950-1 guidelines.
 - .8 **IT Rack Form Factor:** All of the above system components are housed in a metal cabinet, 600 mm (W) x 1070 mm(D) x 2000mm(H)
- .2 **Power Distribution Modules:** For the purpose of providing power distribution to the protected load, a range of power distribution modules and accessories shall be available.
 - .3 **Battery Solutions:** For purposes of providing UPS back-up power, battery cabinets shall be available. For ease of maintenance the battery cabinets shall house draw-out battery cartridges. Battery cartridges shall interlock in place within the battery cabinet to ensure proper contact. This will ensure that the customer will not inadvertently withdraw the battery pack in an unsafe manner. The battery solution shall be housed in a standard 24 inch (610 mm) wide, 36 inch (914 mm) deep, 42 U high cabinet. Up to four battery cabinets may be added for increased battery runtime.
 - .4 **Seismic Anchor Brackets:** Factory seismic anchoring bracket kits are to be supplied and installed for all cabinets; the units shall have an SDS capacity of 1.41g and a Z/h capacity of 1.0 and shall be OSHPD pre-approved.

2.8 SOFTWARE AND CONNECTIVITY

- .1 **Network Adaptor:** The Network Management Card shall allow one or more network management systems (NMS) to monitor and manage the UPS in TCP/IP network environments. The management information base (MIB) shall be provided in DOS and

UNIX "tar" formats. The SNMP interface adaptor shall be connected to the UPS via EthernetPort.

.2 Unattended Shutdown:

.1 The UPS, in conjunction with a network interface card, shall be capable of gracefully shutting down one or more operating systems.

.3 Remote UPS Monitoring: The following methods of remote UPS monitoring shall be available:

.1 **Web Monitoring:** Remote monitoring shall be available via a web browser such as InternetExplorer.

.2 **Simple Network Management Protocol (SNMP):** Remote UPS monitoring shall be possible through a standard MIB II compliant platform.

.4 Software Compatibility: The UPS manufacturer shall have available software to support graceful shutdown and remote monitoring for the following operating system families:

.1 Microsoft Windows

.2 MAC OS X

.3 Hyper-V

.4 VMware

.5 Linux

.6 Unix

Part 3 Execution

3.1 EXAMINATION

.1 **Verification of Conditions:** Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Departmental Representative, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

.1 Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

3.2 INSTALLATION

.1 **General:** Preparation and installation shall be in accordance with reviewed product data, final shop drawings, manufacturer's written recommendations, and as indicated on the Drawings.

.2 **Factory Start-Up:** Provide factory-assisted UPS start-up, where factory-trained service personnel shall perform the following inspections, test procedures, and on-site training:

1. Visual Inspection:

.1 Inspect equipment for signs of damage.

.2 Verify installation per manufacturer's instructions.

.3 Inspect cabinets for foreign objects.

.4 Inspect battery units.

.5 Inspect power modules.

2. Mechanical Inspection:

- .1 Check UPS and external maintenance bypass cabinet internal control wiring connections.
- .2 Check UPS and external maintenance bypass cabinet internal power wiring connections.
- .3 Check UPS and external maintenance bypass cabinet terminal screws, nuts, and/or spade lugs for tightness.

3. Electrical Inspection:

- .1 Verify correct input and bypass voltage.
- .2 Verify correct phase rotation of mains connections.
- .3 Verify correct UPS control wiring and terminations.
- .4 Verify voltage of battery modules.
- .5 Verify neutral and ground conductors are properly landed.
- .6 Inspect external maintenance bypass switch for proper terminations and phasing.

4. Site Testing:

- .1 Ensure proper system start-up.
- .2 Verify proper firmware control functions.
- .3 Verify proper firmware bypass operation.
- .4 Verify proper maintenance bypass switch operation.
- .5 Verify system set points.
- .6 Verify proper inverter operation and regulation circuits.
- .7 Simulate utility power failure.
- .8 Verify proper charger operation.
- .9 Document, sign, and date test results.

5. On-Site Operational Training: During the factory-assisted start-up, operational training for site personnel shall include, but shall not be limited to, key pad operation, LED indicators, start-up and shutdown procedures, maintenance bypass and AC disconnect operation, and alarm information.

3.3

DEMONSTRATION

- .1 **General:** Provide the services of a factory-authorized service representative of the manufacturer to provide start-up service and to demonstrate and train the Departmental Representative's personnel.
 - .1 Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
 - .2 Train the Departmental Representative's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventive maintenance.
 - .3 Review data in operation and maintenance manuals with the Departmental Representative's personnel.
 - .4 Schedule training with the Departmental Representative, through the Consultant if needed, with at least seven day's advanced notice.

3.4 PROTECTION

- .1 Provide final protection and maintain conditions in a manner acceptable to the Installer that shall ensure that the solid state UPS shall be without damage at time of Substantial Completion.

END OF SECTION