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**Part 1            General****1.1            TAXES**

- .1      Pay all taxes properly levied by law (including Federal, Provincial and Municipal).

**1.2            FEES, PERMITS and CERTIFICATES**

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

**1.3            CONSTRUCTION PROGRESS SCHEDULE**

- .1      Schedule and execute work with least possible interference or disturbance to the normal use of premises.
- .2      On award of contract submit bar chart construction schedule for work, indicating anticipated progress stages within time of completion. When the Departmental Representative has reviewed schedule, take necessary measures to complete work within scheduled time. Do not change schedule without notifying Departmental Representative.
- .3      Carry out work during "regular hour", Monday to Friday from 07:00 to 18:00 hours. Air Handling Units are not to be shut down during occupied hours.
- .4      Carry out all noise generating work during off hours Monday to Friday 18:00 to 07:00 hours.
- .5      Give departmental representative 5 days notice for work to be carried off hours.
- .6      Carry out work that will require partial power of mechanical shutdowns in building during off hours Monday to Friday 18:00 to 04:00 hours and on Saturday and Sundays. Coordinate shutdowns with Departmental Representative a minimum of 14 days in advance.
- .7      Carry out work in occupied areas during "off hours", Monday to Friday from 18:00 to 07:00 hours and on Saturdays, Sundays, and statutory holidays.
- .8      Give the Departmental Representative 48 hours notice for work to be carried out during "off hours".

**1.4            SUBMITTAL PROCEDURES**

- .1      Submit promptly to Departmental Representative submittals listed for review, in orderly sequence to not cause delay in work.
- .2      Do not proceed with work affected by submittals until review is complete.
- .3      Shop Drawings:

- .1 Submit five (5) copies of shop drawings: bearing stamp and signature of qualified Professional Engineer registered or licensed in Province of Ontario.
- .2 The review is for the sole purpose of ascertaining conformance with the general design concept, and does not mean approval of the design details inherent in the shop drawings, responsibility for which shall remain with the Contractor. Such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents.
- .4 Product Data:
  - .1 Submit five (5) copies of product data: manufacturers catalogue sheets, brochures, literature, performance charts and diagrams, used to illustrate standard manufactured products.
  - .2 Cross reference product data information to applicable portions on Contract Documents.
- .5 Samples:
  - .1 Submit samples: examples of materials, equipment, quality, finishes and workmanship.
  - .2 Where colour, pattern or texture is criterion, submit full range of samples.
  - .3 Reviewed and accepted samples will become standard of material and workmanship, against which installed work will be verified.
- .6 Submit photographs of surrounding properties, objects and structures liable to be damaged or be the subject of subsequent claims.

## **1.5 REGULATORY REQUIREMENTS**

- .1 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 2010 (NBC) and all applicable Provincial and Municipal codes. In the case of conflict or discrepancy the most stringent requirement shall apply.
- .2 Building Smoking Environment:
  - .1 Smoking is not permitted in the Building. Obey smoking restrictions on building property.
- .3 Hazardous Material Discovery:
  - .1 Stop work immediately when material resembling spray or trowel-applied asbestos, Polychlorinated Biphenyl (PCB), mould or other designated substance/hazardous substance is encountered during demolition work.
    - .1 Take preventative measure and promptly notify Departmental Representative.
    - .2 Do not proceed until written instructions have been received from Departmental Representative.

## 1.6 FIRE SAFETY REQUIREMENTS

- .1 Comply with both the National Building Code of Canada 2010 and the National Fire Code of Canada 2010 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 a building during construction.
  - .2 The National Fire Code (NFC):
    - .1 The on-going maintenance and use of the fire safety and fire protection features incorporated in buildings.
    - .2 The conduct of activities that might cause fire hazards in and around buildings.
    - .3 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 shall be assigned when welding or cutting operations are carried out in areas where combustible materials within 15m 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.

## **1.7 QUALITY CONTROL**

- .1 Testing Laboratory Services:
  - .1 Departmental Representative will appoint and pay for costs of inspection and testing services, unless indicated otherwise.
  - .2 Provide safe working areas and assist with testing procedures, including provisions for materials or services and co-ordination, as required by testing agency and as authorized by Departmental Representative.
  - .3 Where tests indicate non-compliance with specifications, contractor to pay for initial test and all subsequent testing of work to verify acceptability of corrected work.

## **1.8 HAZARDOUS MATERIALS**

- .1 Hazardous Materials: product, substance, or organism that may cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.
- .2 Comply with the requirements of the 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).
- .3 For work in occupied buildings, give the Department Representative one week 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.

## **1.9 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 Give the Departmental Representative one week notice related to each necessary interruption of any mechanical or electrical service throughout the course of the work. Keep duration of these interruptions to a minimum. Carry out all interruptions after normal working hours of the occupants, preferably on weekends.

## **1.10 CONSTRUCTION FACILITIES**

- .1 Access Scaffold:
  - .1 Scaffolding: in accordance with CSA Z797-09 – Code of Practice for Access Scaffold.

- .2 Provide design drawings, signed and sealed by qualified Professional Engineer licensed in the province of Ontario, where prescribed.
- .3 Additions or modifications to scaffolding must be approved by Professional Engineer in writing.
- .2 Existing elevators: to be used by construction personnel and transporting of materials.
  - .1 Co-ordinate with Departmental Representative.
  - .2 Protect from damage, safety hazards and overloading of existing equipment.
- .3 Site Storage:
  - .1 The Departmental Representative will assign storage space that shall be equipped and maintained by the Contractor.
  - .2 Do not unreasonably encumber site with materials or equipment.
  - .3 Move stored products or equipment that interfere with operations of Departmental Representative or other contractors.
  - .4 Obtain and pay for use of additional storage or work areas needed for operations.
  - .5 Do not load or permit to load any part of work with weight or force that will endanger work.
- .4 Where security is reduced by work provide temporary means to maintain security.
- .5 Sanitary facilities: will be assigned for Contractor's personnel. Others shall not be used. Keep facilities clean.
- .6 Signage:
  - .1 Provide common-use signs related to traffic control, information, instruction, use of equipment, public safety devices, etcetera, in both official languages or by the use of commonly understood graphic symbols and to approval of the Departmental Representative.
  - .2 No advertising will be permitted on this project.
  - .3 The Departmental Representative will provide a sign describing the project for the information of building users. Locate sign where indicated and as directed by Departmental Representative.
  - .4 Maintain approved signs and notices in good condition for duration of project and dispose of off site, on completion of project or earlier, as directed by Departmental Representative.

#### **1.11 TEMPORARY BARRIERS AND ENCLOSURES**

- .1 Maintain existing services to building and provide for personnel and vehicle access.
- .2 Hoarding:
  - .1 Design, erect and maintain temporary site enclosure and covered pedestrian walkways and provide protection, complete with signs and electrical lighting as required by authority having jurisdiction.

- .2 Provide one lockable truck entrance gates and one pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys. Paint public side of site enclosure in colour selected by Departmental Representative.
- .3 Weather Enclosures: protect work temporarily until permanent enclosures completed.
- .4 Dust Control:
  - .1 Provide dust tight screens or partitions to localize dust-generating activities, and for protection of workers, finished areas of work and public.
  - .2 Maintain and relocate protection until such work is complete.
  - .3 Protect all furnishings within work area with 0.102mm thick polyethylene film during construction. Remove film during non-construction hours and leave premises in clean, unencumbered and safe manner for normal daytime function.
- .5 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.
- .6 Protection:
  - .1 Protect work against damage until take-over.
  - .2 Protect adjacent work against the spread of dust and dirt beyond the work areas.
  - .3 Protect operatives and other users of site from all hazards.
- .7 Work zones:
  - .1 The contractor shall agree to install proper site separation and identification in order to maintain "Time and Space" at all times throughout the life of the project. When Building Operations staff requires access to equipment in order to operate the building, proper coordination and communication must exist between all parties involved."

## **1.12 COMMON PRODUCT REQUIREMENTS**

- .1 Quality of Work:
  - .1 Carry out work using qualified licenced 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 licenced 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 undamaged condition with manufacturer's seal and labels intact. Do not remove packaging or bundling until required in work.

- .3 Manufacturer's Instructions: unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers

### **1.13 EXAMINATION and PREPARATION**

- .1 Examine site and conditions likely to affect work and be familiar and conversant with existing conditions.
- .2 Before commencing work, establish location and extent of services lines in area of work and notify Departmental Representative of findings.

### **1.14 EXECUTION**

- .1 Cut, Patch and Make Good:
  - .1 Cut existing surfaces as required to accommodate new work.
  - .2 Remove all items so shown or specified.
  - .3 Patch and make good surfaces cut, damaged or disturbed, to Departmental Representative's approval. Match existing material, colour, finish and texture.
- .2 Firestop and smoke seal systems: in accordance with CAN-ULC-S115-05 – Standard Method of Fire Test of Firestop Systems. Install around pipe, ductwork, cables, and other objects penetrating fire separations to provide fire resistance not less than the fire resistance rating of surrounding floor, ceiling, and wall assembly.
- .3 Sleeves, Hangers and Inserts: co-ordinate setting and packing of sleeves and supply and installation of hangers and inserts. Obtain Departmental Representative's approval before cutting into structure.
- .4 Unless otherwise specified, materials for removal become the Contractor's property and shall be taken from site.

### **1.15 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 Conduct "waste audit" to determine what waste will be generated during construction and demolition operations. Prepare written "waste reduction work plan" and implement the principles to reduce, reuse and recycle materials to the extent that is possible.
- .3 Provide a "source separation program" to disassemble and collect in an orderly fashion the following "materials designated for alternative disposal" from the "general waste" stream:
  - .1 brick and Portland cement concrete;
  - .2 cardboard (corrugated);



- .3 gypsum board (unfinished);
- .4 steel; and
- .5 wood (not including painted, treated or laminated wood).
- .4 Submit complete records of all removals from site for both "materials designated for alternative disposal" and "general waste" including:
  - .1 time and date of removal;
  - .2 description of material and quantities; and
  - .3 proof that materials have been received at an approved Waste Processing Site or certified Waste Disposal Site as required.

## **1.16 CLOSEOUT SUBMITTALS**

- .1 Operational and Maintenance Manuals:
  - .1 Two (2) weeks prior to any scheduled training, submit to Departmental Representative six (6) copies of approved Operations Data and Maintenance Manual in both official languages, compiled as follows:
    - .1 Bind data in vinyl hard cover 3 "D" ring type loose-leaf binders for 212 x 275mm size paper. Binders must not exceed 75mm thick or be more than 2/3 full.
    - .2 Enclose title sheet labelled "Operation Data and Maintenance Manual," project name, date and list of contents. Project name must appear on binder face and spine.
    - .3 Organize contents into applicable sections of work to parallel project specifications breakdown. Mark each section by labelled tabs protected with celluloid covers fastened to hard paper dividing sheets.
  - .2 Include following information plus data specified:
    - .1 Maintenance instruction for finished surface and materials.
    - .2 Copy of hardware and paint schedules.
    - .3 Description: operation of the equipment and systems defining start-up, shut-down and emergency procedures, and any fixed or adjustable set points that affect the efficiency of the operation. Include nameplate information such as make, size, capacity and serial number.
    - .4 Maintenance: use clear drawings, diagrams or manufacturers' literature which specifically apply and detail the following:
      - .1 lubrication products and schedules;
      - .2 trouble shooting procedures;
      - .3 adjustment techniques; and
      - .4 operational checks.
    - .5 Suppliers' names, addresses and telephone numbers and components supplied by them must be included in this section. Components must be identified by a description and manufacturers part number.
    - .6 Guarantees showing:
      - .1 name and address of projects;

- .2 guarantee commencement date (date of Interim Certificate of Completion);
  - .3 duration of guarantee;
  - .4 clear indication of what is being guaranteed and what remedial action will be taken under guarantee; and
  - .5 signature and seal of Guarantor.
- .7 Additional material used in project listed under various Sections showing name of manufacturer and source of supply.
- .3 Spare parts: list all recommended spares to be maintained on site to ensure optimum efficiency. List all special tools appropriate to unique application. All parts/tools detailed must be identified as to manufacturer, manufacturer part number and supplier (including address).
- .4 Include one complete set of final shop drawings (bound separately) indicating corrections and changes made during fabrication and installation.
- .2 Records:
  - .1 As work progresses, maintain accurate records to show deviations from contract drawings. Just prior to Departmental Representative's inspection for issuance of final certificate of completion, supply to the Departmental Representative one (1) set of white prints with all deviations neatly inked in. The Departmental Representative will provide two sets of clean white prints for this purpose.
- .3 Guarantees and Warranties:
  - .1 Before completion of work collect all manufacturer's guarantees or warranties and deposit with Departmental Representative.

#### **1.17 CLEANING**

- .1 Clean up as work progresses. At the end of each work period, and more often if ordered by the Departmental Representative, remove debris from site, neatly stack material for use, and clean up generally.
- .2 Upon completion remove scaffolding, temporary protection and surplus materials. Make good defects noted at this stage.
- .3 Clean and polish glass, mirrors, ceramic tile, aluminum, chrome, stainless steel, baked or porcelain enamel, plastic laminate and other plastic surfaces, floors, hardware and washroom fixtures. Clean manufactured articles in accordance with manufacturer's written instructions.
- .4 Clean areas under contract to a condition equal to what previously existed and to approval of Departmental Representative.

#### **1.18 SECURITY CHECK**

- .1 All personnel employed on this project will be subject to security check. Obtain requisite clearance, as instructed, for each individual required to enter the premises.
- .2 Personnel will be checked daily at start of work shift and given a pass, which must be worn at all times. Pass must be returned at end of work shift and personnel checked out.

**1.19 SECURITY ESCORT**

- .1 All personnel employed on this project shall be escorted when executing work in non-public areas during normal working hours. Personnel shall be escorted in all areas after normal working hours.
- .2 Submit an escort request to Departmental Representative at least [14] days before the service is needed. For requests submitted within the time mentioned above, the Departmental Representative will pay for the costs of the security escort. The cost incurred by a late request will be charged to the Contractor.
- .3 Any escort request may be cancelled free of charge if notification of cancellation is given at least [4] hours before the scheduled time of the escort. The cost incurred by a late cancellation will be charged to the Contractor.
- .4 The calculation of costs will be based on the average hourly rate of a security officer for a minimum of [8] hours per day for a late service request and [4] hours for late cancellations.

**1.20 COST BREAKDOWN**

- .1 Before submitting first progress claim, submit breakdown of Contract Amount in detail as directed by Departmental Representative and aggregating the Contract Amount. After approval by Departmental Representative cost breakdown will be used as the basis of progress payments.

**1.21 PRECEDENCE**

- .1 For Federal Government projects, Division 01 Sections take precedence over technical specification sections in other Divisions of this Project Manual

**Part 2 Products****2.1 NOT USED**

- .1 Not used.

**Part 3 Execution****3.1 NOT USED**

- .1 Not used.

**END OF SECTION**

## **PART 1 – GENERAL**

### **1.1 REGULATORY REQUIREMENTS**

.1 An investigation into the presence of designated substances for the Building Automation System (BAS) Replacement Project at the Sir William Logan Building, located at 580 Booth Street, in Ottawa, Ontario, was performed in order to meet the requirements of Section 30 of the *Ontario Occupational Health and Safety Act, Revised Statutes of Ontario, 1990, Chapter 0.1*. The *Canada Labour Code* also stipulates under Part II, Section 124 that every employer shall ensure that the health and safety at work of every person employed by the employer is protected. By having a Designated Substances Report (DSR) completed, the Departmental Representative will be able to inform his or her employees, contractors, and tenants of any designated substances that may be present and possibly disturbed throughout the duration of the project. The informed Departmental Representative will then be able to impose appropriate health and safety precautions for all applicable personnel as required.

.2 The designated substances identified in the *Occupational Health and Safety Act* and its corresponding regulations are:

- .1 **Acrylonitrile:** “Designated Substances”  
*O. Reg 490/09, as amended.*
- .2 **Arsenic:** “Designated Substances”  
*O. Reg 490/09, as amended.*
- .3 **Asbestos**
  - .1 “Designated Substances”  
*O. Reg 490/09, as amended.*
  - .2 “General – Waste Management”  
*O. Reg 347/09, as amended*
  - .3 “Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations”  
*O.Reg 278/05 (as amended)*
  - .4 *PWGSC Departmental Policy DP 057 – “Asbestos Management”*
- .4 **Benzene:** “Designated Substances”  
*O. Reg 490/09, as amended.*
- .5 **Coke Oven Emissions:** “Designated Substances” *O. Reg 490/09, as amended.*
- .6 **Ethylene Oxide:** “Designated Substances”  
*O. Reg 490/09, as amended.*
- .7 **Isocyanates:** “Designated Substances”  
*O. Reg 490/09, as amended.*

- .8 **Lead:**
  - .1 "Designated Substances"  
*O. Reg 490/09, as amended.*
  - .2 "General – Waste Management"  
*O. Reg 347/09, as amended*
  - .3 Hazardous Products Act's *Surface Coating Materials Regulations*  
SOR/2005-109, as amended (2011)
- .9 **Mercury:**
  - .1 "Designated Substances"  
*O. Reg 490/09, as amended.*
  - .2 "General – Waste Management"  
*O. Reg 347/09, as amended*
- .10 **Silica:** "Designated Substances"  
*O. Reg 490/09), as amended.*
- .11 **Vinyl Chloride:** "Designated Substances"  
*O. Reg 490/09, as amended.*
- .3 All contractors requesting tenders from subcontractors shall furnish this report to subcontractors.

## 1.2 VALIDITY DATE

- .1 DST Consulting Engineers Inc. (DST), conducted the on-site survey for this report on April 30, May 1 and May 2, 2013 (DST File No. BE-OT-016362).
- .2 DST completed a survey of all accessible anticipated project areas of the building (excluding roof and exterior) in order to identify designated substances that may be present and impacted by future work operations.
  - .1 The scope of work for this report involved a visual inspection of building materials and contents for the presence of suspected designated substances, within the areas anticipated to be affected by the future work operations at the Sir William Logan Building, hereafter referred to as the 'project areas' on April 30, and May 1 and 2, 2013. As such, the survey did not include a full building designated substances survey. The DSR specifically included all walls, ceilings, dropped ceiling spaces and columns throughout the building which were anticipated to be disturbed during the BAS replacement project. The areas evaluated were representative of the areas and materials that may potentially be affected by the project, and should be assumed representative should planned positions of BAS equipment require altering. The

- basement transformer room and elevator shafts were not accessible to DST at the time of the site survey.
- .2 From the visual inspection, suspect materials were sampled (where necessary) and analyzed, where appropriate, for select designated substances. On the basis of this inspection, a total of sixteen (16) bulk samples of suspected asbestos-containing material, were collected. One (1) bulk paint sample, suspected of containing lead, was also collected during the survey.
  - .3 Samples were then submitted for analysis at Paracel Laboratories Ltd., located at 300-2319 St. Laurent Boulevard, Ottawa, ON K1G 4J8.
  - .4 The surveys were limited to those areas, which could be accessed by non-destructive means. The visual inspection and sampling was limited to readily accessible areas. Destructive testing was not included in the investigation. Due to the nature of building construction, some inherent limitations exist as to the possible thoroughness of the designated substance survey. The survey did not include the demolition of floors, floor finishes, solid ceilings or walls, or the re-sampling of certain materials already determined to be asbestos-containing from previous surveys of the building.
  - .5 It is possible that designated substances are present in non-accessible areas and concealed spaces (i.e., wall and ceiling cavities), or additional confined spaces. No other areas outside the defined work boundaries have been assessed.
  - .6 Prior to beginning work, it must be confirmed with the Departmental Representative that no additional designated substances have been brought to the project area.
  - .7 In addition, the survey refers to Polychlorinated Biphenyls (PCBs) and halocarbons; however, it does not refer to other substances that may be present in the day-to-day usage for specialized equipment or areas in buildings (i.e., lead shields, fume hoods, chemicals, etc.).
  - .8 There is a possibility that materials, which could not be reasonably identified within the scope of this assessment or which were not apparent during previous site visits may exist. Should any designated substance be

encountered in the course of demolition or renovation, work must be stopped, preventative measures taken, and the Departmental Representative must be notified immediately. **Do not proceed until written instructions have been received**

## **PART 2 - DESIGNATED SUBSTANCES**

### **2.1 SURVEY RESULTS**

.1 **ACRYLONITRILE:** Not Identified

.2 **ARSENIC:** Not Identified

.3 **ASBESTOS: Identified**

Asbestos is a naturally occurring material. In general, it has historically been intentionally added to many building materials in the construction industry to increase thermal or chemical resistance properties. More common uses are thermal insulation for pipes and boilers, structural steelwork fireproofing, floor tiles and in-wall and ceiling plasters. There are two classes of asbestos-containing materials: friable and non-friable. Friable asbestos-containing materials are loose in composition or can be easily crumbled using hand pressure. Non-friable asbestos-containing materials are more durable and are held together by a binder such as cement, vinyl or asphalt.

Representative bulk samples, collected on April 30, May 1 and May 2, 2013 from materials located within some of the project areas, have been analyzed for asbestos. Analytical results indicate that select samples contain asbestos in the project areas. Specific materials were not sampled as part of this program due to these materials having been previously confirmed to be ACMs or not containing asbestos.

Table 1 summarizes the analytical laboratory results of building materials identified in a previous survey to not contain asbestos, as they pertain to the project areas. Table 2 summarizes the analytical results of building material samples collected from the project areas by DST that were analyzed for asbestos content using the PLM method:

**Table 1: Previous Asbestos Sample Results – GEC (2007)**

Sample Number	Material Description	Sample Location	Asbestos Type	Asbestos Content (%)
SA-3a to e	Wall plaster - Basement	Basement Mechanical Room	n/d	n/a
SA-4a to g	Plaster on ductwork	Central Mechanical Shaft	n/d	n/a
SA-8a to g	Wall plaster - throughout building	Throughout Building	n/d	n/a
SA-9a to c	2'x2' Acoustic ceiling tile	Basement hallway	n/d	n/a

n/d = none detected, n/a = not applicable

**Table 2: Asbestos Sample Results – DST (2013)**

Sample Number	Material Description	Location	Asbestos Type	Asbestos Content (%)
<b>16362-01A</b>	<b>Drywall Joint Compound</b>	<b>Former E-Print It Room, Basement</b>	<b>Chrysotile</b>	<b>1%</b>
16362-01B		Kitchen storage, Basement	n/d	n/a
16362-01C		Photocopier Area Library, Ground floor	n/d	n/a
16362-01D		Daycare, Ground floor	n/d	n/a
<b>16362-01E</b>		<b>Perimeter wall, east side, 2<sup>nd</sup> floor</b>	<b>Chrysotile</b>	<b>1%</b>
<b>16362-01F</b>		<b>Perimeter wall, north side, 3<sup>rd</sup> floor</b>	<b>Chrysotile</b>	<b>1%</b>
<b>16362-01G</b>		<b>Near elevator, core wall, 8<sup>th</sup> Floor</b>	<b>Chrysotile</b>	<b>1%</b>
<b>16362-02A</b>	<b>Caulking on ductwork</b>	<b>Kitchen storage, Basement</b>	<b>Chrysotile</b>	<b>5.51%</b>
16362-02B			Not analyzed – positive stop	
16362-02C			Not analyzed – positive stop	
<b>16362-03A</b>	<b>Ceiling Stipple</b>	<b>Main lobby, Ground floor</b>	<b>Chrysotile</b>	<b>1%</b>
16362-03B			Not analyzed – positive stop	
16362-03C			Not analyzed – positive stop	
<b>16362-04A</b>	<b>Parging layer</b>	<b>Perimeter wall of Penthouse Mechanical Room, East and West</b>	<b>Chrysotile</b>	<b>5%</b>
16362-04B			Not analyzed – positive stop	
16362-04C			Not analyzed – positive stop	

**Bold** items exceed the 0.5% regulated concentration of asbestos, as per O.Reg. 278/05 and PWGSC DP-057 as amended.

n/d = none detected, n/a = not applicable



The following ACMs may pose a risk if disturbed during the BAS Replacement Project:

- Due to the random mix of asbestos-containing drywall joint compound in the building, all instances of drywall joint compound throughout the building should be considered to contain regulated concentrations of asbestos, unless further laboratory analysis and delineation proves otherwise, or PWGSC can confirm that the installation of drywall in select areas is a newer installation and thus not likely to contain asbestos-containing drywall joint compound.
- A non-friable caulking application observed in the basement kitchen storage area, applied to steel beam above ceiling tiles, adjacent to ductwork.
- Friable stippled ceiling finish, present in the ground floor lobby area only.
- A friable parging layer packed between a metal sheeted wall and a concrete step observed on the East and West sides of the penthouse.

.4 **BENZENE:** Not Identified

.5 **COKE OVEN EMISSIONS:** Not Identified

.6 **ETHYLENE OXIDE:** Not Identified

.7 **ISOCYANATES:** Not Identified

.8 **LEAD: Identified**

Lead is a naturally occurring metal. It was used primarily in paint prior to the 1980s to increase the drying process. Lead in paint becomes a danger when it is old or damaged, as it creates lead dust and chips. Lead can also be found in soldered joints installed on piping up to the mid 1990s and in older cast iron bell and spigot joints.

- .1 According to the Hazard Products Act's *Surface Coating Materials Regulations* SOR/2005-109, as amended, allowable concentration of lead of surface coatings is 0.009 percent by weight (weight of lead to weight of paint), which is equivalent to 90 parts per million (ppm).

- .2 One (1) bulk sample of paint suspected of containing lead was sampled during the survey performed by DST. The sample summary and analytical result is included in Table 3:

**Table 3: Lead in Paint Sample Results – DST (2013)**

Sample number	Sample Location	Sample Description	Lead Content (µg/g or ppm)
16362-LP01	16 <sup>th</sup> Floor	White wall paint on plaster	940 ppm

Laboratory analysis results indicate that lead content in white wall paint on plaster (Sample 16362-LP-01), observed throughout the building is above 90 ppm. This paint is considered to have a lead content of potential concern, as per the Hazardous Products Act's *Regulations Amending the Surface Coating Materials Regulations SOR/2010-224*.

- .3 All paints in the project areas were observed to be intact and in good condition at the time of survey. Sampling of these paints was not performed, as sampling without matrix interference (i.e. removing paint without also removing non-paint substrate such as drywall) would likely prove difficult. Based on the findings of the lead paint sampling reported from previous surveys, select paints were identified as containing detectable concentrations of lead. As such, older interior paint finishes throughout the project areas are suspected to contain detectable concentrations of lead.
- .4 Lead is also suspected to be present in emergency light batteries, ceramic tile glazing, lead sheeting, solder on the joints of copper pipes, and cast iron drain pipe joint caulking in the project areas. Prior to renovation activities it should be established which, if any, of these materials/equipment are present in the work area that may pose a risk to building occupants if disturbed.
- .9 **MERCURY: Identified**
- Mercury is present in fluorescent light tubes throughout the project areas.

- .10 **SILICA: Suspected**  
Free crystalline silica is assumed present in concrete building materials, masonry and mortar, ceiling tiles, plaster, and drywall throughout the project areas.
- .11 **VINYL CHLORIDE MONOMER: Not Identified**
- .12 **POLYCHLORINATED BIPHENYLS (PCBs): Suspected – Select Light Ballasts**  
During the site investigation, the majority of light fixtures in the building contained T8 lamp tubes, which are not suspected to contain PCB ballasts. However, select T12 lamp tubes were identified by DST on-site, which may be indicative of a limited number of light fixtures containing PCB ballasts. High Intensity Discharge (HID) lights were also observed above the stipple ceiling in the ground floor lobby area, resting on the ceiling. DST did not disassemble the light fixtures or HID lights as they were energized or assumed energized and not accessible at the time of the site investigation. Prior to removal of fluorescent lights, the light ballasts should be inspected for PCBs.
- .13 **HALOCARBONS: Suspected**  
Halocarbons are suspected to be present in basement chillers, refrigerators and freezers, water coolers, and water fountains.
- .14 **OTHER HAZARDOUS MATERIALS: Identified**  
Small amounts (less than 1 square metre) of rodent droppings were observed concealed within perimeter column surrounds around the perimeter of the 2nd floor (as observed via column surround access hatches). The column surrounds on the remaining floors did not have access hatches, and thus concealed conditions could not be observed.

## 2.2 RECOMMENDATIONS

### **1. ASBESTOS**

PWGSC's DP 057, Asbestos Management, sets policy, establishes roles and responsibilities and provides a code of practice for the management of and working with asbestos-containing materials. All work must be done in accordance with this directive, as well as all other applicable

legislation. Disturbance of all asbestos (whether friable or non-friable) is regulated in Ontario by "Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations" O.Reg 278/05, as amended, which outlines the precautions required when performing work involving asbestos-containing materials. The regulation stipulates appropriate respiratory protection, work procedures and ventilation requirements that must be utilized during the disturbance of any asbestos-containing materials, or materials suspected to contain asbestos.

In the event of conflict between DP-057 and "Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations" O.Reg 278/05, as amended, the more stringent shall apply.

The removal or disturbance of one square metre or less of friable asbestos containing materials (parging material and stipple ceiling finish) must be conducted using a minimum of Type 2 asbestos work procedures. The removal or disturbance of more than one square metre of friable asbestos-containing materials must be conducted using Type 3 asbestos work procedures. Type 3 asbestos abatement operations performed in occupied buildings require daily asbestos air monitoring outside of each asbestos work area, as per PWGSC DP-057.

As per O.Reg 278/05, the removal or disturbance of less than one square metre of drywall in which the joint-filling compound contains asbestos can be conducted using a minimum of Type 1 asbestos work procedures. The removal or disturbance of one square metre or more of drywall in which the joint filling compounds are asbestos-containing must be conducted using a minimum Type 2 asbestos work procedures.

The breaking, cutting, drilling, abrading, grinding, sanding or vibrating of non-friable ACM caulking can be conducted using Type 1 asbestos precautionary measures, provided the material is wetted to control the spread of dust or fibres, and the work is done only by means of non-powered hand-held tools. If these conditions cannot be met, then more stringent (Type 2 or Type 3) work procedures are required.

## 2. LEAD

If lead-containing materials are disturbed (i.e. during dry sanding, grinding, polishing and sawing operations), then proper precautions, as outlined under "Designated Substances" O.Reg 490/09, as amended, of the Occupational Health and Safety Act, must be followed.

Under Ontario Regulation 490/09, as amended of the Occupational Health and Safety Act, regulatory limits have been established for occupational exposure limits to airborne lead that may be present in a workplace. The Time Weighted Average Exposure Values to airborne lead dust or fumes should not exceed the Ministry of Labour's 0.05 milligram per cubic metre ( $\text{mg}/\text{m}^3$ ) limit during the removal of paints and products containing any concentration of lead. The TWAEV represents the time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse health effects.

Contractors performing work that requires disturbance of lead-containing materials are responsible to ensure that the workers are not exposed to airborne lead dust levels in excess of the time-weighted average and Maximum Exposure Concentration for lead-containing paints.

.1 Ontario Ministry of Labour (MoL) has 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 airborne 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. Where there is conflict with the exposure limits and respiratory protection required by "Designated Substances" Regulation O.Reg 490/09, as amended, the most stringent requirements of Regulation 490/09 must apply

.2 The disposal of construction waste containing lead is controlled by "General – Waste Management" O.Reg 347/09, as amended, under the *Ontario Environmental Protection Act*. The classification of the waste is dependent upon the result(s) of leachate test(s). The waste can be classified as "hazardous", "non-hazardous" or "registerable solid waste", depending on the results of the leachate test.

Emergency light batteries should be removed intact and disposed of according to applicable regulations.

Copper piping can be cut a small distance (e.g. 50 mm) from the joints to avoid direct disturbance of the lead solder.

Cast iron drain pipes can be cut away from the joints to avoid direct disturbance of the lead caulking (and possibly asbestos packings) in the joints.

Ceramic tiles can be removed using Type 1 work procedures and respiratory protection provided that only non-powered hand tools are used.

### 3. MERCURY

.1 Mercury is governed by "Designated Substances" *O.Reg 490/09*, as amended, under the Occupational Health and Safety Act. The regulation provides requirements for allowable exposure levels.

.2 In addition, mercury waste is considered a hazardous waste under "General – Waste Management" *O.Reg 347/09, as amended*, of the *Ontario Environmental Protection Act*. Fluorescent lamp tubes are considered hazardous material and should be recycled if removed from service. For information regarding the collection of fluorescent lamp tubes, please consult the PWGSC Representative.

### 4. SILICA

.1 Silica occurs as crystalline material in cement. Crystalline silica is regulated under "Designated Substances" *O.Reg 490/09*, as amended, of the *Occupational Health and Safety Act* as a Designated Substance.

.2 Silica dust can be generated through such processes as blasting, grinding, crushing, and sandblasting silica-containing material. Since silica is presumed present in concrete building materials, masonry and mortar, ceiling tiles, plaster, and drywall within the project areas, appropriate respiratory protection and ventilation must be donned during the demolition and modifications of these structures.

.3 The Occupational Health and Safety Branch of the MoL has published the document entitled "*Guideline: Silica on Construction Projects*". This document classifies the disturbance of materials containing silica as Type 1, Type 2 or Type 3 work, and assigns different levels of respiratory protection and work procedures for each classification. These work procedures should be followed when

performing work involving the disturbance of silica-containing materials.

## **5. POLYCHLORINATED BIPHENYLS (PCBs)**

(Not recognized as a designated substance)

.1 During the site investigation, select fluorescent light fixtures containing T12 lamp tubes were observed in the project areas. Remnant High Intensity Discharge (HID) lights were also identified above the stipple ceiling in the ground floor lobby of the building. Ballasts associated with these fluorescent light tubes and HID lights are suspected to contain PCBs. If any fluorescent light or HID light ballasts are removed during this project, please refer to the Environmental Canada, *Identification of Lamp Ballasts Containing PCBs, August 1991* report in order to identify the ballast type. Ballasts for a typical 1.2 metre fluorescent light fixture made with PCBs contain approximately 23.6 grams of PCB.

.2 If any fluorescent light or HID light ballasts are removed during this project they must be sorted by a licensed electrician.

PCB-containing equipment and/or PCB-containing material must be disposed of in accordance with:

- Canadian Environmental Protection Act's (CEPA) *PCB Regulations*

- Canadian Council of Ministers of the Environment's "*Guidelines for the Management of Wastes Containing Polychlorinated Biphenyls*

- Ontario Environmental Protection Act's O.Reg 362/90 "*Waste Management – PCB's*" (O.Reg 33/07, French version)

All PCB-containing equipment and/or PCB-containing material that is removed from the site or placed into storage shall be appropriately reported in accordance with the requirements of the CEPA PCB Regulations.

## **6. HALOCARBONS**

(Not Recognized as a Designated Substance)

.1 When halocarbons-containing equipment requires dismantling or disposal, this equipment must be tagged by a certified technician before it can be dismantled or disposed, as per section 10 of the Refrigerants Regulations 189/94 under the Ontario Environmental Protection Act and the Federal Halocarbon Regulations 2003. If the units are to be removed, no release of the refrigerant shall occur in accordance with the Canadian Environmental Protection Act. If the units are being disposed, a qualified ODS technician with environmental awareness training must drain and

remove the ODSs. ODS recycling and recovery initiatives must be undertaken for any ODS-containing units being displaced by proposed work.

.2 The Ozone-Depleting Substances (ODS) Regulations made under the Canadian Environmental Protection Act came into force on June 2, 1994. These regulations control the reclamation, recovery and recycling of ODSs. Environment Canada has prepared a Code of Practice for the Reduction of Chlorofluorocarbon Emissions from Refrigeration and Air Conditioning Systems (1991) which outlines practices to be followed when conducting maintenance on these refrigerant-containing units. The Federal Halocarbon Regulation which came into effect in 1999, regulates releases, recovery and recycling of ODS and their halocarbon alternatives in the federal domain and also to ensure that these releases are minimized. Even though halocarbon alternatives to ODSs may have no impact on the ozone layer, they are greenhouse gases and thus contribute to climate change. The Regulations ensure that actions are taken to prevent releases of ODS and their halocarbon alternatives; to report these releases; that adequate training is provided to personnel; that operational and emergency procedures and strategic plans are developed for the use, control and phase-out of these substances. During this project, these regulations must be followed when dealing with ODSs.

## **7. OTHER HAZARDOUS MATERIALS**

Small amounts (less than 1 square metre) of rodent droppings were observed concealed within perimeter column surrounds around the perimeter of the 2nd floor. Due to the health implications of microbials associated with fecal matter, it is recommended that prior to disturbance, if required, animal fecal matter be cleaned and removed following the appropriate work procedures given in the document Mould Guidelines for the Canadian Construction Industry CCA 82-2004 published by the Canadian Construction Association (CCA 82-2004). Following clean-up, packaging and disposal of all animal fecal matter impacted waste should be performed in such a manner as to avoid cross-contamination of unaffected areas. Disposal of waste should be performed in accordance with local, municipal, provincial, and/or federal jurisdictions having authority.

## **8. CONTRACTORS DUTIES**

The contractor must review the designated substance report and take the necessary



precautions to protect the health and safety of the workers and the environment. As per Section 30(4) of the *Ontario Occupational Health and Safety Act*, the party hiring the contractor (i.e., Departmental Representative) shall ensure that the contractor and subcontractor (if any) for the project has received a copy of the designated substance report prior to entering a binding contract for the supply of work on the project. As per Section 27(2) (a, b, and c) of the *Ontario Occupational Health and Safety Act*, while onsite, the contractor supervisor shall exercise every reasonable precaution for the protection of a worker. If you have any questions about the designated substance report, please contact the Departmental Representative.

**END OF SECTION**

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS .1 Section 25 05 02 - EMCS: Submittal and Review Process.

1.2 ADMINISTRATIVE .1 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.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify Departmental Representative in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are co-ordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.

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- 1.2 ADMINISTRATIVE (Cont'd)
- .10 Keep one reviewed copy of each submission on site.
- 1.3 SHOP DRAWINGS AND PRODUCT DATA
- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow 10 days for Departmental Representative's review of each submission.
- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 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.
- .7 Accompany submissions with transmittal letter, in duplicate, containing:
- .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.
- .8 Submissions include:
- .1 Date and revision dates.
  - .2 Project title and number.
-

1.3 SHOP DRAWINGS  
AND PRODUCT DATA  
(Cont'd)

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- .8 Submissions include:(Cont'd)
- .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationship to adjacent work.
  - .9 After Departmental Representative's review, distribute copies.
  - .10 Delete information not applicable to project.
  - .11 Supplement standard information to provide details applicable to project.
  - .12 If upon review by Departmental Representative no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
  - .13 The review of shop drawings by Public Works and Government Services Canada (PWGSC) is for sole purpose of ascertaining conformance with general concept.
    - .1 This review shall not mean that PWGSC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting
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- 1.3 SHOP DRAWINGS AND PRODUCT DATA  
(Cont'd)
- .13 (Cont'd)
- .1 (Cont'd)  
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 sub-trades.
- 1.4 SAMPLES
- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Departmental Representative's business address or site office, as directed.
- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.
- 1.5 CERTIFICATES AND TRANSCRIPTS
- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
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PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

PART 1 - GENERAL1.1 RELATED  
REQUIREMENTS

- .1 Section 25 05 01 - EMCS: General requirements.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System - WHMIS
  - .1 Material Safety Data Sheets (MSDS).
- .2 Province of Ontario
  - .1 Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. 1990, c.0.1, as amended and O.Reg. 213/91, current edition.

1.3 ACTION AND  
INFORMATIONAL  
SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
  - .1 Results of site specific safety 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, health and safety inspectors.
- .4 Submit copies of incident and accident reports.
- .5 Submit WHMIS MSDS - Material Safety Data Sheets.
- .6 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 10 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 10 days after receipt of comments from Departmental Representative.
- .7 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does

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1.3 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)	.7	(Cont'd) not reduce the Contractor's overall responsibility for construction Health and Safety.
	.8	On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.
1.4 FILING OF NOTICE	.1	File Notice of Project with Provincial authorities prior to beginning of Work.
1.5 SAFETY ASSESSMENT	.1	Perform site specific safety hazard assessment related to project.
1.6 MEETINGS	.1	Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.
1.7 REGULATORY REQUIREMENTS	.1	Comply with specified standards and regulations to ensure safe operation at site containing hazardous or toxic materials.
1.8 GENERAL REQUIREMENTS	.1	Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
	.2	Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.
1.9 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 and assume the

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1.9	RESPONSIBILITY	.1	(Cont'd)
	(Cont'd)		role of "Constructor" as described in the Ontario Occupational Health & Safety Act and Regulations for construction projects.
		.2	Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.
1.10	COMPLIANCE	.1	Comply with the Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. 1990, c.0.1, as amended and O.Reg. 213/91, current edition.
	REQUIREMENTS		
1.11	UNFORSEEN	.1	When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.
	HAZARDS		
1.12	POSTING OF	.1	Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Departmental Representative.
	DOCUMENTS		
1.13	CORRECTION OF	.1	Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
	NON-COMPLIANCE		
		.2	Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
		.3	Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

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1.14 BLASTING .1 Blasting or other use of explosives is not permitted without prior receipt of written instruction by Departmental Representative.

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 USED .1 Not used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not used.

PART 1 - GENERAL1.1 ACTION AND  
INFORMATIONAL  
SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit written request in advance of cutting or alteration which affects:
  - .1 Structural integrity of elements of project.
  - .2 Integrity of weather-exposed or moisture-resistant elements.
  - .3 Efficiency, maintenance, or safety of operational elements.
  - .4 Visual qualities of sight-exposed elements.
  - .5 Work of Owner or separate contractor.
- .3 Include in request:
  - .1 Identification of project.
  - .2 Location and description of affected Work.
  - .3 Statement on necessity for cutting or alteration.
  - .4 Description of proposed Work, and products to be used.
  - .5 Alternatives to cutting and patching.
  - .6 Effect on Work of Owner or separate contractor.
  - .7 Written permission of affected separate contractor.
  - .8 Date and time work will be executed.

1.2 MATERIALS

- .1 Required for original installation.
- .2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

1.3 PREPARATION

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
  - .2 After uncovering, inspect conditions affecting performance of Work.
  - .3 Beginning of cutting or patching means acceptance of existing conditions.
-

1.3 PREPARATION  
(Cont'd)

- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.

1.4 EXECUTION

- .1 Execute cutting, fitting, and patching to complete Work.
  - .2 Fit several parts together, to integrate with other Work.
  - .3 Uncover Work to install ill-timed Work.
  - .4 Remove and replace defective and non-conforming Work.
  - .5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
  - .6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
  - .7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
  - .8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
  - .9 Restore work with new products in accordance with requirements of Contract Documents.
  - .10 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
  - .11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material full thickness of the construction element.
  - .12 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
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1.4 EXECUTION  
(Cont'd)

.13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.5 WASTE  
MANAGEMENT AND  
DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

PART 2 - PRODUCTS2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION3.1 NOT USED

.1 Not Used.

PART 1 - GENERAL

1.1 WASTE  
MANAGEMENT GOALS

- .1 Prior to start of Work conduct meeting with Departmental Representative to review and discuss PWGSC's Waste Management Plan and Goals.
- .2 PWGSC's Waste Management Goal 75 percent of total Project Waste to be diverted from landfill sites. Provide Departmental Representative documentation certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.
- .3 Accomplish maximum control of solid construction waste.
- .4 Preserve environment and prevent pollution and environment damage.

1.2 DEFINITIONS

- .1 Class III: non-hazardous waste - construction renovation and demolition waste.
  - .2 Cost/Revenue Analysis Workplan (CRAW): based on information from WRW, and intended as financial tracking tool for determining economic status of waste management practices.
  - .3 Demolition Waste Audit (DWA): relates to actual waste generated from project.
  - .4 Inert Fill: inert waste - exclusively asphalt and concrete.
  - .5 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
  - .6 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
  - .7 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
-

1.2 DEFINITIONS  
(Cont'd)

- .8 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .9 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
  - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
  - .2 Returning reusable items including pallets or unused products to vendors.
- .10 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .11 Separate Condition: refers to waste sorted into individual types.
- .12 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.
- .13 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to Schedule A.
- .14 Waste Management Co-ordinator (WMC) : contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .15 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

1.3 DOCUMENTS

- .1 Maintain at job site, one copy of following documents:
  - .1 Waste Audit.
  - .2 Waste Reduction Workplan.

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|---------------------------|--|
| 1.3 DOCUMENTS<br>(Cont'd) | .1 (Cont'd)<br>.3 Material Source Separation Plan. |
|---------------------------|--|
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|-------------------------|--|
| 1.4 WASTE AUDIT<br>(WA) | .1 Conduct WA prior to project start-up.<br>.2 Record, on WA - Schedule A, extent to which materials or products used consist of recycled or reused materials or products. |
|-------------------------|--|
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|---------------------------------------|--|
| 1.5 WASTE REDUCTION<br>WORKPLAN (WRW) | .1 Prepare WRW prior to project start-up.<br>.2 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.<br>.3 Describe management of waste.<br>.4 Identify opportunities for reduction, reuse, and recycling of materials. Based on information acquired from WA.<br>.5 Post WRW or summary where workers at site are able to review content.<br>.6 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.<br>.7 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project. |
|---------------------------------------|--|
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|--|---|
| 1.6 MATERIALS<br>SOURCE SEPARATION<br>PROGRAM (MSSP) | .1 Prepare MSSP and have ready for use prior to project start-up.<br>.2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Departmental Representative.<br>.3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.<br>.4 Provide containers to deposit reusable and recyclable materials. |
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| 1.6 MATERIALS<br>SOURCE SEPARATION<br>PROGRAM (MSSP)<br>(Cont'd) | .5 | Locate containers in locations, to facilitate deposit of materials without hindering daily operations.   |
|  | .6 | Locate separated materials in areas which minimize material damage.  |
|  | .7 | Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.<br>.1 Transport to approved and authorized recycling facility.                                 |
|  | .8 | Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.<br>.1 Materials must be immediately separated into required categories for reuse or recycling. |
| 1.7 STORAGE,<br>HANDLING AND<br>PROTECTION                       | .1 | Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.  |
|  | .2 | Unless specified otherwise, materials for removal do not become Contractor's property.   |
|  | .3 | Protect, stockpile, store and catalogue salvaged items.  |
|  | .4 | Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.   |
|  | .5 | Protect structural components not removed for demolition from movement or damage.  |
|  | .6 | Support affected structures. If safety of building is endangered, cease operations and immediately notify Departmental Representative.   |
|  | .7 | Protect surface drainage, mechanical and electrical from damage and blockage.  |
| 1.8 DISPOSAL OF<br>WASTES  | .1 | Do not bury rubbish or waste materials.  |
-

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|---------------------------------------|----|--|
| 1.8 DISPOSAL OF<br>WASTES<br>(Cont'd) | .2 | Do not dispose of waste volatile materials mineral spirits oil paint thinner into waterways, storm, or sanitary sewers.                      |
|                                       | .3 | Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit. |

- |                                   |    |   |
|-----------------------------------|----|---|
| 1.9 USE OF SITE<br>AND FACILITIES | .1 | Execute work with least possible interference or disturbance to normal use of premises. |
|                                   | .2 | Maintain security measures established by existing facility.                            |

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|-----------------|----|---|
| 1.10 SCHEDULING | .1 | Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work. |
|-----------------|----|---|

## PART 2 - PRODUCTS

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|--------------|----|-----------|
| 2.1 NOT USED | .1 | Not Used. |
|--------------|----|-----------|

## PART 3 - EXECUTION

- |                             |    |  |
|-----------------------------|----|--|
| 3.1 SELECTIVE<br>DEMOLITION | .1 | Reuse of Building Elements: this project has been designed to result in end of project rates for reuse of building elements as follows: do not demolish building elements beyond what is indicated on Drawings without approval by Departmental Representative.<br>.1 Building Structure and Shell: 75 100 percent.<br>.2 Interior Non-Shell Elements: 50 percent. |
|-----------------------------|----|--|

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|-----------------|----|--|
| 3.2 APPLICATION | .1 | Do Work in compliance with WRW.  |
|                 | .2 | Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes. |
-

- 3.3 CLEANING
- .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
  - .2 Clean-up work area as work progresses.
  - .3 Source separate materials to be reused/recycled into specified sort areas.
- 3.4 DIVERSION OF MATERIALS
- .1 From following list, separate materials from general waste stream and stockpile in separate piles or containers, as reviewed by Departmental Representative and consistent with applicable fire regulations.
    - .1 Mark containers or stockpile areas.
    - .2 Provide instruction on disposal practices.
  - .2 On-site sale of salvaged recovered reusable recyclable materials is permitted is not permitted.
  - .3 Demolition Waste:
 

Material Type	Recommended Diversion %	Actual Diversion %
Acoustic Tile	50	
Acoustical Insulation	100	
Electrical Equipment	80	
Mechanical Equipment	100	
Metals	100	
Rubble	100	
Wood (uncontaminated)	100	
Other		
  - .4 Construction Waste:
 

Material Type	Recommended Diversion %	Actual Diversion %
Cardboard	100	
Plastic Packaging	100	
Rubble	100	
Steel	100	
Wood (uncontaminated)	100	
Other		
- 3.5 WASTE AUDIT (WA)
- .1 Schedule A - Waste Audit (WA):

3.5 WASTE AUDIT .1 (Cont'd)  
(WA)  
(Cont'd)

(1)	(2)	(3)	(4)	(5)	(6) %	(7) %
Material	Material	Estimate	Total	Generati	Recycled	Reused
Category	Quantity	d Waste	Quantity	on Point		
	Unit	%	of Waste			
			(unit)			

Wood  
and  
Plastics  
Material  
Descript  
ion

Off-cuts

Warped  
Pallet  
Forms

Plastic  
Packaging

Cardboard  
Packaging

Other

Wood

Metal

3.5 WASTE AUDIT  
(WA)  
(Cont'd)

(1) Material Category	(2) Material Quantity Unit	(3) Estimate d Waste %	(4) Total Quantity of Waste (unit)	(5) Generati on Point	(6) % Recycled	(7) % Reused
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Other

3.6 WASTE REDUCTION .1 Schedule B:  
WORKPLAN (WRW)

(1) Material Category	(2) Person(s) Responsible	(3) Total Quantity of Waste (unit)	(4) Reused Amount (units) Projected	Actual	(5) Recycle d Amount (unit) Projected	Actual	(6) Material(s) Destination
-----------------------------	---------------------------------	--	---	--------	--	--------	-----------------------------------

Wood  
and  
Plastics  
Material  
Description

Warped  
Pallet  
Forms

Plastic  
Packaging

Cardboard  
Packaging

Other

Descrip-  
tion

Wood

Metal

Other

3.7 DEMOLITION .1 Schedule C - Demolition Waste Audit (DWA):  
WASTE AUDIT (DWA)

(1) Material Description	(2) Quantity	(3) Unit	(4) Total	(5) Volume (cum)	(6) Weight (cum)	(7) Remarks and Assumpti ons
--------------------------------	-----------------	----------	--------------	------------------------	------------------------	--

Plywood

Baseboar  
d-Wood

3.8 COST/REVENUE .1 Schedule D - Cost/Revenue Analysis Workplan  
ANALYSIS WORKPLAN (CRAW)

(1) Material Description	(2) Total Quantity (unit)	(3) Volume (cum)	(4) Weight (cum)	(5) Disposal Cost/Credi t \$(+/-)	(6) Category Sub-Total \$(+/-)
--------------------------------	---------------------------------	---------------------	---------------------	--	---

Wood

Plywood

3.8 COST/REVENUE (Cont'd)  
ANALYSIS WORKPLAN  
(CRAW)  
(Cont'd)

(1) Material Description n	(2) Total Quantity (unit)	(3) Volume (cum)	(4) Weight (cum)	(5) Disposal Cost/Credi t \$(+/-)	(6) Category Sub-Total \$(+/-)
					\$
(7) Cost (-) / Revenue (+)					

3.9 CANADIAN .1 Schedule E - Government Chief Responsibility  
GOVERNMENTAL  
DEPARTMENTS CHIEF  
RESPONSIBILITY FOR  
THE ENVIRONMENT

for the Environment:

Province	Address	General Inquires	Fax
Ontario	Ministry of Environmen t and Energy, 135 St. Clair Avenue West Toronto ON M4V 1P5 Environmen t Canada Toronto ON	416-323-43 21 800-565-49 23      416-734-44 94	416-323-46 82

PART 1 - GENERAL

- |  |    |   |
|--|----|---|
| <u>1.1 REFERENCES</u>                                  | .1 | Canadian Environmental Protection Act (CEPA)<br>.1 SOR/2012-197, Storage Tank Systems for<br>Petroleum Products and Allied Petroleum<br>Products Regulations.   |
| <u>1.2 ADMINISTRATIVE<br/>REQUIREMENTS</u>             | .1 | Pre-warranty Meeting:<br><br>.1 Convene meeting one week prior to<br>contract completion with contractor's<br>representative and Departmental Representative<br>to:<br>.1 Verify Project requirements.<br>.2 Review manufacturer's installation<br>instructions and warranty requirements.<br>.2 Departmental Representative to establish<br>communication procedures for:<br>.1 Notifying construction warranty<br>defects.<br>.2 Determine priorities for type of<br>defects.<br>.3 Determine reasonable response time.<br>.3 Contact information for bonded and<br>licensed company for warranty work action:<br>provide name, telephone number and address of<br>company authorized for construction warranty<br>work action.<br>.4 Ensure contact is located within local<br>service area of warranted construction, is<br>continuously available, and is responsive to<br>inquiries for warranty work action. |
| <u>1.3 ACTION AND<br/>INFORMATIONAL<br/>SUBMITTALS</u> | .1 | Provide submittals in accordance with Section<br>01 33 00 - Submittal Procedures.   |
|  | .2 | Two weeks prior to Substantial Performance of<br>the Work, submit to the Departmental<br>Representative, four final copies of operating<br>and maintenance manuals in English and French.   |
|  | .3 | Provide spare parts, maintenance materials<br>and special tools of same quality and<br>manufacture as products provided in Work.  |
|  | .4 | Provide evidence, if requested, for type,<br>source and quality of products supplied.   |
-



1.4 FORMAT

- .1 Organize data as 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 used correlate data into related consistent groupings.
  - .1 Identify contents of each binder on spine.
- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems, process flow, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.
  - .1 Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dxf dwg format on CD.

1.5 CONTENTS -  
PROJECT RECORD  
DOCUMENTS

- .1 Table of Contents for Each Volume: provide title of project;
    - .1 Date of submission; names.
    - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
    - .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 and replacement parts.
-

1.5 CONTENTS -  
PROJECT RECORD  
DOCUMENTS  
(Cont'd)

---

- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data.
  - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions
- .6 Training: refer to Section 01 79 00 - Demonstration and Training.

1.6 AS -BUILT  
DOCUMENTS AND  
SAMPLES

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- .1 Maintain, in addition to requirements in General Conditions, at site for Departmental Representative Owner one record copy of:
    - .1 Contract Drawings.
    - .2 Specifications.
    - .3 Addenda.
    - .4 Change Orders and other modifications to Contract.
    - .5 Reviewed shop drawings, product data, and samples.
    - .6 Field test records.
    - .7 Inspection certificates.
    - .8 Manufacturer's certificates.
  - .2 Store record documents and samples in field office apart from documents used for construction.
    - .1 Provide files, racks, and secure storage.
  - .3 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.
  - .4 Maintain record documents in clean, dry and legible condition.
    - .1 Do not use record documents for construction purposes.
  - .5 Keep record documents and samples available for inspection by Departmental Representative.
-

1.7 RECORDING  
INFORMATION ON  
PROJECT RECORD  
DOCUMENTS

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- .1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Departmental Representative.
  - .2 Use 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 Work until 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 References to related shop drawings and modifications.
  - .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 manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
  - .7 Provide digital photos, if requested, 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 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
  - .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 servicing and lubrication schedule, and list of lubricants required.
  - .7 Include manufacturer's printed operation and maintenance instructions.
  - .8 Include sequence of operation by controls manufacturer.
  - .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
  - .10 Provide installed control diagrams by controls manufacturer.
  - .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
  - .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
-

- 1.8 EQUIPMENT AND SYSTEMS  
(Cont'd)
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and 01 91 13 - General Commissioning (Cx) Requirements.
- .15 Additional requirements: as specified in individual specification sections.
- 1.9 MATERIALS AND FINISHES
- .1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.  
.1 Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .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 specification sections.  
.2 Provide items of same manufacture and quality as items in Work.  
.3 Deliver to site; 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.
-

1.10 MAINTENANCE  
MATERIALS  
(Cont'd)

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- .2 Extra Stock Materials:
  - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
  - .2 Provide items of same manufacture and quality as items in Work.
  - .3 Deliver to site; 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 Provide special tools, in quantities specified in individual specification section.
  - .2 Provide items with tags identifying their associated function and equipment.
  - .3 Deliver to site; place and store.
  - .4 Receive and catalogue items.
    - .1 Submit inventory listing to Departmental Representative.
    - .2 Include approved listings in Maintenance Manual.

1.11 DELIVERY,  
STORAGE AND  
HANDLING

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- .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.

1.12 WARRANTIES AND  
BONDS

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- .1 Develop warranty management plan to contain information relevant to Warranties.
  - .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Departmental Representative approval.
-

1.12 WARRANTIES AND .3  
BONDS  
(Cont'd)

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- Warranty management plan to include required actions and documents to assure that Departmental Representative receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to Departmental Representative for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
- .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
  - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
  - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
  - .4 Verify that documents are in proper form, contain full information, and are notarized.
  - .5 Co-execute submittals when required.
  - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint 4 month and 9 month warranty inspection, measured from time of acceptance, by Departmental Representative.
- .9 Include information contained in warranty management plan as follows:
- .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
-

1.12 WARRANTIES AND .9  
BONDS  
(Cont'd)

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(Cont'd)

.2 Provide list for each warranted equipment, item, feature of construction or system indicating:

- .1 Name of item.
- .2 Model and serial numbers.
- .3 Location where installed.
- .4 Name and phone numbers of manufacturers or suppliers.
- .5 Names, addresses and telephone numbers of sources of spare parts.
- .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
- .7 Cross-reference to warranty certificates as applicable.
- .8 Starting point and duration of warranty period.
- .9 Summary of maintenance procedures required to continue warranty in force.
- .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
- .11 Organization, names and phone numbers of persons to call for warranty service.
- .12 Typical response time and repair time expected for various warranted equipment.
- .3 Contractor's plans for attendance at 4 and 9 month post-construction warranty inspections.
- .4 Procedure and status of tagging of equipment covered by extended warranties.
- .5 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

.10 Respond in timely manner to oral or written notification of required construction warranty repair work.

.11 Written verification to follow oral instructions.

- .1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.



- 1.13 WARRANTY TAGS .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Departmental Representative.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
- .1 Type of product/material.
  - .2 Model number.
  - .3 Serial number.
  - .4 Contract number.
  - .5 Warranty period.
  - .6 Inspector's signature.
  - .7 Construction Contractor.

PART 2 - PRODUCTS

- 2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

- 3.1 NOT USED .1 Not Used.

PART 1 - GENERAL

- |  |    |  |
|--|----|--|
| <u>1.1 RELATED REQUIREMENTS</u>                | .1 | Section Section 01 91 13 - General Commissioning Requirements.   |
| <br>   |    |  |
| <u>1.2 ADMINISTRATIVE REQUIREMENTS</u>         | .1 | Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of final inspection.   |
|  | .2 | Owner: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.   |
|  | .3 | Preparation:<br>.1 Verify conditions for demonstration and instructions comply with requirements.<br>.2 Verify designated personnel are present.<br>.3 Ensure testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements and equipment and systems are fully operational.  |
|  | .4 | Demonstration and Instructions:<br>.1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled times, at the equipment designated location.<br>.2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.<br>.3 Review contents of manual in detail to explain aspects of operation and maintenance.<br>.4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions. |
| <br>   |    |  |
| <u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u> | .1 | Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.   |
|  | .2 | Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Departmental Representative's approval.  |
-

1.3 ACTION AND  
INFORMATIONAL  
SUBMITTALS

(Cont'd)

- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4 Give time and date of each demonstration, with list of persons present.
- .5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.4 QUALITY  
ASSURANCE

- .1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
  - .1 Instruct Owner's personnel.
  - .2 Provide written report that demonstration and instructions have been completed.

PART 2 - PRODUCTS2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION3.1 NOT USED

- .1 Not Used.

PART 1 - GENERAL

- |                                 |    |   |
|---------------------------------|----|---|
| <u>1.1 RELATED REQUIREMENTS</u> | .1 | Section 01 33 00 - Submittal Procedures.  |
|                                 | .2 | Section 25 30 02 - EMCS: Field Control Devices.   |
|                                 |    |   |
| <u>1.2 REFERENCES</u>           | .1 | Health Canada/Workplace Hazardous Materials Information System (WHMIS)<br>.1 Material Safety Data Sheets (MSDS).  |
|                                 | .2 | Underwriter's Laboratories of Canada (ULC)<br>.1 ULC-S115-2005, Fire Tests of Fire stop Systems.  |
|                                 |    |   |
| <u>1.3 DEFINITIONS</u>          | .1 | Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.                                |
|                                 | .2 | Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.   |
|                                 | .3 | Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.  |
|                                 | .4 | Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.<br>.1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation. |
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1.4 ACTION AND  
INFORMATIONAL  
SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
  - .1 Submit duplicate 300 x 300 mm samples showing actual fire stop material proposed for project.

PART 2 - PRODUCTS2.1 MATERIALS

- .1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.
    - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN- ULC-S115 and not to exceed opening sizes for which they are intended and conforming to specified special requirements described in PART 3.
    - .2 Fire stop system rating: 1 hour.
  - .2 Service penetration assemblies: systems tested to CAN-ULC-S115.
  - .3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.
  - .4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.
  - .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
  - .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
  - .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
  - .8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
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- 2.1 MATERIALS  
(Cont'd)
- .9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
  - .10 Sealants for vertical joints: non-sagging.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS
- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- 3.2 PREPARATION
- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
    - .1 Ensure that substrates and surfaces are clean, dry and frost free.
  - .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
  - .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.
  - .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.
- 3.3 INSTALLATION
- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
  - .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
  - .3 Provide temporary forming as required and remove forming only after materials have
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- 3.3 INSTALLATION (Cont'd)
- .3 (Cont'd)  
gained sufficient strength and after initial curing.
  - .4 Tool or trowel exposed surfaces to neat finish.
  - .5 Remove excess compound promptly as work progresses and upon completion.
- 3.4 FIELD QUALITY CONTROL
- .1 Inspections: notify Departmental Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.
  - .2 Manufacturer's Field Services:
    - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
    - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
    - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- 3.5 CLEANING
- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
  - .2 Remove temporary dams after initial set of fire stopping and smoke seal materials.
- 3.6 SCHEDULE
- .1 Fire stop and smoke seal at:
    - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
    - .2 Edge of floor slabs at curtain wall and precast concrete panels.
    - .3 Top of fire-resistance rated masonry and gypsum board partitions.
    - .4 Intersection of fire-resistance rated masonry and gypsum board partitions.
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3.6 SCHEDULE  
(Cont'd)

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.1 (Cont'd)

.5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.

.6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.

.7 Openings and sleeves installed for future use through fire separations.

.8 Around mechanical and electrical assemblies penetrating fire separations.

.9 Rigid ducts: greater than 129 cm<sup>2</sup>: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.



PART 1 - GENERAL

- 1.1 QUALIFICATIONS OF TAB PERSONNEL
- .1 Submit names of personnel to perform TAB to Departmental Representative within 90 days of award of contract.
  - .2 Provide documentation confirming qualifications, successful experience.
  - .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
    - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
    - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
    - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
  - .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
  - .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
  - .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
  - .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
  - .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
    - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
    - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

- 1.2 PURPOSE OF TAB .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.
- 1.3 EXCEPTIONS .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.
- 1.4 CO-ORDINATION .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.
- 1.5 PRE-TAB REVIEW .1 Review contract documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Departmental Representative in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.
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|--|---|
| <u>1.6 START-UP</u>                            | <ul style="list-style-type: none"><li>.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.</li><li>.2 Follow special start-up procedures specified elsewhere in Division 23.</li></ul>  |
| <u>1.7 OPERATION OF<br/>SYSTEMS DURING TAB</u> | <ul style="list-style-type: none"><li>.1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.</li></ul>  |
| <u>1.8 START OF TAB</u>                        | <ul style="list-style-type: none"><li>.1 Notify Departmental Representative 7 days prior to start of TAB.</li><li>.2 Start TAB when building is essentially completed, including:</li><li>.3 Installation of ceilings, doors, windows, other construction affecting TAB.</li><li>.4 Application of weatherstripping, sealing, and caulking.</li><li>.5 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:<ul style="list-style-type: none"><li>.1 Proper thermal overload protection in place for electrical equipment.</li><li>.2 Air systems:<ul style="list-style-type: none"><li>.1 Filters in place, clean.</li><li>.2 Duct systems clean.</li><li>.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.</li><li>.4 Correct fan rotation.</li><li>.5 Fire, smoke, volume control dampers installed and open.</li><li>.6 Coil fins combed, clean.</li><li>.7 Access doors, installed, closed.</li><li>.8 Outlets installed, volume control dampers open.</li></ul></li><li>.3 Liquid systems:<ul style="list-style-type: none"><li>.1 Flushed, filled, vented.</li><li>.2 Correct pump rotation.</li><li>.3 Strainers in place, baskets clean.</li><li>.4 Isolating and balancing valves installed, open.</li><li>.5 Calibrated balancing valves installed, at factory settings.</li></ul></li></ul></li></ul> |
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1.8	START OF TAB (Cont'd)	.5	(Cont'd)
		.3	Liquid systems:(Cont'd)
		.6	Chemical treatment systems complete, operational.
1.9	APPLICATION TOLERANCES	.1	Do TAB to following tolerances of design values:
		.1	HVAC systems: plus 5 %, minus 5 %.
		.2	Hydronic systems: plus or minus 10 %.
1.10	ACCURACY TOLERANCES	.1	Measured values accurate to within plus or minus 2 % of actual values.
1.11	INSTRUMENTS	.1	Prior to TAB, submit to Departmental Representative list of instruments used together with serial numbers.
		.2	Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
		.3	Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.
1.12	ACTION AND INFORMATIONAL SUBMITTALS	.1	Submit, prior to commencement of TAB:
		.2	Proposed methodology and procedures for performing TAB if different from referenced standard.
1.13	PRELIMINARY TAB REPORT	.1	Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
		.1	Details of instruments used.
		.2	Details of TAB procedures employed.
		.3	Calculations procedures.
		.4	Summaries.

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- 1.14 TAB REPORT
- .1 Format in accordance with referenced standard.
  - .2 TAB report to show results in SI units and to include:
    - .1 Project record drawings.
    - .2 System schematics.
  - .3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in both official languages in D-ring binders, complete with index tabs.
- 1.15 VERIFICATION
- .1 Reported results subject to verification by Departmental Representative.
  - .2 Provide personnel and instrumentation to verify up to 30 % of reported results.
  - .3 Number and location of verified results as directed by Departmental Representative.
  - .4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.
- 1.16 SETTINGS
- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
  - .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.
- 1.17 COMPLETION OF TAB
- .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.
- 1.18 AIR SYSTEMS
- .1 Standard: TAB to most stringent of TAB standards of AABC, NEBB, SMACNA or ASHRAE.
  - .2 Do TAB of systems, equipment, components, controls specified Divisions 23 and 25.
-

1.18 AIR SYSTEMS  
(Cont'd)

- .3 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB.
- .4 Quality assurance: perform TAB under direction of supervisor qualified by AABC or NEBB.
- .5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: to include as appropriate:
  - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
  - .2 At controllers, controlled device.
- .7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.19 OTHER TAB  
REQUIREMENTS

- .1 General requirements applicable to work specified in this paragraph:
  - .1 Qualifications of TAB personnel: as for air systems specified in this section.
  - .2 Quality assurance: as for air systems specified in this section.
- .2 Building pressure conditions:
  - .1 Adjust HVAC systems, equipment, controls to ensure pressure conditions at all times.
- .3 Zone pressure differences:
  - .1 Adjust HVAC systems, equipment, controls to establish air pressure differentials, with systems in every possible combinations of normal operating modes.
- .4 Smoke management systems:
  - .1 Test for proper operation of all smoke and fire dampers, sensors, detectors, installed as component parts of air systems.
- .5 Measurement of noise and vibration from equipment specified in Divisions 23 and 25.

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- 1.20 POST-OCCUPANCY TAB .1 Measure DBT, WBT (or %RH), air velocity, air flow patterns, NC levels, in occupied zone of all areas.
- .2 Emergency evacuation: participate in full scale emergency evacuation exercises. Repeat smoke management tests at this time.
- .3 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 1 month of termination of Warranty Period.

PART 2 - PRODUCTS

- 2.1 NOT USED .1 Not used.

PART 3 - EXECUTION

- 3.1 NOT USED .1 Not used.

PART 1 - GENERAL

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|---------------------------------|----|---|
| <u>1.1 RELATED REQUIREMENTS</u> | .1 | Section 25 05 01 - EMCS: General Requirements.  |
| <u>1.2 DEFINITIONS</u>          | .1 | For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.   |
|                                 | .2 | AEL: ratio between total test period less any system downtime accumulated within that period and test period.   |
|                                 | .3 | Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:<br>.1 Outage of main power supply in excess of back-up power sources, provided that:<br>.1 Automatic initiation of back-up was accomplished.<br>.2 Automatic shut-down and re-start of components was as specified.<br>.2 Failure of communications link, provided that:<br>.1 Controller automatically and correctly operated in stand-alone mode.<br>.2 Failure was not due to failure of any specified EMCS equipment.<br>.3 Functional failure resulting from individual sensor inputs or output devices, provided that:<br>.1 System recorded said fault.<br>.2 Equipment defaulted to fail-safe mode.<br>.3 AEL of total of all input sensors and output devices is at least 99 % during test period. |
| <u>1.3 DESIGN REQUIREMENTS</u>  | .1 | Confirm with Departmental Representative that Design Criteria and Design Intents are still applicable.  |



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|--|----|---|
| <u>1.3 DESIGN REQUIREMENTS (Cont'd)</u>        | .2 | Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intent.  |
| <u>1.4 ACTION AND INFORMATIONAL SUBMITTALS</u> | .1 | Submittals in accordance with Section 01 33 00 - Submittal Procedures.  |
|  | .2 | Final Report: submit report to Departmental Representative.<br>.1 Include measurements, final settings and certified test results.<br>.2 Bear signature of commissioning technician and supervisor<br>.3 Report format to be approved by Departmental Representative before commissioning is started.<br>.4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals.<br>.5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption. |
| <u>1.5 CLOSEOUT SUBMITTALS</u>                 | .1 | Provide documentation, O&M Manuals, and training of O&M personnel for review of Departmental Representative before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.  |
| <u>1.6 COMMISSIONING</u>                       | .1 | Do commissioning in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.   |
|  | .2 | Carry out commissioning under direction of Departmental Representative and in presence of Departmental Representative.  |
|  | .3 | Inform, and obtain approval from, Departmental Representative in writing at least 14 days prior to commissioning or each test. Include:<br>.1 Location and part of system to be tested or commissioned.<br>.2 Testing/commissioning procedures, anticipated results.  |
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|---|----|---|
| 1.6 COMMISSIONING<br>(Cont'd)                         | .3 | (Cont'd)<br>.3 Names of testing/commissioning personnel.  |
|   | .4 | A narrative sequence of operation (in English and French language) directly translating all CDL's into English language.  |
|   | .5 | Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.  |
|   | .6 | Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.  |
|   | .7 | Load system with project software.  |
|   | .8 | Perform tests as required.  |
| 1.7 COMPLETION OF<br>COMMISSIONING                    | .1 | Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative.   |
| 1.8 ISSUANCE OF<br>FINAL CERTIFICATE<br>OF COMPLETION | .1 | Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation. |

## PART 2 - PRODUCTS

- |               |    |  |
|---------------|----|--|
| 2.1 EQUIPMENT | .1 | Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.                                |
|               | .2 | Instrumentation accuracy tolerances : higher order of magnitude than equipment or system being tested.                                   |
|               | .3 | Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests. |
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2.1 EQUIPMENT  
(Cont'd)

- .4 Locations to be approved, readily accessible and readable.
- .5 Application: to conform to normal industry standards.

PART 3 - EXECUTION3.1 PROCEDURES

- .1 Test each system independently and then in unison with other related systems.
- .2 Commission each system using procedures prescribed by the Departmental Representative.
- .3 Commission integrated systems using procedures prescribed by Departmental Representative.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- .6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

- .1 Pre-Installation Testing.
  - .1 General: consists of field tests of equipment just prior to installation.
  - .2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.
  - .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
  - .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, BI, BO).
  - .5 Additional instruments to include:
    - .1 DP transmitters.
    - .2 VAV supply duct SP transmitters.
    - .3 DP switches used for dirty filter indication and fan status.

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3.2 FIELD QUALITY .1  
CONTROL  
(Cont'd)

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(Cont'd)

.6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp meter at source.

.7 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.

.8 Departmental Representative to mark instruments tracking within 0.5 % in both directions as "approved for installation".

.9 Transmitters above 0.5% error will be rejected.

.10 DP switches to open and close within 2% of setpoint.

.2 Completion Testing.

.1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.

.2 Include following activities:

.1 Test and calibrate field hardware including stand-alone capability of each controller.

.2 Verify each A-to-D convertor.

.3 Test and calibrate each AI using calibrated digital instruments.

.4 Test each BI to ensure proper settings and switching contacts.

.5 Test each BO to ensure proper operation and lag time.

.6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.

.7 Test operating software.

.8 Test application software and provide samples of logs and commands.

.9 Verify each CDL including energy optimization programs.

.10 Debug software.

.11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.

.12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on the list for remarks and the signature of the commissioning technician and Departmental Representative. This document will be used in final startup testing.

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3.2 FIELD QUALITY .2  
CONTROL  
(Cont'd)

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(Cont'd)

.3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and provide:

.1 2 technical personnel capable of re-calibrating field hardware and modifying software.

.2 Detailed daily schedule showing items to be tested and personnel available.

.3 Departmental Representative's acceptance signature to be on executive and applications programs.

.4 Commissioning to commence during final startup testing.

.5 O&M personnel to assist in commissioning procedures as part of training.

.6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.

.7 Commission systems considered as life safety systems before affected parts of the facility are occupied.

.8 Operate systems as long as necessary to commission entire project.

.9 Monitor progress and keep detailed records of activities and results.

.4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.

.1 Prior to beginning of 30day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.

.1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.

.2 Test to last at least 30consecutive 24 hour days.

.3 Tests to include:

.1 Demonstration of correct operation of monitored and controlled points.

.2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.

.4 System will be accepted when:

.1 EMCS equipment operates to meet overall performance

3.2 FIELD QUALITY CONTROL  
(Cont'd)

- .2 (Cont'd)  
.4 Final Operational Testing:(Cont'd)  
.4 (Cont'd)

requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.

.2 Requirements of Contract have been met.

.5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.

.6 Correct defects when they occur and before resuming tests.

.5 Departmental Representative to verify reported results.

3.3 ADJUSTING

- .1 Final adjusting: upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

- .1 Demonstrate to Departmental Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 79 00 - Demonstration and Training.

PART 1 - GENERAL

- |  |   |
|--|---|
| <u>1.1 RELATED REQUIREMENTS</u>                | <ul style="list-style-type: none"><li>.1 Section 01 33 00 - Submittal Procedures.</li><li>.2 Section 01 79 00 - Demonstration and Training.</li><li>.3 Section 25 05 01 - EMCS: General Requirements.</li></ul>   |
| <u>1.2 DEFINITIONS</u>                         | <ul style="list-style-type: none"><li>.1 CDL - Control Description Logic.</li><li>.2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.</li></ul>  |
| <u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u> | <ul style="list-style-type: none"><li>.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures, supplemented and modified by requirements of this Section.</li><li>.2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.<ul style="list-style-type: none"><li>.1 List name of trainer, and type of visual and audio aids to be used.</li><li>.2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.</li></ul></li><li>.3 Submit reports within one week after completion of Phase 1 and Phase 2 training program that training has been satisfactorily completed.</li></ul> |
| <u>1.4 QUALITY ASSURANCE</u>                   | <ul style="list-style-type: none"><li>.1 Provide bilingual, competent instructors thoroughly familiar with aspects of EMCS installed in facility.</li><li>.2 Departmental Representative reserves right to approve instructors.</li></ul>   |
-

- 1.5 INSTRUCTIONS .1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
- .2 Training to be project-specific.
- 1.6 TIME FOR TRAINING .1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).
- 1.7 TRAINING MATERIALS .1 Provide equipment, visual and audio aids, and materials for classroom training.
- .2 Supply manual for each trainee, describing in detail data included in each training program.
- .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).
- 1.8 TRAINING PROGRAM .1 To be in 2 phases over 6 month period.
- .2 Phase 1: 2 day program to begin before 30 day test period at time mutually agreeable to Contractor and Departmental Representative.
- .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
- .2 Supplement with on-the-job training during 30 day test period.
- .3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
- .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.
- .3 Phase 2: 5 day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.
- .1 Provide multiple instructors on pre-arranged schedule. Include at least following:
- .1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.
-



- 1.8 TRAINING PROGRAM  
(Cont'd)
- .3 Phase 2:(Cont'd)
- .1 (Cont'd)
- .2 Equipment maintenance training:  
provide personnel with 2 days training  
within 5 day period in maintenance of  
EMCS equipment, including general  
equipment layout, trouble shooting and  
preventive maintenance of EMCS  
components, maintenance and calibration  
of sensors and controls.
- .3 Programmers: provide personnel with  
2 days training within 5 day period in  
following subjects in approximate  
percentages of total course shown:
- .1 Software and architecture: 10%
- .2 Application programs: 15%
- .3 Controller programming: 50%
- .4 Trouble shooting and  
debugging:10%
- .5 Colour graphic generation: 15%
- 1.9 ADDITIONAL TRAINING  
TRAINING
- .1 List courses offered by name, duration and  
approximate cost per person per week. Note  
courses recommended for training supervisory  
personnel.
- 1.10 MONITORING OF TRAINING  
TRAINING
- .1 Departmental Representative to monitor  
training program and may modify schedule and  
content.

PART 2 - PRODUCTS

- 2.1 NOT USED
- .1 Not Used.
-

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

PART 1 - GENERAL1.1 RELATED  
REQUIREMENTS

- .1 Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Section 25 05 54 - EMCS: Identification.
- .3 Section 25 90 01 - EMCS: Site Requirements Applications and System Sequences of Operation.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
    - .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.
  - .2 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE).
    - .1 ANSI/IEEE 260.1-2004, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
  - .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
    - .1 ASHRAE STD 135-R2010, BACNET - Data Communication Protocol for Building Automation and Control Network.
  - .4 Canadian Standards Association (CSA International).
    - .1 CAN/CSA-Z234.1-89(R2011), Canadian Metric Practice Guide.
  - .5 Consumer Electronics Association (CEA).
    - .1 CEA-709.1-B-2002, Control Network Protocol Specification.
  - .6 Department of Justice Canada (Jus).
    - .1 Canadian Environmental Assessment Act (CEAA), 2012, c. 37.
    - .2 Canadian Environmental Protection Act (CEPA), 2008, c. 33.
  - .7 Electrical and Electronic Manufacturers Association (EEMAC).
    - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
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## 1.2 REFERENCES (Cont'd)

- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .9 Transport Canada (TC).
  - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

## 1.3 ACRONYMS AND ABBREVIATIONS

- .1 Acronyms used in EMCS:
  - .1 AEL - Average Effectiveness Level.
  - .2 AI - Analog Input.
  - .3 AIT - Agreement on International Trade.
  - .4 AO - Analog Output.
  - .5 BACnet - Building Automation and Control Network.
  - .6 BC(s) - Building Controller(s).
  - .7 BECC - Building Environmental Control Center.
  - .8 CAD - Computer Aided Design.
  - .9 CDL - Control Description Logic.
  - .10 CDS - Control Design Schematic.
  - .11 COSV - Change of State or Value.
  - .12 CPU - Central Processing Unit.
  - .13 BI - Binary Input.
  - .14 BO - Binary Output.
  - .15 DP - Differential Pressure.
  - .16 ECU - Equipment Control Unit.
  - .17 EMCS - Energy Monitoring and Control System.
  - .18 HVAC - Heating, Ventilation, Air Conditioning.
  - .19 IDE - Interface Device Equipment.
  - .20 I/O - Input/Output.
  - .21 ISA - Industry Standard Architecture.
  - .22 LAN - Local Area Network.
  - .23 LCU - Local Control Unit.
  - .24 MCU - Master Control Unit.
  - .25 NAFTA - North American Free Trade Agreement.
  - .26 NC - Normally Closed.
  - .27 NO - Normally Open.
  - .28 OS - Operating System.
  - .29 O&M - Operation and Maintenance.
  - .30 OWS - Operator Work Station.
  - .31 PC - Personal Computer.
  - .32 PCI - Peripheral Control Interface.
  - .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
  - .34 PID - Proportional, Integral and Derivative.
  - .35 RAM - Random Access Memory.
  - .36 SP - Static Pressure.

### 1.3 ACRONYMS AND ABBREVIATIONS

(Cont'd)

- .1 (Cont'd)
- .37 ROM - Read Only Memory.
- .38 TCU - Terminal Control Unit.
- .39 USB - Universal Serial Bus.
- .40 UPS - Uninterruptible Power Supply.
- .41 VAV - Variable Air Volume.

### 1.4 DEFINITIONS

- .1 Point: may be logical or physical.
  - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
  - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: composed of two parts, point identifier and point expansion.
  - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
    - .1 Area descriptor: building or part of building where point is located.
    - .2 System descriptor: system that point is located on.
    - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
  - .2 Point expansion : comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
  - .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
    - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.

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|-----------------------------|---|
| 1.4 DEFINITIONS<br>(Cont'd) | .3 Point Object Type: points fall into following object types: <ul style="list-style-type: none"><li>.1 AI (analog input).</li><li>.2 AO (analog output).</li><li>.3 BI (binary input).</li><li>.4 BO (binary output).</li><li>.5 Pulse inputs.</li></ul> |
|                             | .4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5. <ul style="list-style-type: none"><li>.1 Printouts: to ANSI/IEEE 260.1.</li><li>.2 Refer also to Section 25 05 54 - EMCS: Identification.</li></ul>                 |
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- |                           |  |
|---------------------------|--|
| 1.5 SYSTEM<br>DESCRIPTION | .1 Refer to control schematics for system architecture.  |
|                           | .2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following: <ul style="list-style-type: none"><li>.1 Building Controllers.</li><li>.2 Control devices as listed in I/O point summary tables.</li><li>.3 OWS(s).</li><li>.4 Data communications equipment necessary to effect EMCS data transmission system.</li><li>.5 Field control devices.</li><li>.6 Software/Hardware complete with full documentation.</li><li>.7 Complete operating and maintenance manuals.</li><li>.8 Training of personnel.</li><li>.9 Acceptance tests, technical support during commissioning, full documentation.</li><li>.10 Wiring interface co-ordination of equipment supplied by others.</li><li>.11 Miscellaneous work as specified in these sections and as indicated.</li></ul> |
|                           | .3 Design Requirements: <ul style="list-style-type: none"><li>.1 Design and provide conduit and wiring linking elements of system.</li><li>.2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.</li><li>.3 Location of controllers as reviewed by Departmental Representative prior to installation.</li><li>.4 Provide utility power to EMCS and emergency power to EMCS as indicated. Existing</li></ul>  |
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1.5 SYSTEM  
DESCRIPTION  
(Cont'd)

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- .3 Design Requirements:(Cont'd)
    - .4 (Cont'd)  
systems on emergency power to remain on emergency power
    - .5 Metric references: in accordance with CAN/CSA Z234.1.
  - .4 Language Operating Requirements:
    - .1 Provide English or French operator selectable access codes.
    - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English and French.
    - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English and French.
    - .4 System manager software: include in English and French system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
    - .5 Include, in English and French:
      - .1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definitions).
      - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in French and English at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.
      - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.
  - .5 BACnet Protocol
    - .1 The Building Control System shall use devices that are compliant with BACnet standard (ANSI/ASHRAE Standard 135-2010). The BAS shall support BACnet Profiles, BIBBs and Objects as described in BACnet standards (ANSI/ASHRAE Standard 135-2010), including Annexes.
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1.5 SYSTEM  
DESCRIPTION  
(Cont'd)

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- .5 (Cont'd)
- .2 The controllers and software packages shall be linked together using Local Area Network (LAN).
- .3 The new system shall be a fully BACnet native. All levels of controllers shall be BACnet native. All software for Operator Workstation and WEB Server shall also be BACnet native.
- .4 Each BAS shall support BACnet communication on all its controller communication port. These ports included Ethernet, MS/TP (RS485) and PTP (RS232).
- .5 The BAS shall support the following standard BACnet objects: Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Calendar, Device, Event Enrolment, File, Loop, Notification Class, Program, Schedule and Trend Log.
- .6 The BAS devices shall support the BIBBs that are related to their BACnet product profile.
- .7 All BAS controllers shall be "BACnet Testing Laboratory" (BTL) certified products.
- .8 The BAS software shall be submitted to the "BACnet Manufacturer Association" (BMA) and posted on their WEB site. The software shall be a product that will be submitted to the "BACnet Testing Laboratory" (BTL) when this level of profile will be tested for certification. Any other equipment will be rejected.
- .9 Provides standard Protocol Implementation Conformance Statement (PICS) for each controller and software that will be used on the project. PICS shall show at minimum, Objects, Networks, BIBBs and Profile supported. The PICS shall be based on the BACnet standard (ANSI/ASHRAE Standard 135-2001)
- .10 BACnet compatible systems that employ the use of gateways will not be accepted.

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1.6 ACTION AND  
INFORMATIONAL  
SUBMITTALS

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- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .2 Submit for review:
- .1 Equipment list and systems manufacturers at time of bid within 48 h after award of contract.
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1.6 ACTION AND  
INFORMATIONAL  
SUBMITTALS  
(Cont'd)

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- .2 Submit for review:(Cont'd)
  - .2 List existing field control devices to be re-used included in bid, along with unit price.
- .3 Quality Control:
  - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
  - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
  - .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Submittals and Review Process. Label or listing of specified organization is acceptable evidence.
  - .4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
  - .5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
  - .6 Permits and fees: in accordance with general conditions of contract.
  - .7 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative.
  - .8 Existing devices intended for re-use: submit test report.

1.7 QUALITY  
ASSURANCE

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- .1 All electrical work, including the installation of low voltage wiring and EMT, to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks the activities permitted shall be determined based on the level of training

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1.7 QUALITY  
ASSURANCE  
(Cont'd)

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- .1 (Cont'd)  
attained and the demonstration of ability to perform specific duties.
- .2 The electrical work of this division (Division 25), identified in the above paragraph, is to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province in which the work is being contracted.
- .3 Have local office within 50 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,
- .4 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.
- .5 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
- .6 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.
- .7 Provide proof of required qualifications.
- .8 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

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1.8 DELIVERY,  
STORAGE AND  
HANDLING

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- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.
  - .2 Waste Management and Disposal:
    - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
    - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
    - .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins
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1.8 DELIVERY,  
STORAGE AND  
HANDLING  
(Cont'd)

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- .2 Waste Management and Disposal:(Cont'd)
  - .3 (Cont'd)  
for recycling in accordance with Waste Management Plan.
  - .4 Separate for reuse and recycling and place in designated containers Steel, Metal and Plastic waste in accordance with Waste Management Plan.
  - .5 Place materials defined as hazardous or toxic in designated containers.
  - .6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
  - .7 Label location of salvaged material's storage areas and provide barriers and security devices.
  - .8 Ensure emptied containers are sealed and stored safely.
  - .9 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
  - .10 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.9 EXISTING-  
CONTROL COMPONENTS

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- .1 Remove all existing control wiring and install all new control wiring in EMT.
  - .2 Remove existing field devices and install new field devices as indicated on drawings. Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
    - .1 Do not modify original design of existing devices without written permission from Departmental Representative.
    - .2 Provide for new, properly designed device where re-usability of components is uncertain.
  - .3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.
    - .1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Departmental Representative.
    - .2 Failure to produce test report will constitute acceptance of existing devices by contractor.
-

1.9 EXISTING-  
CONTROL COMPONENTS  
(Cont'd)

- .4 Non-functioning items:
  - .1 Provide with report specification sheets or written functional requirements to support findings.
  - .2 Departmental Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.
- .5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.
- .6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.
  - .1 Be responsible for items repaired or replaced by Departmental Representative.
  - .2 Be responsible for repair costs due to negligence or abuse of equipment.
  - .3 Responsibility for existing devices terminates upon final acceptance of applicable portions of EMCS as approved by Departmental Representative.
- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.
- .8 Keep operational all existing control components until complete installation, testing and commissioning of the new system.

PART 2 - PRODUCTS2.1 EQUIPMENT

- .1 Control Network Protocol and Data Communication Protocol: to ASHRAE STD 135.
- .2 Complete list of equipment and materials to be used on project and forming part of bid documents by adding manufacturer's name, model number and details of materials, and submit for approval.

2.2 ADAPTORS

- .1 Provide adaptors between metric and imperial components.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS .1 Installation: to manufacturer's recommendations.

3.2 PAINTING .1 Painting: as follows:  
.1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.  
.2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.  
.3 Clean and prime exposed hangers, racks, fastenings, and other support components.  
.4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

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PART 1 - GENERAL

- |  |   |
|--|---|
| <u>1.1 RELATED REQUIREMENTS</u>                | <ul style="list-style-type: none"><li>.1 Section Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.</li><li>.2 Section Section 25 05 01 - EMCS: General Requirements.</li></ul>   |
| <u>1.2 DEFINITIONS</u>                         | <ul style="list-style-type: none"><li>.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.</li></ul>  |
| <u>1.3 DESIGN REQUIREMENTS</u>                 | <ul style="list-style-type: none"><li>.1 Preliminary Design Review: to contain following contractor and systems information.<ul style="list-style-type: none"><li>.1 Location of local office.</li><li>.2 Description and location of installing and servicing technical staff.</li><li>.3 Location and qualifications of programming design and programming support staff.</li><li>.4 List of spare parts.</li><li>.5 Location of spare parts stock.</li><li>.6 Names of sub-contractors and site-specific key personnel.</li><li>.7 Sketch of site-specific system architecture.</li><li>.8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.</li><li>.9 Descriptive brochures.</li><li>.10 Sample CDL and graphics (systems schematics).</li><li>.11 Response time for each type of command and report.</li><li>.12 Item-by-item statement of compliance.</li><li>.13 Proof of demonstrated ability of system to communicate utilizing BACnet.</li></ul></li></ul> |
| <u>1.4 ACTION AND INFORMATIONAL SUBMITTALS</u> | <ul style="list-style-type: none"><li>.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.</li><li>.2 Submit preliminary design document within 5 working days after tender closing and before contract award, for review by Departmental Representative.</li></ul>   |
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1.4 ACTION AND  
INFORMATIONAL  
SUBMITTALS  
(Cont'd)

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- .3 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.
- .4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.
- .5 Soft copy to be in Autocad - latest version and Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

1.5 PRELIMINARY  
SHOP DRAWING REVIEW

- .1 Submit preliminary shop drawings within 30 working days of award of contract and include following:
    - .1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
    - .2 Detailed system architecture showing all points associated with each controller including signal levels, pressures where new EMCS ties into existing control equipment.
    - .3 Spare point capacity of each controller by number and type.
    - .4 Controller locations.
    - .5 Auxiliary control cabinet locations.
    - .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
    - .7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
    - .8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
    - .9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at
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1.5 PRELIMINARY SHOP DRAWING REVIEW (Cont'd)	.1	(Cont'd) .9 Flow measuring stations:(Cont'd) design flow rate, manufacturer, model and range of velocity transmitter.
1.6 DETAILED SHOP DRAWING REVIEW	.1	Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following: .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review. .2 Wiring diagrams. .3 Piping diagrams and hook-ups. .4 Interface wiring diagrams showing termination connections and signal levels. .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including: .1 Sensing element type and location. .2 Transmitter type and range. .3 Associated field wiring schematics, schedules and terminations. .4 Complete Point Name Lists. .5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range. .6 Software and programming details associated with each point. .7 Manufacturer's recommended installation instructions and procedures. .8 Input and output signal levels or pressures where new system ties into existing control equipment. .6 Control schematics, sequence of operation, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS. .7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, and typical floor plans as specified. .8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs. .9 Listing and example of specified reports. .10 Listing of time of day schedules.

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- 1.6 DETAILED SHOP DRAWING REVIEW (Cont'd)
- .1 (Cont'd)
- .11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
  - .12 Type and size of memory with statement of spare memory capacity.
  - .13 Full description of software programs provided.
  - .14 Sample of "Operating Instructions Manual" to be used for training purposes.
  - .15 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

- 1.7 QUALITY ASSURANCE
- .1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:
- .1 Undertake functional review of preliminary design documents, resolve inconsistencies.
  - .2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).
  - .3 Review interface requirements of materials supplied by others.
  - .4 Review "Sequence of Operations".
- .2 Contractor's programmer to attend meeting.
- .3 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Departmental Representative.

PART 2 - PRODUCTS

- 2.1 NOT USED
- .1 Not Used.
-

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

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PART 1 - GENERAL1.1 RELATED  
REQUIREMENTS

- .1 Section Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- .2 Section Section 25 05 01 - EMCS: General Requirements.
- .3 Section Section 25 05 02 - EMCS: Submittal and Review Process.

1.2 DEFINITIONS

- .1 BECC - Building Environmental Control Centre.
- .2 OWS - Operator Work Station.
- .3 For additional acryonyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 ACTION AND  
INFORMATIONAL  
SUBMITTALS

- .1 Submittals in accordance with Section 01 78 00 - Closeout Procedures, supplemented and modified by requirements of this Section.
- .2 Submit Record Documents, As-built drawings, Operation and Maintenance Manual to Departmental Representative in English and French.
- .3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
  - .1 Binders to be 2/3 maximum full.
  - .2 Provide index to full volume in each binder.
  - .3 Identify contents of each manual on cover and spine.
  - .4 Provide Table of Contents in each manual.
  - .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.4 AS-BUILTS

- .1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
    - .1 Changes to contract documents as well as addenda and contract extras.
    - .2 Changes to interface wiring.
-

1.4 AS-BUILTS  
(Cont'd)

- .1 (Cont'd)
  - .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
  - .4 Locations of obscure devices to be indicated on drawings.
  - .5 Listing of alarm messages.
  - .6 Panel/circuit breaker number for sources of normal/emergency power.
  - .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
  - .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
  - .9 Basic system design and full documentation on system configuration.
- .2 Submit for final review by Departmental Representative.
- .3 Provide before acceptance 4 Hard and 1 soft copy incorporating changes made during final review.

1.5 O&M MANUALS

- .1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.
- .2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests
- .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
- .4 Functional description to include:
  - .1 Functional description of theory of operation.
  - .2 Design philosophy.
  - .3 Specific functions of design philosophy and system.
  - .4 Full details of data communications, including data types and formats, data processing and disposition data link

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1.5 O&M MANUALS  
(Cont'd)

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- .4 Functional description to include:(Cont'd)
    - .4 (Cont'd)  
components, interfaces and operator tests or self-test of data link integrity.
    - .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
    - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.
  - .5 System operation to include:
    - .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
    - .2 Operation of computer peripherals, input and output formats.
    - .3 Emergency, alarm and failure recovery.
    - .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
  - .6 Software to include:
    - .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
    - .2 Detailed descriptions of program requirements and capabilities.
    - .3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.
    - .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device.
    - .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
    - .6 Software for each Controller and single section referencing Controller common parameters and functions.
-

1.5 O&M MANUALS  
(Cont'd)

- .7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.
- .8 System configuration document:
  - .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
  - .2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.
- .9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

PART 1 - GENERAL

- |  |    |  |
|--|----|--|
| <u>1.1 RELATED REQUIREMENTS</u>                | .1 | Section Section 25 05 01 - EMCS: General Requirements.   |
| <u>1.2 REFERENCES</u>                          | .1 | Canadian Standards Association (CSA International).<br>.1 CSA C22.1-12, The Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations. |
| <u>1.3 DEFINITIONS</u>                         | .1 | For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.   |
| <u>1.4 SYSTEM DESCRIPTION</u>                  | .1 | Language Operating Requirements: provide identification for control items in English and French.   |
| <u>1.5 ACTION AND INFORMATIONAL SUBMITTALS</u> | .1 | Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.   |
|  | .2 | Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.  |

PART 2 - PRODUCTS

- |                                  |    |   |
|----------------------------------|----|---|
| <u>2.1 NAMEPLATES FOR PANELS</u> | .1 | Identify by Plastic laminate, 3 mm thick, matt white finish, black core, square corners, lettering accurately aligned and engraved into core. |
|                                  | .2 | Sizes: 25 x 67 mm minimum.  |
|                                  | .3 | Lettering: minimum 7 mm high, black.  |
|                                  | .4 | Inscriptions: machine engraved to identify function.  |
-

- 2.2 NAMEPLATES FOR FIELD DEVICES
- .1 Identify by plastic encased cards attached by plastic tie.
  - .2 Sizes: 50 x 100 mm minimum.
  - .3 Lettering: minimum 5 mm high produced from laser printer in black.
  - .4 Data to include: point name and point address.
  - .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.
- 2.3 NAMEPLATES FOR ROOM SENSORS
- .1 Identify by stick-on labels using point identifier.
  - .2 Location: as directed by Departmental Representative.
  - .3 Letter size: to suit, clearly legible.
- 2.4 WARNING SIGNS
- .1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
  - .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Departmental Representative's.
- 2.5 WIRING
- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
  - .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
  - .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.
-



2.6 PNEUMATIC TUBING .1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

2.7 CONDUIT .1 Colour code EMCS conduit.  
.2 Pre-paint box covers and conduit fittings.  
.3 Coding: use fluorescent orange paint and confirm colour with Departmental Representative during "Preliminary Design Review".

PART 3 - EXECUTION

3.1 NAMEPLATES AND LABELS .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.2 EXISTING PANELS .1 Remove existing nameplates, tags and legends where new nameplates, tags and legends are installed.  
.2 Correct remaining existing nameplates and legends to reflect changes made during Work.

---

PART 1 - GENERAL1.1 RELATED  
REQUIREMENTS

- .1 Section 25 05 01 - EMCS: General Requirements.
- .2 References.
  - .1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.
  - .2 Canadian Standards Association (CSA International).
    - .1 CSA Z204-94(R1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

1.2 DEFINITIONS

- .1 BC(s) - Building Controller(s).
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 ACTION AND  
INFORMATIONAL  
SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Submit detailed preventative maintenance schedule for system components to Departmental Representative.
  - .3 Submit detailed inspection reports to Departmental Representative.
  - .4 Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:
    - .1 Point name and location.
    - .2 Device type and range.
    - .3 Measured value.
    - .4 System displayed value.
    - .5 Calibration detail
    - .6 Indication if adjustment required,
    - .7 Other action taken or recommended.
  - .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
-

1.3 ACTION AND  
INFORMATIONAL  
SUBMITTALS  
(Cont'd)

- .6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.
  - .1 Maintain records and logs of each maintenance task on site.
  - .2 Organize cumulative records for each major component and for entire EMCS chronologically.
  - .3 Submit records to Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.
- .7 Revise and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.4 SERVICE  
CONTRACTS

- .1 Provide in-depth technical expertise and assistance to Departmental Representative and Commissioning Manager in preparation and implementation of service contracts and in-house preventive maintenance procedures.
- .2 Service Contracts to include:
  - .1 Annual verification of field points for operation and calibration.
  - .2 4 visits per year.
  - .3 12 responses to emergency calls during day, per year.
  - .4 6 responses to emergency calls during silent hours per year.
  - .5 Silent hours defined as 18:00 to 6:00.
  - .6 Complete inventory of installed system.

PART 2 - PRODUCTS2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION3.1 MAINTENANCE  
SERVICE DURING  
WARRANTY PERIOD

- .1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .2 Emergency Service Calls:
  - .1 Initiate service calls when EMCS is not functioning correctly.
  - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
  - .3 Furnish Departmental Representative with telephone number where service personnel may be reached at any time.
  - .4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
  - .5 Perform Work continuously until EMCS restored to reliable operating condition.
- .3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .4 Work requests: record each service call request, when received separately on approved form and include:
  - .1 Serial number identifying component involved.
  - .2 Location, date and time call received.
  - .3 Nature of trouble.
  - .4 Names of personnel assigned.
  - .5 Instructions of work to be done.
  - .6 Amount and nature of materials used.
  - .7 Time and date work started.
  - .8 Time and date of completion.
- .5 Provide system modifications in writing.
  - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

3.2 FIELD QUALITY  
CONTROL

- .1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Departmental Representative as described in Submittal article.
- .2 Perform inspections during regular working hours, 08:00 to 16:30 h, Monday through Friday, excluding statutory holidays.
- .3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
  - .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
  - .2 Check and Calibrate each field input/output device in accordance with Canada Labour Code - Part I and CSA Z204.
  - .3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.
- .4 Minor inspections to include, but not limited to:
  - .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
  - .2 Check equipment cooling fans as required.
  - .3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
  - .4 Review system performance with Operations Supervisor to discuss suggested or required changes.
- .5 Major inspections to include, but not limited to:
  - .1 Minor inspection.
  - .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
  - .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
  - .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
  - .5 Provide mechanical adjustments, and necessary maintenance on printers.

- 3.2 FIELD QUALITY CONTROL  
(Cont'd)
- 
- .5 (Cont'd)
- .6 Run system software diagnostics as required.
- .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
- .1 Perform network analysis and provide report as described in Submittal article.
- .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .7 Continue system debugging and optimization.
- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
- .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

PART 1 - GENERAL

- 1.1 RELATED REQUIREMENTS .1 Section 25 05 01 - EMCS: General Requirements.
- 1.2 REFERENCES .1 Canadian Standards Association (CSA International).  
.1 CSA T529-95(R2010), Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).  
.2 ANSI/TIA/EIA-569-B plus addenda.
- .2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.  
.1 IEEE Std 802.3TM -2002, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.
- .3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)  
.1 TIA/EIA-568-March 2009, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.  
.2 TIA/EIA-569-A-December 2001, Commercial Building Standard for Telecommunications Pathways and Spaces.
- .4 Treasury Board Information Technology Standard (TBITS).  
.1 TBITS 6.9-2000, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.
- 1.3 DEFINITIONS .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS - General Requirements.
-

1.4 SYSTEM  
DESCRIPTION

- .1 Data communication network to link Operator Workstations (OWS), Master Control Units (MCU) and Local Control Units (LCU) in accordance with CSA T529 TIA/EIA-568 and CSA T530 TIA/EIA-569-A and IEEE 802.3/Ethernet Standard and TBITS 6.9.
  - .1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.
  - .2 Allow for future expansion of network, with selection of networking technology and communication protocols.
- .2 Data communication network to include, but not limited to:
  - .1 EMCS-LAN.
  - .2 Modems.
  - .3 Network interface cards.
  - .4 Network management hardware and software.
  - .5 Network components necessary for complete network.

1.5 DESIGN  
REQUIREMENTS

- .1 EMCS Local Area Network (EMCS-LAN).
  - .1 High speed, high performance, local area network over which MCUs, LCUs and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.
  - .2 EMCS-LAN to: BACnet,.
  - .3 Each EMCS-LAN to be capable of supporting at least 50 devices.
  - .4 Support of combination of MCUs, LCUs and OWSs directly connected to EMCS-LAN.
  - .5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 100 Megabits per second minimum.
  - .6 Detection and accommodation of single or multiple failures of either OWSs, MCUs. LCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.
  - .7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.
- .2 Dynamic Data Access.
  - .1 LAN to provide capabilities for OWSs, either network resident or connected remotely,



1.5 DESIGN  
REQUIREMENTS  
(Cont'd)

- .2 (Cont'd)
  - .1 (Cont'd)  
to access point status and application report  
data or execute control functions for other  
devices via LAN.
  - .2 Access to data to be based upon logical  
identification of building equipment.
- .3 Network Medium.
  - .1 Network medium: fibre optic cable  
compatible with network protocol to be used  
within buildings.

PART 2 - PRODUCTS

- 2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

- 3.1 NOT USED .1 Not Used.

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PART 1 - GENERAL1.1 RELATED  
REQUIREMENTS

- .1 Section 25 05 01 - EMCS: General Requirements.
- .2 Section 25 05 02 - EMCS: Submittals and Review Process.
- .3 Section 25 05 03 - EMCS: Project Record Documents.
- .4 Section 25 30 01 - EMCS: Building Controllers.
- .5 Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequence of Operation.

1.2 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.
- .2 Secondary OWS: serves as backup to primary OWS, is storage and retrieval facility of soft copy of as-built contractor supplied data as described in Section 25 05 03 - EMCS: Project Record Documents.
- .3 Portable OWS: used as remote dial-up OWS with same capabilities as primary OWS including graphic display.
- .4 Remote Auxiliary OWS: performs identical user interface functions as primary OWS.

1.3 OWS SYSTEM  
DESCRIPTION

- .1 Consists of commercially available personal computer in current production, with sufficient memory and processor capacity to perform functions specified.
  - .2 Primary OWS to include:
    - .1 Report printer.
    - .2 Colour graphics printer.
    - .3 Modem.
  - .3 Secondary OWS.
  - .4 Remote auxiliary OWS.
  - .5 Portable Laptop.
-

1.4 ACTION AND INFORMATIONAL SUBMITTALS .1 Make submittals in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

1.5 ENVIRONMENTAL CONDITIONS .1 OWS to operate in conditions of 10 degrees C to 32 degrees C and 20% to 90% non-condensing RH.

1.6 MAINTENANCE .1 Provide maintenance in accordance with Section 25 05 03 - EMCS: Project Record Documents.

PART 2 - PRODUCTS

2.1 OWS HARDWARE .1 PC system to include:

- .1 Processor: Intel Coremicro-processor, operating at minimum clock speed of 3.33 Gigahertz, capable of supporting software necessary to perform functions specified in this section. System backplane bus (100 Megahertz) to support PCI and ISA boards.
- .2 Internal clock.
  - .1 Uninterruptible clock: accuracy of plus or minus 5 seconds/month, capable of deriving year / month / day / hour / minute / second.
  - .2 Rechargeable batteries: to provide minimum 48 h clock operation in event of power failure.
- .3 Asynchronous interfaces for connection to listed peripheral devices including LAN and remote devices.

.2 Power supply unit to accept 120 V 60 Hz source and include line surge and low voltage protection for processor and its peripherals.

.3 Include UPS to provide 5 minutes minimum operation of PC, CRT and communication and peripheral devices; applies to fixed (non portable) OWSS and peripherals.

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2.2 OWS PC  
COMPONENTS

- .1 Primary OWS: IBM PC compatible with following as minimum:
  - .1 Processor: Intel Core 2 E8600 3.33 GHz, 6M, 1333 FSB
  - .2 Operating System: genuine Windows 7 Professionnal, 64 bit, English
  - .3 Hard Drive: 1 TB Serial ATA Hard Drive (7200 RPNM) w/databurst cache
  - .4 Memory: 4 GB dual Channel DDR3 SDRAM 1333 MHZ-2 DIMMs
  - .5 Video card : Integrated video, Intel GMA X4500
  - .6 Optical Drive: Dual Drives: 16X DVD-ROM drive + 16x DVD+/-RW burner
  - .7 Data/fax modem plus 1525 wireless WLAN 11n PCIe card
  - .8 Quiet Keyboard standard with F keys
  - .9 Monitor: 23 inch Widescreen E2310H Flat panel display.
  - .10 UBS Mouse optical.
  - .11 Logitech LS21 Stereo Speakers System
  - .12 Internal Modem - 56 k.
  - .13 PCI Ethernet LAN Adapter to connect to local Ethernet LAN network.
  - .14 300 W minimum power supply.
- .2 Secondary OWS: IBM PC compatible workstation as defined for primary OWS.
- .3 Portable OWS: IBM compatible personal laptop computer.

2.3 PRINTERS

- .1 Report printer: Include following features:
  - .1 Laser printer.
  - .2 Accommodate 8.5 X 11" and 8.5 X 14" paper.
  - .3 Minimum 1200 by 1200 dpi resolution.
  - .4 Minimum 16 MB RAM, expandable to minimum 72 MB RAM.
  - .5 Minimum 18 pages per minute print speed.
- .2 Colour graphics printer include following features:
  - .1 Ink-jet technology capable of printing high quality colour images at speed of 4 pages per minute.
  - .2 Black cartridge to be separate cartridge from red, green and blue cartridge.
  - .3 Minimum colour resolution 2400 by 1200 dpi.
  - .4 Minimum black and white resolution 1200 by 1200 dpi.
  - .5 Minimum 8 MB RAM.

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2.3 PRINTERS (Cont'd)	.3	Include one box of 8.5 X 11" and one box of 8.5 X 14" paper.
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2.4 OPERATING SYSTEM (OS) OR EXECUTIVE	.1	OS to support complement of hardware terminals and software programs specified.
	.2	OS to be true multitasking operating environment. .1 MS DOS or PC DOS based software platforms not permitted.
	.3	OWS software to operate in "Windows" based operating environment: Windows 7, XP or Unix "X" Windows based system.

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2.5 OWS CONTROL SOFTWARE	.1	OWS is not to form part of real-time control functions either directly or indirectly or as part of communication link. Real-time control functions to reside in MCUs, LCUs, and TCUs with peer to peer communication occurring at MCU to MCU device level.
	.2	Time Synchronization Module. .1 System to provide Time Synchronization of real-time clocks in controllers. .2 System to perform this feature on regular scheduled basis and on operator request.
	.3	User Display Interface Module. .1 OWS software to support "Point Names" as defined in Section 25 05 01 - EMCS: General Requirements. .2 Upon operator's request in either text, graphic or table mode, system to present condition of single point, system, area, or connected points on system to OWS. Display analog values digitally to 1 place of decimal with negative sign as required. Update displayed analog values and status when new values received. Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm. For systems supporting COSV, refresh rate of screen data not to exceed 5 seconds from time of field change and system is to execute supervisory background scan every 20 seconds to verify point data value. For other systems refresh rate not to exceed 5 seconds for points displayed. Initial display of new system graphic display (with up

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2.5 OWS CONTROL  
SOFTWARE  
(Cont'd)

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- .3 (Cont'd)
    - .2 (Cont'd)  
to 30 active points), including presentation  
of associated dynamic data not to exceed 8  
seconds.
  - .4 General Event Log Module: to record system  
activities occurring at OWS or elsewhere in  
system including:
    - .1 Operator Log-in from user interface  
device.
    - .2 Communication messages: errors, failures  
and recovery.
    - .3 Event notifications and alarms by  
category.
    - .4 Record of operator initiated commands.
  - .5 General Event Log:
    - .1 Hold minimum of 4 months information and  
be readily accessible to operator.
    - .2 Able to be archived as necessary to  
prevent loss of information.
  - .6 Operator Control Software Module: to support  
entry of information into system from keyboard  
and mouse, DVD, USB, or from another network  
device. Display of information to user;  
dynamic displays, textual displays, and  
graphic displays to display logging and  
trending of system information and following  
tasks:
    - .1 Automatic logging of digital alarms and  
change of status messages.
    - .2 Automatic logging of analog alarms.
    - .3 System changes: alarm limits,  
set-points, alarm lockouts.
    - .4 Display specific point values, states as  
selected.
    - .5 Provide reports as requested and on  
scheduled basis when required.
    - .6 Display graphics as requested, and on  
alarm receptions (user's option).
    - .7 Display list of points within system.
    - .8 Display list of systems within building.
    - .9 Direct output of information to selected  
peripheral device.
    - .10 On-line changes:
      - .1 Alarm limits.
      - .2 Setpoints.
      - .3 Deadbands.
      - .4 Control and change of state  
changes.
      - .5 Time, day, month, year.
      - .6 Control loop configuration changes  
for controller-based CDLs.
-

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2.5 OWS CONTROL  
SOFTWARE  
(Cont'd)

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- .6 Operator Control Software Module:(Cont'd)
    - .10 On-line changes:(Cont'd)
      - .7 Control loop tuning changes.
      - .8 Schedule changes.
      - .9 Changes, additions, or deletions, of points, graphics, for installed and future systems.
    - .11 According to assigned user privileges (password definition) following functions are to be supported:
      - .1 Permit operator to terminate automatic (logic based) control and set value of field point to operator selected value. These values or settings to remain in effect until returned to automatic (logic based) control by operator.
      - .2 Requests for status, analog values, graphic displays, logs and controls to be through user interface screens.
    - .12 Software and tools utilized to generate, modify and configure building controllers to be installed and operational on the OWS.
  - .7 Remote host Module for off site OWSs.
    - .1 Operators at remote OWS to be able to perform control functions, report functions, data base generation and modification functions as described for OWS's connected via LAN. Provide routines to automatically answer calls and either file or display information sent from remote panels.
    - .2 Operator to be able to access remote buildings by selection of facility by its logical name.
    - .3 Local OWS may serve as remote host for remotely connecting OWSs, remote controllers or networks. Alarms and data file transfers handled via remote transactions must not interfere with local LAN activity. LAN activity not to prevent work-station from handling incoming calls.
    - .4 Remote host to communicate by Internet connection.
  - .8 Message Handling Module - and Error Messages: to provide message handling for following conditions:
    - .1 Message and alarm buffering to prevent loss of information.
    - .2 Error detection correction and retransmission to guarantee data integrity.
    - .3 Informative messages to operator for data error occurrences, errors in keyboard entry, failure of equipment to respond to
-

2.5 OWS CONTROL  
SOFTWARE  
(Cont'd)

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- .8 (Cont'd)
    - .3 (Cont'd)  
requests or commands and failure of communications between EMCS devices.
    - .4 Default device definition to be implemented to ensure alarms are reported as quickly as possible in event of faulty designated OWS.
  - .9 Access ControlModule.
    - .1 Minimum 5 levels of password access protection to limit control, display, or data base manipulation capabilities. Following is preferred format of progression of password levels:
      - .1 Guest: no password data access and display only.
      - .2 Operator Level: full operational commands including automatic override.
      - .3 Technician: data base modifications.
      - .4 Programmer: data base generation.
      - .5 Highest Level : system administration - password assignment addition, modification.
    - .2 User-definable, automatic log-off timers from 1 to 60 min. to prevent operators leaving devices on-line inadvertently. Default setting = 3 minutes.
  - .10 Trend Data Module: includes historical data collection utility, trend data utility, control loop plot utility. Each utility to permit operator to add trend point, delete trend point, set scan rate.
    - .1 Historical data collection utility: collect concurrently operator selected real or calculated point values at operator selectable rate 30-480 minutes. Samples to include for each time interval (time-stamped), minimum present value, maximum present value, and average present value for point selected. Rate to be individually selectable for each point. Data collection to be continuous operation, stored in temporary storage until removed from historical data list by operator. Temporary storage to have at least 6 month capacity.
    - .2 Trend data utility: continuously collect point object data variables for variables from building controllers as selected by operator, including at minimum; present value of following point object types - DI, DO, AI, AO set points value, calculated values. Trend data utility to have capacity to trend concurrently points at operator-selectable
-



2.5 OWS CONTROL  
SOFTWARE  
(Cont'd)

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- .10 Trend Data Module:(Cont'd)
    - .2 Trend data utility:(Cont'd)  
rate of 05 seconds to 3600 seconds,  
individually selectable for selected value, or  
use of COSV detection. Collected trend data to  
be stored on minimum 96 h basis in temporary  
storage until removed from trend data list by  
operator. Option to archive data before  
overwriting to be available.
    - .3 Control loop plot utility: for AO Points  
provide for concurrent plotting of Measured  
value input - present value, present value of  
output, and AO setpoint. Operator selectable  
sampling interval to be selectable between 1  
second to 20 seconds. Plotting utility to  
scroll to left as plot reaches right side of  
display window. Systems not supporting control  
loop plot as separate function must provide  
predefined groups of values. Each group to  
include values for one control loop display.
    - .4 Trend data Module to include display of  
historical or trend data to OWS screen in X Y  
plot presentation. Plot utility to display  
minimum of 6 historical points or 6 trend  
points concurrently or 1 Control Loop Plot.  
For display output of real time trend data,  
display to automatically index to left when  
window becomes full. Provide plotting  
capabilities to display collected data based  
on range of selected value for (Y) component  
against time/date stamp of collected data for  
(X) component.
    - .5 Provide separate reports for each trend  
utility. Provide operator feature to specify  
report type, by point name and for output  
device. Reports to include time, day, month,  
year, report title, and operator's initials.  
Implement reports using report module. Ensure  
trend data is exportable to third party  
spreadsheet or database applications for PCs.
  - .11 Report Module: reports for energy management  
programs, function totalization, analog/pulse  
totalization and event totalization features  
available at MCU level. Refer also to Section  
25 30 01 - EMCS: Building Controllers.
    - .1 Reports to include time, day, month,  
year, report title, operator's initials.
    - .2 Software to provide capability to:
      - .1 Generate and format reports for  
graphical and numerical display from real  
time and stored data.
      - .2 Print and store reports as selected  
by operator.
-

2.5 OWS CONTROL  
SOFTWARE  
(Cont'd)

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- .11 Report Module:(Cont'd)
  - .2 (Cont'd)
    - .3 Select and assign points used in such reports.
    - .4 Sort output by area, system, as minimum.
  - .3 Periodic/automatic report:
    - .1 Generate specified report(s) automatically including options of start time and date, interval between reports (hourly, daily, weekly, monthly), output device. Software to permit modifying periodic/automatic reporting profile at any time.
    - .2 Reports to include:
      - .1 Power demand and duty cycle summary: see application program for same.
      - .2 Disabled "Locked-out" point summary: include point name, whether disabled by system or by operator.
      - .3 Run time summary: summary of accumulated running time of selected equipment. Include point name, run time to date, alarm limit setting. Run time to accumulate until reset individually by operator.
      - .4 Summary of run time alarms: include point name, run time to date, alarm limit.
      - .5 Summary of start/stop schedules: include start/stop times and days, point name.
      - .6 Motor status summary.
  - .4 Report types:
    - .1 Dynamic reports: system to printout or display of point object data value requested by operator. System to indicate status at time of request, when displayed, updated at operator selected time interval. Provide option for operator selection of report type, by point name, and/or output device. Ensure reports are available for following point value combinations:
      - .2 Points in accessible from this OWS (total connected for this location), multiple "areas".
      - .3 Area (points and systems in Area).
      - .4 Area, system (points in system).
      - .5 System (points by system type).
      - .6 System point (points by system and point object type).
      - .7 Area point (points by system and point object type).

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2.5 OWS CONTROL  
SOFTWARE  
(Cont'd)

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- .11 Report Module:(Cont'd)
    - .4 Report types:(Cont'd)
      - .8 Point (points by point object type).
      - .5 Summary report: printout or display of point objet data value selected by operator. Report header to indicate status at time of request. Ensure reports are available on same basis as dynamic reports. Provide option as to report type, point name, output device.
      - .6 Include preformatted reports as listed in Event/Alarm Module.
  - .12 Graphics Display Module: graphics software utility to permit user to create, modify, delete, file, and recall graphics required by Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation.
    - .1 Provide capacity for 100% expansion of system graphics. Graphic interface to provide user with multiple layered diagrams for site, building in plan view, floor furniture plan view and building systems, overlaid with dynamic data appropriately placed and permitting direct operator interaction. Graphic interface to permit operator to start and stop equipment, change set points, modify alarm limits, override system functions and points from graphic system displays by use of mouse or similar pointing device.
    - .2 Display specific system graphics: provide for manual and/or automatic activation (on occurrence of an alarm). Include capability to call up and cancel display of graphic picture.
    - .3 Library of pre-engineered screens and symbols depicting standard air handling components (fans, coils, filters, dampers, VAV), complete mechanical system components (chillers, boilers, pumps), electrical symbols.
    - .4 Graphic development, creation, modification package to use mouse and drawing utility to permit user to:
      - .1 Modify portion of graphic picture/schematic background.
      - .2 Delete graphic picture.
      - .3 Call up and cancel display of graphic picture.
      - .4 Define symbols.
      - .5 Position and size symbols.
      - .6 Define background screens.
      - .7 Define connecting lines, curves.
-

2.5 OWS CONTROL  
SOFTWARE  
(Cont'd)

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- .12 Graphics Display Module:(Cont'd)
- .4 (Cont'd)
    - .8 Locate, orient, size descriptive text.
    - .9 Define, display colours of elements.
    - .10 Establish co-relation between symbols or text and associated system points or other graphic displays.
    - .11 Import graphic images of maps, building plans, system schematics to use as background for interactive labels and BAS navigation.
  - .5 User to be able to build graphic displays showing on-line point data from multiple MCU panels. Graphic displays to represent logical grouping of system points or calculated data based upon building function, mechanical system, building layout, other logical grouping of points which aids operator in analysis of facility operation. Data to be refreshed on screen as "changed data" without redrawing of entire screen or row on screen.
  - .6 Dynamic data (temperature, humidity, flow, status) to be shown in actual schematic locations, to be automatically updated to show current values without operator intervention.
  - .7 Windowing environment to allow user to view several graphics simultaneously to permit analysis of building operation, system performance, display of graphic associated with alarm to be viewed without interrupting work in progress. If interface is unable to display several different types of display at same time, provide at minimum 2 OWS's.
  - .8 Utilize graphics package to generate system schematic diagrams as required in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation, and as directed by Departmental Representative. In addition provide graphics for schematic depicted on mechanical plan flow diagrams, point lists and system graphics. Provide graphic for floor depicting room sensors and control devices located in their actual location. For floor graphic include secondary diagram to show TCU-VAV box actuator and flow sensor. Diagram to be single line schematic of ductwork as well as associated heating coil or radiation valve. Departmental Representative to provide CAD floor layouts. Provide display of TCU -VAV's in table form, include following values as minimum; space temp, setpoint, mode, actual flow, min flow setpoint, max flow setpoint, cooling signal
-

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2.5 OWS CONTROL  
SOFTWARE  
(Cont'd)

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- .12 Graphics Display Module:(Cont'd)
    - .8 (Cont'd)  
value, and heating signal value. Organize table by rooms and floor groupings.
    - .9 Provide complete directory of system graphics, including other pertinent system information. Utilize mouse or pointing device to "point and click" to activate selected graphic.
    - .10 Provide unique sequence of operation graphic or pop-up window for each graphic that is depicted on OWS. Provide access to sequence of operation graphic by link button on each system graphic. Provide translation of sequence of operation, a concise explanation of systems operation, from control descriptive logic into plain English and/or French language.
  - .13 Event/Alarm Module : displays in window alarms as received and stored in General Event Log.
    - .1 Classify alarms as "critical", "cautionary", "maintenance". Alarms and alarm classifications to be designated by personnel requiring password level.
    - .2 Presentation of alarms to include features identified under applicable report definitions of Report Module paragraph.
    - .3 Alarm reports.
      - .1 Summary of points in critical, cautionary or maintenance alarm. Include at least point name, alarm type, current value, limit exceeded.
      - .2 Analog alarm limit summary: include point name, alarm limits, deviation limits.
      - .3 Summary of alarm messages: include associated point name, alarm description.
    - .4 Software to notify operator of each occurrence of alarm conditions. Each point to have its own secondary alarm message.
    - .5 EMCS to notify operator of occurrence of alarms originating at field device within following time periods of detection:
      - .1 Critical - 5 seconds.
      - .2 Cautionary - 10 seconds.
      - .3 Maintenance - 10 seconds.
    - .6 Display alarm messages in English and French.
    - .7 Primary alarm message to include as minimum: point identifier, alarm classification, time of occurrence, type of alarm. Provide for initial message to be automatically presented to operator whenever
-

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2.5 OWS CONTROL  
SOFTWARE  
(Cont'd)

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- .13 Event/Alarm Module :(Cont'd)
- .7 (Cont'd)  
associated alarm is reported. Assignment of secondary messages to point to be operator-editable function. Provide secondary messages giving further information (telephone lists, maintenance functions) on per point basis.
- .8 System reaction to alarms: provide alarm annunciation by dedicated window (activated to foreground on receipt of new alarm or event) of OWS with visual and audible hardware indication. Acknowledgement of alarm to change visual indicator from flashing to steady state and to silence audible device. Acknowledgment of alarm to be time, date and operator stamped and stored in General Event Log. Steady state visual indicator to remain until alarm condition is corrected but must not impede reporting of new alarm conditions. Notification of alarm not to impede notification of subsequent alarms or function of Controller's/CDL. Do not allow random occurrence of alarms to cause loss of alarm or over-burden system. Do not allow acknowledgment of one alarm as acknowledgement of other alarms.
- .9 Controller network alarms: system supervision of controllers and communications lines to provide following alarms as minimum:
- .1 Controller not responding - where possible delineate between controller and communication line failure.
- .2 Controller responding - return to normal.
- .3 Controller communications bad - high error rate or loss of communication.
- .4 Controller communications normal - return to normal.
- .10 Digital alarm status to be interrogated every 2 seconds as minimum or be direct interrupting non-polling type (COV). Annunciate each non-expected status with alarm message.
- .14 Archiving and Restoration Module.
- .1 Primary OWS to include services to store back-up copies of controller databases. Perform complete backup of OWS software and data files at time of system installation and at time of final acceptance. Provide backup copies before and after Controller's revisions or major modifications.
- .2 Provide continuous integrity supervision of controller data bases. When controller
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2.5 OWS CONTROL  
SOFTWARE  
(Cont'd)

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- .14 (Cont'd)
  - .2 (Cont'd)  
encounters database integrity problems with its data base, system to notify operator of need to download copy data base to restore proper operation.
  - .3 Ensure data base back-up and downloading occurs over LAN without specialized operator technical knowledge. Provide operator with ability to manually download entire controller data base, or parts thereof as required.
- .15 CDL Generator and Modifier Module.
  - .1 CDL Generator module to permit generation and modification of CDLs.
  - .2 Provide standard reference modules for text based systems module that will permit modification to suit site specific applications. Module to include cut, paste, search and compare utilities to permit easy CDL modification and verification.
  - .3 Provide full library of symbols used by manufacturer for system product installed accessible to operators for systems using graphical environment for creation of CDLs Module to include graphic tools required to generate and create new object code for downloading to building controllers.
  - .4 Module to permit testing of code before downloading to building controllers.

2.6 ADDITIONAL  
UTILITY SOFTWARE

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- .1 Supply and install on primary OWS, following CAD software products by Autodesk Inc. and include:
    - .1 AutoCAD LT latest version.
    - .2 Include special drivers, fonts, to ensure complete and proper functioning of software packages specified. Deliver system complete with full set of User Manuals.
    - .3 Enter soft copy submissions, including "Record" drawings specified in Section 25 05 03 - EMCS: Project Record Documents in OWS.
    - .4 Enter soft copy of Architectural, Electrical, Mechanical systems plans and "Record" drawings in OWS. Plans and drawings to be provided by Departmental Representative.
-

PART 3 - EXECUTION3.1 INSTALLATION  
REQUIREMENTS

- .1 Provide necessary power as required from local 120 V emergency power branch circuit panels for OWS's and peripheral equipment.
  - .1 Install tamper locks on breakers of circuit panels.
  - .2 Refer to UPS requirements stated under OWS Hardware in PART 2.



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PART 1 - GENERAL1.1 RELATED  
REQUIREMENTS

- .1 Section 25 05 01 - EMCS: General Requirements.
- .2 Section 25 05 02 - EMCS: Submittals and Review Process.
- .3 Section 25 05 03 - EMCS: Project Record Documents.
- .4 Section 25 30 02 - EMCS: Field Control Devices.
- .5 Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequence of Operation.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
  - .1 ASHRAE 2003, Applications Handbook, SI Edition.
- .2 Canadian Standards Association (CSA International).
  - .1 C22.2 No.205-M1983(R1999), Signal Equipment.
- .3 Institute of Electrical and Electronics Engineers (IEEE).
  - .1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
- .4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
  - .1 MD250005-2009, Energy Monitoring and Control Systems (EMCS) Design Guidelines

1.3 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 DESCRIPTION

- .1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated in System Architecture Diagram to support building systems and
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- 1.4 DESCRIPTION  
(Cont'd)
- 
- .1 General:(Cont'd)  
associated sequence(s) of operations as detailed in these specifications.  
.1 Provide sufficient controllers to meet intents and requirements of this section.  
.2 Controller quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.
- .2 Controllers: stand-alone intelligent Control Units.  
.1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.  
.2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.  
.3 Capable of interfacing with operator interface device.  
.4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).  
.1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
- 1.5 DESIGN REQUIREMENTS
- 
- .1 To include:  
.1 Scanning of AI and BI connected inputs for detection of change of value and processing detection of alarm conditions.  
.2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.  
.3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.  
.4 Control of systems as described in sequence of operations.  
.5 Execution of optimization routines as listed in this section.
- .2 Total spare capacity for MCUs and LCUs: at least 25 % of each point type distributed throughout the MCUs and LCUs.
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1.5 DESIGN  
REQUIREMENTS  
(Cont'd)

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- .3 Field Termination and Interface Devices:
  - .1 To: CSA C22.2 No.205.
  - .2 Electronically interface sensors and control devices to processor unit.
  - .3 Include, but not be limited to, following:
    - .1 Programmed firmware or logic circuits to meet functional and technical requirements.
    - .2 Power supplies for operation of logics devices and associated field equipment.
    - .3 Lockable wall cabinet.
    - .4 Required communications equipment and wiring (if remote units).
    - .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
    - .6 Input Output interface to accept as minimum AI, AO, BI, BO functions as specified.
    - .7 Wiring terminations: use conveniently located screw type or spade lug terminals.
- .4 AI interface equipment to:
  - .1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.
  - .2 Provide for following input signal types and ranges:
    - .1 4 - 20 mA;
    - .2 0 - 10 V DC;
    - .3 100/1000 ohm RTD input;
  - .3 Meet IEEE C37.90.1 surge withstand capability.
  - .4 Have common mode signal rejection greater than 60 dB to 60 Hz.
  - .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
- .5 AO interface equipment:
  - .1 Convert digital data from controller processor to acceptable analog output signals using 10 bit digital-to-analog resolution.
  - .2 Provide for following output signal types and ranges:
    - .1 4 - 20 mA.
    - .2 0 - 10 V DC.
  - .3 Meet IEEE C37.90.1 surge withstand capability.

1.5 DESIGN  
REQUIREMENTS  
(Cont'd)

- .3 (Cont'd)
- .6 BI interface equipment:
  - .1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
  - .2 Meet IEEE C37.90.1 surge withstand capability.
  - .3 Accept pulsed inputs up to 2 kHz.
- .7 DO interface equipment:
  - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
  - .2 Switch up to 5 amps at 220 V AC using optional interface relay.
- .4 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.
- .5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.
  - .1 Provide for conduit entrance from top, bottom or sides of panel.
  - .2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.
  - .3 Mounting details as approved by Departmental Representative for ceiling mounting.
- .6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .7 Provide surge and low voltage protection for interconnecting wiring connections.

1.6 ACTION AND  
INFORMATIONAL  
SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Submittals and Review Process.
  - .1 Submit product data sheets for each product item proposed for this project.

1.7 MAINTENANCE

- .1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.

PART 2 - PRODUCTS

- 2.1 MASTER CONTROL UNIT (MCU)
- .1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.
  - .2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.
    - .1 MCU must support BACnet.
    - .2 MCU must support Ethernet VPN connection for remote access via the Internet.
  - .3 MCU local I/O capacity as follows:
    - .1 LCUs may be added to support system functions.
  - .4 Central Processing Unit (CPU).
    - .1 Processor to consist of minimum 32 bit microprocessor capable of supporting software to meet specified requirements.
    - .2 CPU idle time to be more than 30 % when system configured to maximum input and output with worst case program use.
    - .3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:
      - .1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software.
      - .2 Battery backed (7 day minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.
    - .4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 7 day operation in event of power failure.
-

- 
- |  |   |
|--|---|
| <u>2.2 LOCAL CONTROL<br/>UNIT (LCU)</u>                          | <ul style="list-style-type: none"><li>.1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.</li><li>.2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 BIs, 4 BOs.</li><li>.3 Points integral to one Building System to be resident on only one controller.</li><li>.4 32 bit microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:<ul style="list-style-type: none"><li>.1 Include minimum 2 interface ports for connection of local computer terminal.</li><li>.2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.</li><li>.3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.</li><li>.4 Include power supplies for operation of LCU and associated field equipment.</li><li>.5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.</li><li>.6 Provide conveniently located screw type or spade lug terminals for field wiring.</li></ul></li></ul> |
| <u>2.3<br/>TERMINAL/EQUIPMENT<br/>CONTROL UNIT<br/>(TCU/ECU)</u> | <ul style="list-style-type: none"><li>.1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.<ul style="list-style-type: none"><li>.1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.</li></ul></li><li>.2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.</li><li>.3 VAV Terminal Controller.<ul style="list-style-type: none"><li>.1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and</li></ul></li></ul>   |
-

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- 2.3  
TERMINAL/EQUIPMENT  
CONTROL UNIT  
(TCU/ECU)  
(Cont'd)
- .3 (Cont'd)
- .1 (Cont'd)  
measure temperatures as per I/O Summary  
required inputs. Sequence of operation to  
ASHRAE HVAC Applications Handbook.
- .2 Controller to support point definition;  
in accordance with Section 25 05 01 - EMCS:  
General Requirements.
- .3 Controller to operate independent of  
network in case of communication failure.
- .4 Controller to include damper actuator  
and terminations for input and output sensors  
and devices.
- .5 TCU must be programmable in order to be  
adaptable to the sequence of operation  
required in these specifications.
- .6 TCU must support BACnet protocol at this  
level.
- 2.4 SOFTWARE
- .1 General.
- .1 Include as minimum: operating system  
executive, communications, application  
programs, operator interface, and systems  
sequence of operation - CDL's.
- .2 Include "firmware" or instructions which  
are programmed into ROM, EPROM, EEPROM or  
other non-volatile memory.
- .3 Include initial programming of  
Controllers, for entire system.
- .4 Software must support BACnet protocol.
- .2 Program and data storage.
- .1 Store executive programs and site  
configuration data in ROM, EEPROM or other  
non-volatile memory.
- .2 Maintain CDL and operating data  
including setpoints, operating constants,  
alarm limits in battery-backed RAM or EEPROM  
for display and modification by operator.
- .3 Programming languages.
- .1 Program Control Description Logic  
software (CDL) using English like or  
graphical, high level, general control  
language.
- .2 Structure software in modular fashion to  
permit simple restructuring of program modules  
if future software additions or modifications  
are required. GO TO constructs not allowed  
unless approved by Departmental  
Representative.
-

## 2.4 SOFTWARE (Cont'd)

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- .4 Operator Terminal interface.
    - .1 Operating and control functions include:
      - .1 Multi-level password access protection to allow user/manager to limit workstation control.
      - .2 Alarm management: processing and messages.
      - .3 Operator commands.
      - .4 Reports.
      - .5 Displays.
      - .6 Point identification.
  - .5 Pseudo or calculated points.
    - .1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.
    - .2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).
  - .6 Control Description Logic (CDL):
    - .1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.
    - .2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.
    - .3 Perform changes to CDL on-line.
    - .4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.
    - .5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.
    - .6 MCU, TCU and LCU to be able to perform following pre-tested control algorithms:
      - .1 Two position control.
      - .2 Proportional Integral and Derivative (PID) control.
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## 2.4 SOFTWARE (Cont'd)

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- .6 Control Description Logic (CDL):(Cont'd)
    - .7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.
    - .8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
    - .9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.
  - .7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.
  - .8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.
    - .1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:
      - .1 Time of day scheduling.
      - .2 Calendar based scheduling.
      - .3 Holiday scheduling.
      - .4 Temporary schedule overrides.
      - .5 Optimal start stop.
      - .6 Night setback control.
      - .7 Enthalpy (economizer) switchover.
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- 2.4 SOFTWARE  
(Cont'd)
- 
- .8 Energy management programs:(Cont'd)
- .1 (Cont'd)
- .8 Peak demand limiting.
- .9 Temperature compensated load rolling.
- .10 Fan speed/flow rate control.
- .11 Cold deck reset.
- .12 Hot deck reset.
- .13 Hot water reset.
- .14 Chilled water reset.
- .15 Condenser water reset.
- .16 Chiller sequencing.
- .17 Night purge.
- .2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.
- .3 Apply programs to equipment and systems as specified or requested by the Departmental Representative.
- .9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.
- .1 MCUs to accumulate and store automatically run-time for binary input and output points.
- .2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.
- .3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
- .4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.
- .5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (eg. kWH, litres, tonnes, etc.).
- .6 Store event totalization records with minimum of 9,999,999 events before reset.
- .7 User to be able to define warning limit and generate user-specified messages when limit reached.
- 2.5 LEVELS OF  
ADDRESS
- 
- .1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.
-

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- 2.5 LEVELS OF ADDRESS  
(Cont'd)
- .1 (Cont'd)
- .1 Display analog values digitally to 1 place of decimals with negative sign as required.
  - .2 Update displayed analog values and status when new values received.
  - .3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
  - .4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

- 2.6 POINT NAME SUPPORT
- .1 Controllers (MCU, LCU) to support PWGSC point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

### PART 3 - EXECUTION

- 3.1 LOCATION
- .1 Location of Controllers to be approved by Departmental Representative.

- 3.2 INSTALLATION
- .1 Install Controllers in secure locking enclosures as indicated or as directed by Departmental Representative.
  - .2 Provide necessary power from local 120V branch circuit panel for equipment.
  - .3 Install tamper locks on breakers of circuit breaker panel.
  - .4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

PART 1 - GENERAL1.1 RELATED  
REQUIREMENTS

- .1 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
- .2 Section 25 05 01 - EMCS: General Requirements.
- .3 Section 25 05 02 - EMCS: Submittals and Review Process.
- .4 Section 25 05 54 - EMCS: Identification.
- .5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI).
  - .1 ANSI C12.7-2005, Requirements for Watthour Meter Sockets.
  - .2 ANSI/IEEE C57.13-2008, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM B 148-97(2009), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
  - .1 NEMA 250-2008, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
  - .1 AMCA Standard 500-D-12, Laboratory Method of Testing Dampers For Rating.
- .5 Canadian Standards Association (CSA International).
  - .1 CSA-C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.
-

1.4 ACTION AND  
INFORMATIONAL  
SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Pre-Installation Tests.
  - .1 Submit samples at random from equipment shipped, as requested by Departmental Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.
- .3 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.5 EXISTING  
CONDITIONS

- .1 Cutting and Patching: in accordance with Section 01 73 00 - Execution Requirements supplemented as specified herein.
- .2 Repair surfaces damaged during execution of Work.
- .3 Turn over to Departmental Representative existing materials removed from Work not identified for re-use.

PART 2 - PRODUCTS2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
  - .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.
  - .3 Operating conditions: 0 - 32 degrees C with 10 - 90% RH (non-condensing) unless otherwise specified.
  - .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
  - .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
-

2.1 GENERAL  
(Cont'd)

- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

2.2 TEMPERATURE  
SENSORS

- .1 General: except for room sensors to be resistance or thermocouple type to following requirements:
  - .1 Thermocouples: limit to temperature range of 200 degrees C and over.
  - .2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
  - .3 Sensing element: hermetically sealed.
  - .4 Stem and tip construction: copper or type 304 stainless steel.
  - .5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.
  - .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 150 mm as indicated.
- .2 Room temperature sensors and display wall modules.
  - .1 Temperature sensing and display wall module.
    - .1 LCD display to show space temperature and temperature setpoint.
    - .2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
    - .3 Jack connection for plugging in laptop personal computer contractor supplied zone terminal unit and contractor supplied palm compatible handheld device for access to zone bus.

- 
- 2.2 TEMPERATURE SENSORS  
(Cont'd)
- .2 (Cont'd)
- .1 (Cont'd)
- .4 Integral thermistor sensing element 10,000 ohm at 24 degrees.
- .5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
- .6 Stability 0.02 degrees C drift per year.
- .7 Separate mounting base for ease of installation.
- .2 Room temperature sensors.
- .1 Wall mounting, in slotted type covers having brushed stainless steel finish, with guard as indicated.
- .2 Element 10-50 mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.
- .3 Duct temperature sensors:
- .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460 mm or as indicated.
- .2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.
- .4 Outdoor air temperature sensors:
- .1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure.
- 2.3 CARBON DIOXIDE (CO2) SENSOR/  
TRANSMITTER
- .1 Requirements: Combined sensor and transmitter measuring carbon dioxide.
- .1 Sensor type: Non-Dispersive Infrared. (NDIR)
- .2 Output signal; 4-20ma, 0-10 Vdc
- .3 Accuracy:  $\pm 2\%$  of range..
- .4 Repeatability:  $\pm 20$  ppm.
- .5 Range: 0-2000
- .6 Operating temperature range: 10°C to 50°C.
- .7 Operating humidity range: 0-95% RH non-condensing.
- .8 Enclosure: ABS
- .9 Mounting: duct
-

2.4 TEMPERATURE  
TRANSMITTERS.1 Requirements:

- .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
- .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.
- .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .4 Input and output short circuit and open circuit protection.
- .5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.
- .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.
- .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
- .8 Integral zero and span adjustments.
- .9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 50degrees C.
- .10 Long term output drift: not to exceed 0.25 % of full scale/ 6 months.
- .11 Transmitter ranges: select narrowest range to suit application from following:
  - .1 Minus 50 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.
  - .2 0 to 100 degrees C, plus or minus 0.5 degrees C.
  - .3 0 to 50 degrees C, plus or minus 0.25 degrees C.
  - .4 0 to 25 degrees C, plus or minus 0.1 degrees C.
  - .5 10 to 35 degrees C, plus or minus 0.25 degrees C.

2.5 HUMIDITY  
SENSORS.1 Room and Duct Requirements:

- .1 Range: 5 - 90% RH minimum.
- .2 Operating temperature range: 0 - 60 degrees C.
- .3 Absolute accuracy:
  - .1 Duct sensors: plus or minus 3%.
  - .2 Room sensors: plus or minus 2%.
- .4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.
- .5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.
- .6 Room sensors: locate in air stream near RA grille. Wall mounted as indicated.



2.5 HUMIDITY  
SENSORS  
(Cont'd)

- .1 (Cont'd)
  - .7 Duct mounted sensors: locate so that sensing element is in air flow in duct.
- .2 Outdoor Humidity Requirements:
  - .1 Range: 0 - 100% RH minimum.
  - .2 Operating temperature range: -40 to 50 degrees C.
  - .3 Absolute accuracy: plus or minus 2%.
  - .4 Temperature coefficient: plus or minus 0.03%RH/ degrees C over 0 to 50 degrees C.
  - .5 Must be unaffected by condensation or 100% saturation.
  - .6 No routine maintenance or calibration is required.

2.6 HUMIDITY  
TRANSMITTERS

- .1 Requirements:
  - .1 Input signal: from RH sensor.
  - .2 Output signal: 4 - 20 mA onto 500 ohm maximum load.
  - .3 Input and output short circuit and open circuit protection.
  - .4 Output variations: not to exceed 0.2 % of full scale output for supply voltage variations of plus or minus 10 %.
  - .5 Output linearity error: plus or minus 1.0% maximum of full scale output.
  - .6 Integral zero and span adjustment.
  - .7 Temperature effect: plus or minus 1.0 % full scale/ 6 months.
  - .8 Long term output drift: not to exceed 0.25 % of full scale output/ 6 months.

2.7 PRESSURE  
TRANSDUCERS

- .1 Requirements:
  - .1 Combined sensor and transmitter measuring pressure.
    - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
  - .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
  - .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
  - .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.

2.7 PRESSURE  
TRANSDUCERS  
(Cont'd)

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- .1 Requirements:(Cont'd)
- .5 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
  - .6 Over-pressure input protection to at least twice rated input pressure.
  - .7 Output short circuit and open circuit protection.
  - .8 Accuracy: plus or minus 1% of Full Scale.

2.8 DIFFERENTIAL  
PRESSURE  
TRANSMITTERS

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- .1 Requirements:
- .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
  - .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
  - .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
  - .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
  - .5 Integral zero and span adjustment.
  - .6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
  - .7 Over-pressure input protection to at least twice rated input pressure.
  - .8 Output short circuit and open circuit protection.
  - .9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.9 STATIC PRESSURE .1  
SENSORS

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- Requirements:
- .1 Multipoint element with self-averaging manifold.
    - .1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).
  - .2 Accuracy: plus or minus 1 % of actual duct static pressure.
-

2.10 STATIC PRESSURE.1  
TRANSMITTERS

## Requirements:

- .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
- .2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.
- .3 Accuracy: 0.4 % of span.
- .4 Repeatability: within 0.5 % of output.
- .5 Linearity: within 1.5 % of span.
- .6 Deadband or hysteresis: 0.1% of span.
- .7 External exposed zero and span adjustment.
- .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

2.11 VELOCITY .1  
PRESSURE SENSORS

## Requirements:

- .1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.
- .2 Maximum pressure loss: 37Pa at 1000 m/s.
- .3 Accuracy: plus or minus 1% of actual duct velocity.

2.12 VELOCITY .1  
PRESSURE  
TRANSMITTERS

## Requirements:

- .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
- .2 Calibrated span: not to exceed 125% of duct velocity pressure at maximum flow.
- .3 Accuracy: 0.4% of span.
- .4 Repeatability: within 0.1% of output.
- .5 Linearity: within 0.5% of span.
- .6 Deadband or hysteresis: 0.1% of span.
- .7 External exposed zero and span adjustment.
- .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.13 LIQUID AND .1  
STEAM FLOW METERS

## Requirements:

- .1 Pressure rating: as specified in I/O summaries.
- .2 Temperature rating: as specified in I/O summaries.
- .3 Repeatability: plus or minus 0.2%.

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2.13 LIQUID AND STEAM FLOW METERS (Cont'd)	.1	Requirements:(Cont'd) .4 Accuracy and linearity: plus or minus 1.0%. .5 Flow rangability: at least 10:1. .6 Ends: .1 NPS 2 and under: screwed. .2 NPS 2.1/2 and over: flanged.
2.14 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES	.1	Requirements: .1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable. .2 Adjustable setpoint and differential. .3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC. .4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure. .5 Accuracy: within 2% repetitive switching. .6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source. .7 Switches on steam and high temperature hot water service: provide pigtail syphon.
2.15 TEMPERATURE SWITCHES	.1	Requirements: .1 Operate automatically. Reset automatically, except as follows: .1 Low temperature detection: manual reset. .2 High temperature detection: manual reset. .2 Adjustable setpoint and differential. .3 Accuracy: plus or minus 1 degree C. .4 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections. .5 Type as follows: .1 Room: for wall mounting on standard electrical box with protective guard as indicated. .2 Duct, general purpose: insertion length = 460 mm. .3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.

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- 2.15 TEMPERATURE SWITCHES  
(Cont'd)
- .1 Requirements:(Cont'd)
- .5 Type as follows:(Cont'd)
- .4 Low temperature detection:  
continuous element with 6000 mm insertion  
length, duct mounting, to detect coldest  
temperature in any 30 mm length.
- .5 Strap-on: with helical screw  
stainless steel clamp.
- 2.16 TANK LEVEL SWITCHES
- .1 Requirements:
- .1 Indicate high/low water level and to  
alarm.
- .2 For mounting on top of tank.
- .3 Maximum operating temperature: 120  
degrees C.
- .4 Snap action contacts rated 15 amp at 120  
V.
- .5 Adjustable setpoint and differential.
- 2.17 SUMP LEVEL SWITCHES
- .1 Requirements:
- .1 Liquid level activated switch sealed in  
waterproof and shockproof enclosure.
- .2 Complete with float, flexible cord,  
weight. Instrument casing to be suitable for  
immersion in measured liquid.
- .3 N.O./N.C. Contacts rated at 15 amps at  
120V AC. CSA approval for up to 250 volt 10  
amps AC.
- 2.18 WIND VELOCITY TRANSMITTERS
- .1 Requirements:
- .1 3-cup anemometer and airfoil vane  
mounted on common vertical axis, designed for  
mast mounting.
- .2 Anemometer:
- .1 Range: 0-160 km/h.
- .2 Threshold: 3.0 km/h.
- .3 Accuracy: +/- 2%.
- .3 Airfoil vane
- .1 Range: 0-360 degrees with infinite  
resolution potentiometer with no loss of  
reading at transition point.
- .2 Starting threshold: 1.1 M/s.
- .3 Accuracy: +/- 0.5%.
- .4 Output signals: 4 to 20Ma into 500  
ohm load.
-

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- 2.18 WIND VELOCITY TRANSMITTERS  
(Cont'd)
- .1 Requirements:(Cont'd)
- .3 (Cont'd)
- .5 Provide two output signals: velocity, direction.
- .6 Mast: aluminum, size and height as indicated.
- .1 Provide at least 3 stainless steel guys, turnbuckles, anchor bolts. Follow manufacturers installation guidelines.
- .2 Lightning protection as indicated on electrical drawings.
- 2.19 SOLAR SENSORS
- .1 Monitor solar radiation as indicated.
- .2 Pyranometer, black and white, producing proportional 0-50 mV signal. Include converter for 4-20 mA signal.
- 2.20 CURRENT / PNEUMATIC (I/P) TRANSDUCERS
- .1 Requirements:
- .1 Input range: 4 to 20 mA.
- .2 Output range: proportional 20-104 kPa or 20-186 kPa as applicable.
- .3 Housing: dustproof or panel mounted.
- .4 Internal materials: suitable for continuous contact with industrial standard instrument air.
- .5 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 2 % of full scale over entire range.
- .6 Integral zero and span adjustment.
- .7 Temperature effect: plus or minus 2.0 % of full scale/ 50degrees C or less.
- .8 Regulated supply pressure: 206 kPa maximum.
- .9 Air consumption: 16.5 ml/s maximum.
- .10 Integral gauge manifold c/w gauge (0-206 kPa).
- 2.21 SOLENOID CONTROL AIR VALVES
- .1 Coil: 120V AC or 24V DC, as indicated.
- .2 Capacity: to pass a minimum of 0.15 l/s air at 140 kPa differential.
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2.22 AIR PRESSURE GAUGES	<div><div>.1</div><div>.2</div></div>	<div>Diameter: 38 mm minimum.</div> <div>Range: zero to two times operating pressure of measured pressure media or nearest standard range.</div>
2.23 ELECTROMECHANICAL RELAYS	<div><div>.1</div><div><div>.1</div><div>.2</div><div>.3</div><div>.4</div></div></div>	<div>Requirements:</div> <div><div>.1 Double voltage, DPDT, plug-in type with termination base.</div><div>.2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.</div><div>.3 Contacts: rated at 5 amps at 120 V AC.</div><div>.4 Relay to have visual status indication</div></div>
2.24 SOLID STATE RELAYS	<div><div>.1</div><div><div><div>.1</div><div>.2</div><div>.3</div><div>.4</div><div>.5</div><div>.6</div><div>.7</div></div><div>.2</div><div>.3</div></div></div>	<div>General:</div> <div><div>.1 Relays to be socket or rail mounted.</div><div>.2 Relays to have LED Indicator</div><div>.3 Input and output Barrier Strips to accept 14 to 28 AWG wire.</div><div>.4 Operating temperature range to be -20 degrees C to 70 degrees C.</div><div>.5 Relays to be CSA Certified.</div><div>.6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.</div><div>.7 Operational frequency range, 45 to 65 HZ.</div></div> <div><div>.2 Input:<div><div>.1 Control voltage, 3 to 32 VDC.</div><div>.2 Drop out voltage, 1.2 VDC.</div><div>.3 Maximum input current to match AO (Analog Output) board.</div></div></div><div>.3 Output.<div><div>.1 AC or DC Output Model to suit application.</div></div></div></div>
2.25 CURRENT TRANSDUCERS	<div><div>.1</div><div>.2</div></div>	<div>Requirements:</div> <div>Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:<div><div>.1 4-20 mA DC.</div><div>.2 0-1 volt DC.</div><div>.3 0-10 volts DC.</div><div>.4 0-20 volts DC.</div></div></div>

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2.25 CURRENT  
TRANSDUCERS  
(Cont'd)

- .3 Frequency insensitive from 10 - 80 hz.
- .4 Accuracy to 0.5% full scale.
- .5 Zero and span adjustments. Field adjustable range to suit motor applications.
- .6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.26 CURRENT  
SENSING RELAYS

- .1 Requirements:
  - .1 Suitable to detect belt loss or motor failure.
  - .2 Trip point adjustment, output status LED.
  - .3 Split core for easy mounting.
  - .4 Induced sensor power.
  - .5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
  - .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
  - .7 Adjustable latch level.

2.27 CONTROL  
DAMPERS

- .1 Construction: blades, 152 mm wide, 1219 mm long, maximum. Modular maximum size, 1219 mm wide x 1219 mm high. Three or more sections to be operated by jack shafts.
- .2 Materials:
  - .1 Frame: 2.03 mm minimum thickness extruded aluminum. For outdoor air and exhaust air applications, frames to be insulated.
  - .2 Blades: extruded aluminum. For outdoor air/exhaust air applications, blades to be internally insulated.
  - .3 Bearings: maintenance free, synthetic type of material.
  - .4 Linkage and shafts: aluminum, zinc and nickel plated steel.
  - .5 Seals: synthetic type, mechanically locked into blade edges.
    - .1 Frame seals: synthetic type, mechanically locked into frame sides.
- .3 Performance: minimum damper leakage meet or exceed AMCA Standard 500-D ratings.
  - .1 Size/Capacity: refer to damper schedule



2.27 CONTROL  
DAMPERS  
(Cont'd)

- .3 Performance:(Cont'd)
  - .2 25 L/s/m<sup>2</sup> maximum allowable leakage against 1000 Pa static pressure for outdoor air and exhaust air applications.
  - .3 Temperature range: minus 40 degrees C to plus 100 degrees C.
- .4 Arrangements: dampers mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.
- .5 Jack shafts:
  - .1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shaft and operate dampers throughout their range.
  - .2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.
  - .3 Install using manufacturers installation guidelines.
  - .4 Use same manufacturer as damper sections.

2.28 PNEUMATIC  
CONTROL DAMPER  
ACTUATORS

- .1 Requirements:
  - .1 Piston type with spring return for "fail-safe" in Normally Open or Normally Closed position, as indicated.
  - .2 Operator: size to control dampers against maximum pressure and dynamic opening/closing pressure, whichever is greater.
  - .3 Adjustable spring and stroke external stops to limit strokes in either direction.
  - .4 For modulating applications provide with full relay type positioner with interconnecting linkage for mechanical feedback. Adjust to operate between range of 20-90 kPa unless otherwise indicated in control sequence of operation or input/output summary sheet.
  - .5 Positioners not required on single damper sections with less than 1 m<sup>2</sup> face area.

2.29 ELECTRONIC  
CONTROL DAMPER  
ACTUATORS

- .1 Requirements:
- .1 Direct mount proportional type as indicated.
  - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
  - .3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
  - .4 Power requirements: 5 VA maximum at 24 V AC.
  - .5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
  - .6 For VAV box applications floating control type actuators may be used.
  - .7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.30 CONTROL VALVES

- .1 Body: globe style, characterized ball.
- .1 Flow characteristic as indicated on control valve schedule: linear, equal percentage, quick opening.
  - .2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
  - .3 Normally open or Normally closed, as indicated.
  - .4 Two or Three port, as indicated.
  - .5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.
  - .6 Packing easily replaceable.
  - .7 Stem, stainless steel.
  - .8 Plug and seat bronze.
  - .9 Disc, replaceable, material to suit application.
  - .10 NPS 2 and under:
    - .1 Screwed National Pipe Thread (NPT) tapered female connections.
    - .2 Valves to ANSI Class 250, valves to bear ANSI mark.
    - .3 Rangeability 50:1 minimum.
  - .11 NPS 2½ and larger:
    - .1 Flanged connections.
    - .2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark.
    - .3 Rangeability 100:1 minimum.
- .2 Butterfly Valves NPS 2 and larger:
- .1 Body: for chilled water ANSI Class 150 cast iron lugged body and wafer body installed in locations as indicated. For steam and

2.30 CONTROL VALVES .2  
(Cont'd)

Butterfly Valves NPS 2 and larger:(Cont'd)

- .1 Body:(Cont'd)  
heating water ANSI Class 150 carbon steel  
lugged body and wafer body.
- .2 End connections to suit flanges that are  
ANSI Class 150.
- .3 Extended stem neck to provide adequate  
clearance for flanges and insulation.
- .4 Pressure limit: bubble tight sealing to  
170 kilopascals.
- .5 Disc/vane: 316 stainless steel, aluminum  
bronze to ASTM B 148.
- .6 Seat: for service on chilled water PTFE  
(polytetrafluoroethylene), EPDM (ethylene  
propylene diene monomer). For service on steam  
and heating water PTFE, RTFE (reinforced  
PTFE).
- .7 Stem: 316 stainless steel.
- .8 Flow factor (KV) as indicated on control  
valve schedule: CV in imperial units.
- .9 Flow characteristic linear.
- .10 Maximum flow requirement as indicated on  
control valve schedule.
- .11 Maximum pressure drop as indicated on  
control valve schedule: pressure drop not to  
exceed one half of inlet pressure.
- .12 Normally open or Normally closed, as  
indicated.
- .13 Valves are to be provided complete with  
mounting plate for installation of actuators.

2.31 INDUCTION UNIT .1  
CONTROL VALVES

Body: globe style.

- .1 Flow characteristic: equal percentage.
- .2 Flow factor (CV): 2.0.
- .3 Normally open.
- .4 Two port.
- .5 Body: Bronze or forged brass.
- .6 Leakage rate ANSI class IV, 0.01% of  
full open valve capacity.
- .7 Close-off pressures: 820 kPa. (160psi)
- .8 Packing easily replaceable.
- .9 Stainless steel trim.
- .10 Stainless steel stem.
- .11 Seat style: Metal to metal.
- .12 NPS 2 and under:
  - .1 15 mm screwed National Pipe Thread  
(NPT) tapered female connection x 15 mm  
union male connection.
  - .2 Valve body rating: ANSI Class 250,  
valves to bear ANSI mark.
  - .3 Rangeability 100:1 minimum.

2.32 PNEUMATIC  
VALVE ACTUATORS.1 Requirements:

- .1 Construction: steel, cast iron, aluminum.
- .2 Diaphragm: moulded Buna-N rubber, nylon reinforced.
- .3 Spring return to normal position.
- .4 Spring range adjustment and position indicator.
- .5 Provide pilot positioners on modulating control valves over 50 mm and where indicated on drawings and I/O summary. Positioners to operate between 20 to 90 kPa unless otherwise noted or required by sequence.
- .6 Minimum shut-off pressure: refer to control valve schedule.

2.33 ELECTRONIC /  
ELECTRIC VALVE  
ACTUATORS.1 Requirements:

- .1 Construction: steel, cast iron, or plastic
- .2 Control signal: 0 10V DC or 4-20 mA DC. (Floating control is not acceptable)
- .3 Positioning time: to suit application. 40 sec maximum.
- .4 Fail to normal open position.
- .5 Scale or dial indication of actual control valve position.
- .6 Manual override.
- .7 Nominal force 300 N (67 lb.)
- .8 Noise level running: Maximum 35 db.
- .9 Motor type: AC or DC Brushless.
- .10 Ambient operating temperature: 5°C to 50°C.
- .11 Ambient humidity: 0 to 90% RH, non-condensing.
- .12 Media temperature: 5°C to 120°C.
- .13 CSA certified.

2.34 WATTHOUR  
METERS AND CURRENT  
TRANSFORMERS.1 Requirements:

- .1 Include three phases, test and terminal blocks for watthour meter connections and connections for monitoring of current. Provide two transformers for 600 V 3 wire systems for watthour meter use. Accuracy: plus or minus 0.25% of full scale. For chiller applications: to have instantaneous indicator with analog or digital display.
  - .2 Watthour meter sockets: to ANSI C12.7.
  - .3 Potential and current transformers: to ANSI/IEEE C57.13.
-

- 
- |   |    |  |
|---|----|--|
| <u>2.34 WATTHOUR<br/>METERS AND CURRENT<br/>TRANSFORMERS<br/>(Cont'd)</u> | .1 | Requirements:(Cont'd)<br>.4 Potential transformers: provide two primary fuses.<br>.5 Demand meters: configure to measure demand at 15 minute intervals.  |
| <br>  |    |  |
| <u>2.35 SURFACE WATER<br/>DETECTORS</u>                                   | .1 | Requirements:<br>.1 Provide alarm on presence of water on floor.<br>.2 Expendable cartridge sensor.<br>.3 Internal waterproof switch.<br>.4 One set of dry contacts 2 amps at 24 V.<br>.5 Unaffected by moisture in air.<br>.6 Self-powered. |
| <br>  |    |  |
| <u>2.36 PANELS</u>  | .1 | Wall mounted enamelled steel cabinets with hinged and key-locked front door.   |
|   | .2 | Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Departmental Representative without adding additional cabinets.   |
|   | .3 | Panels to be lockable with same key.   |
| <br>  |    |  |
| <u>2.37 CONTROL AIR<br/>COMPRESSOR STATIONS</u>                           | .1 | Requirements: provide 2 high pressure, base mounted, each complete with belts, guards, intake muffler, replaceable cartridge intake cleaner, starter, pressure switches, alternator.   |
|   | .2 | Capacity: size to maintain air pressure, meet control air requirements on 25% maximum running time.  |
|   | .3 | Receiver: size to suit running time. Complete with electronic automatic drain with strainer, pressure relief valve, pressure gauge ASME code rated for 1400 kPa.   |
|   | .4 | Vibration isolation: 5 % transmissibility.   |
|   | .5 | Refrigerated air drier:<br>.1 2 continuous operating type, complete with refrigerant evaporator, mechanical condensate separator, installed with 2   |
-

2.37 CONTROL AIR  
COMPRESSOR STATIONS  
(Cont'd)

- .5 Refrigerated air drier:(Cont'd)
  - .1 (Cont'd)  
isolating valves. Designed for 1400 kPa maximum operating pressure.
  - .2 Capacity: sized for full capacity of compressors, to reduce dewpoint to minus 10 degrees C when dehydrating at 700 kPa. Maximum pressure drop 19kPa at rated capacity.
  - .3 Provide 2 filter and PRV assemblies, with isolating valves and filter element, having 99% efficiency in removal of 0.5 micron diameter solid particles and oil aerosols and with indication of degree of saturation.  
Piping: ensure one dryer is always in circuit and active.

2.38 WIRING

- .1 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring. Wiring not run in conduit to be installed tight to underside of floor above. There are to be no dips or sags in the wiring. Installation to be neat.
- .2 Wiring must be continuous without joints.
- .3 Sizes:
  - .1 Field wiring to digital device: #18AWG stranded twisted pair.
  - .2 Analog input and output: shielded #20 minimum stranded twisted pair.

PART 3 - EXECUTION3.1 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.

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### 3.1 INSTALLATION (Cont'd)

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- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
  - .5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 - Firestopping. Maintain fire rating integrity.
  - .6 Electrical:
    - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.
    - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
    - .3 Refer to electrical control schematics included as part of control design schematics on drawings. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning Work.
    - .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
    - .5 Install communication wiring in conduit.
      - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
      - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
      - .3 Maximum conduit fill not to exceed 40%.
      - .4 Design drawings do not show conduit layout.
    - .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.
  - .7 VAV Terminal Units: supply, install and adjust as required.
    - .1 Air probe, actuator and associated vav controls.
    - .2 Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.
    - .3 Co-ordinate air flow adjustments with balancing trade.
-

3.2 TEMPERATURE AND  
HUMIDITY SENSORS

- .1 Stabilize to ensure minimum field adjustments or calibrations.
  - .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
  - .3 Outdoor installation:
    - .1 Protect from solar radiation and wind effects by non-corroding shields.
    - .2 Install in NEMA 4 enclosures.
  - .4 Duct installations:
    - .1 Do not mount in dead air space.
    - .2 Locate within sensor vibration and velocity limits.
    - .3 Securely mount extended surface sensor used to sense average temperature.
    - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
    - .5 Support sensor element separately from coils, filter racks.
  - .5 Averaging duct type temperature sensors.
    - .1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
    - .2 Wire multiple sensors in series for low temperature protection applications.
    - .3 Wire multiple sensors separately for temperature measurement.
    - .4 Use software averaging algorithm to derive overall average for control purposes.
  - .6 Thermowells: install for piping installations.
    - .1 Locate well in elbow where pipe diameter is less than well insertion length.
    - .2 Thermowell to restrict flow by less than 30%.
    - .3 Use thermal conducting paste inside wells.
-



- |  |    |   |
|--|----|---|
| <u>3.3 PANELS</u>  | .1 | Arrange for conduit and tubing entry from top, bottom or either side.   |
|  | .2 | Wiring and tubing within panels: locate in trays or individually clipped to back of panel.  |
|  | .3 | Identify wiring and conduit clearly.  |
|  |    |   |
| <u>3.4 MAGNEHELIC<br/>PRESSURE INDICATORS</u>                                  | .1 | Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by Departmental Representative.          |
|  | .2 | Locations: as indicated.  |
|  |    |   |
| <u>3.5 PRESSURE AND<br/>DIFFERENTIAL<br/>PRESSURE SWITCHES<br/>AND SENSORS</u> | .1 | Install isolation valve and snubber on sensors between sensor and pressure source where code allows.  |
|  | .1 | Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.                              |
|  |    |   |
| <u>3.6 I/P TRANSDUCERS</u>   | .1 | Install air pressure gauge on outlet.   |
|  |    |   |
| <u>3.7 AIR PRESSURE<br/>GAUGES</u>   | .1 | Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators. |
|  | .2 | Install pressure gauge on output of auxiliary cabinet pneumatic devices.  |
|  |    |   |
| <u>3.8 IDENTIFICATION</u>  | .1 | Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.  |
|  |    |   |
| <u>3.9 AIR FLOW<br/>MEASURING STATIONS</u>                                     | .1 | Protect air flow measuring assembly until cleaning of ducts is completed.   |
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3.10 TESTING AND  
COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

PART 1 - GENERAL

- 1.1 REFERENCES .1 Public Works and Government Services Canada (PWGSC) / Real Property Branch / Architectural and Engineering Services.  
.1 MD250005-2009, Energy Monitoring and Control Systems (EMCS) Design Guidelines.
- 1.2 SEQUENCING .1 All equipment can be started manually or automatically by the BAS. The equipment is started automatically when in the auto position according to the schedule programmed in the BAS. All set points to be operator adjustable.
- .2 Interior AHUs For Schematic and point list refer to M26 and M38.  
.1 The outside air and return air dampers shall modulate above the minimum position, based on the discharge air temperature.  
.2 The economizer shall override the damper control to the minimum outside air position (Interior Unit #1 15.0%, Interior Unit #2 20.0%, Interior Unit #3 15.0% and Interior Unit #4 30.0%) when the enthalpy of the outside air exceeds that of the return air.  
.3 The mixed air low limit temperature to be set at 8°C.  
.4 When the outdoor air temperature is below the heating coil lockout limit of 4.4°C and supply fan SF-1 is running, the control valve shall modulate to maintain the heating loop set point of 11.1°C. When the outdoor air temperature is above the heating lockout limit of 4.4°C or the fan is off, the heating valve shall close.  
.5 The heating coil pump shall start when control valve has started to open or when outdoor air temperature is below 4.0°C, and remain be open while the outside air temperature is below 4.0°C. The freeze protection shall shut down the supply fan SF-1 when the leaving heating coil temperature falls to 3.0°C and shall provide alarm at the BAS. Outside air dampers to close 100%, heating valve to remain open and pump to remain operational.  
.6 The cooling system shall operate when supply fan SF-1 is running in occupied mode and the chilled water flow is proven. The cooling coil valve shall be modulated from the

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1.2 SEQUENCING  
(Cont'd)

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.2

(Cont'd)

.6 (Cont'd)

discharge air temperature sensor. The cooling loop set point shall be reset by the BAS to between 10.0°C and 20.0°C by monitoring supply air flow. On fan start-up, the cooling set point will be equal to adjustable start-up set point at 13.5°C for 20 minutes. If supply air flow exceeds its low or high limits, then the cooling set point will be reset warmer or colder by 0.5°C every 20 minutes until the supply air flow is within its limits. The set points, times, and values are adjustable.

.7 The humidifier control valve shall be modulated by the average of the space and return air humidity sensors to maintain the relative humidity set point. The supply air humidity shall be limited to 80% RH. During unoccupied periods, humidification shall lock off. The relative humidity set point shall be adjustable to the following conditions:

.1 OAT = -20.0°C, R.H. Setpoint = 25%

.2 OAT = 5.0°C, R.H. Setpoint = 30%

.8 Winter Supply air setpoint shall be 18°C and summer supply air setpoint shall be 14°C.

.9 Filter conditions shall be monitored at the BAS through differential pressure sensor.

.10 The supply fan SF-1 start/stop request shall be issued based on the calls from the network controller. Delay the morning start up until the perimeter units' morning warm up sequence is completed.

.11 When all the air handling units fans are off, the exhaust and main outdoor air dampers shall be closed.

.12 The supply fan's variable speed control drive shall be modulated from the duct static pressure sensor.

.13 Dampers to modulate open/close as required to maintain CO2 setpoint.

.14 Supply fan control to be overridden by high limit static pressure sensor when setpoint is exceeded. Unit to continue operating while maintaining high limit setpoint.

.15 Provide on Interior Unit graphic summary of % opening of the VAV boxes associated with the corresponding AHU. This information is to be used by operator for adjusting supply air temperature setpoint as required. Summary to include the following:

.1 # Boxes < 30%

.2 # Boxes > 70%

.3 Total # of Boxes

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1.2 SEQUENCING  
(Cont'd)

## .3 AHU 21

.1 The summer supply temperature shall be maintained by modulating the mixed air dampers and DX compressor in sequence in accordance with the highest space temperature sensor. Minimum summer supply air temperature to be 10 °C when maximum space temperature is 25°C. Maximum summer supply temperature to be 15°C when minimum space temperature is 18°C.

.2 When the outside air temperature exceeds 24°C the mixed air dampers shall revert to the calculated minimum position.

.3 The winter supply air temperature shall be varied in accordance with the lowest space sensor by control of the SCR. Maximum winter supply temperature to be 37°C when lowest space temperature is 18°C. Minimum winter supply temperature to be 20°C when highest space temperature is 25°C.

.4 Return air humidity shall be maintained by modulating the humidifier control valve. The relative humidity set point shall be adjustable to the following conditions:

.1 OAT = -20.0°C, R.H. Setpoint = 25%

.2 OAT = 5.0°C, R.H. Setpoint = 30%

.5 High limit thermostat located in return air shall stop system if return air temperature exceeds 57°C.

.6 Low limit thermostat shall stop system if mixed air temperature drops below 3°C.

Outside air dampers to close and fans to stop.

.7 During unoccupied hours, the mixed air dampers shall be in full recirculation mode.

.8 Filter conditions shall be monitored at the BAS through differential pressure sensor.

.9 The supply fan's variable speed control drive shall be modulated from the duct static pressure sensor.

.10 Supply fan control to be overridden by high limit static pressure sensor when setpoint is exceeded. Unit to continue operating while maintaining high limit setpoint.

.11 The supply fan start/stop request shall be issued based on the calls from the network controller. Delay the morning start up until the perimeter units' morning warm up sequence is completed.

.12 When all the air handling units fans are off, the exhaust and main outdoor air dampers shall be closed .

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1.2 SEQUENCING  
(Cont'd)

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- .4 Perimeter AHUs For schematic and point list.  
For schematic and point list refer M27 and M38.
- .1 The morning warm up mode occurs when return air temperature falls below 17.0°C. During the morning warm up mode start induction supply fans and return fans. Valves, dampers and pumps shall be activated. The discharge air temperature shall be reset linearly relative to the outside air temperature by modulating the heating and cooling coils valves in sequence. In heating mode at outside air temperature of -6.7°C the supply air temperature shall be at 48.8°C; at outside air temperature of 21.1° the supply air temperature shall be at 26.7°C. In cooling mode at outside air temperature of 25.6°C the supply air temperature shall be at 23.9°C; at outside air temperature of 32.2° the supply air temperature shall be at 12.8°C.
- .2 The supply air temperature in the summer shall be maintained as follows:
- .1 supply air temperature shall be maintained at 12.8°C by modulating the dampers and cooling coil valve in sequence;
- .2 the economizer shall override the damper control to the minimum outside air position when the enthalpy of outside air exceeds that of the return air;
- .3 the mixed air temperature shall be varied in accordance with calculation to provide the required minimum outside air at all times. Minimum setting shall be 4,000 L/s for perimeter AHU-1 and AHU-2, and 3,000 L/s for perimeter AHU-3. These valves are to be adjustable by the operator.
- .3 The supply air temperature in the winter shall be maintained as follows:
- .1 The supply air temperature in the winter shall be maintained at 13.0°C by modulating of the dampers and heating coil valve in sequence. The mixed air sensors shall assure a minimum percentage of outside air at all times through calculation.
- .2 Unit will be normally off at night except when the average of space temperature at any of the floors drops below 15.0°C at which time the perimeter unit shall start. Outside air dampers shall be fully closed and unit shall maintain 48.8°C supply air temperature. During this mode the return fans shall
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1.2 SEQUENCING  
(Cont'd)

- .4 (Cont'd)  
.3 (Cont'd)

also recirculate air in the building.  
Units will stop when space temperature rises above 18.0°C.

.4 Humidifier valve shall be modulated by the average of the space and return air humidity sensors to maintain the relative humidity set point. The supply air humidity shall be limited to 80% RH. During unoccupied periods humidification shall lock off. The relative humidity set point shall be scheduled from the outdoor air temperature as follows:

- .1 at outside temperature of minus 20.0°C the relative humidity set point shall be at 25% RH;  
.2 at outside temperature of 5.0°C the relative humidity set point shall be at 30% RH

.5 Filter conditions shall be monitored at the BAS through the differential pressure sensor.

.6 Dampers to modulate open/close as required to maintain CO2 setpoint.

.7 The freeze protection shall shutdown the unit when the low limit sensor falls below 3.0°C and shall provide an alarm to the BAS. Outside air dampers to close 100% and heating valve to remain open.

- .5 VAVs and Induction unit control. For schematic and points list refer to 1/M31 and M45.

.1 VAV Box Only

.1 VAV box damper modulates to maintain space temperature setpoint.

.2 VAV Box with Induction Unit.

.1 VAV box damper modulates to maintain space temperature setpoint.

.2 Induction unit control valve modulates the flow of chilled water in summer cooling mode to maintain space temperature setpoint.

.3 Induction unit control valve modulates the flow of heating water in winter heating mode to maintain space temperature setpoint.

.4 Induction unit control valve operation shall be reversed at the time of summer/winter mode changeover.

.5 Following Chart indicates VAV and induction unit valves to be controlled by the same controller:

1.2 SEQUENCING  
(Cont'd)

.5 (Cont'd)  
.2 (Cont'd)

Floor	West	South	East	North
2	X	X		
3	X	X		
4	X	X		
5	X	X		
6	X	X		
7	X	X	X	
8	X	X	X	
9	X	X	X	
10	X	X		
11	X	X		
12	X	X		
13	X	X		
14	X	X		
15	X	X		
16	X	X		
17	X	X		
18	X	X		
19	X	X		
20	X	X		
21	X	X		

.6 Individual floor volume control. For schematic and points list refer to M28 and M39.

.1 Flow station to monitor return air flow from each floor.

.2 The static pressure sensor located in the return air duct on each floor shall maintain 38 Pa negative pressure relative to the outside.

.3 Return air dampers on each floor to modulate as required to maintain static pressure setpoint.

.7 General return and exhaust fans. For schematic and points list refer to M28 and M39.

.1 Return air fans (RF-1 and RF-2) shall be started by BAS and shall run when any of the perimeter or interior AHU are running.

.2 The static pressure sensor located in the shaft at the 10th floor shall monitor pressure in the return air shaft. The static pressure sensor in the lobby shall maintain 25 Pa pressure in reference to the outside. This sensor is to be connected to both return air fans. On increase in lobby pressure, the return air inlet vanes shall modulate open. On further increase in lobby pressure, exhaust fan (EF-1) to start and modulate vanes until



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1.2 SEQUENCING  
(Cont'd)

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- .7 (Cont'd)
- .2 (Cont'd)
- lobby pressure setpoint is achieved. Upon start of EF-1, an alarm is to be sent to the BAS. When lobby setpoint is reached, EF-1 to stop.
- .3 Penthouse exhaust damper shall modulate to maintain 25 Pa in the main return plenum with reference to outside. Exhaust damper shall modulate as long as at least one supply fan is running.
- .4 The west side basement exhaust air damper is hard wired to open if one of the following is on:
- .1 transformer room exhaust fan;
  - .2 basement exhaust fan;
  - .3 ground floor free cooling;
  - .4 generator room exhaust fan.
- .8 Ground floor AHU. For schematics and points list refer to M29, M30, and M40.
- .1 On start signal outside air damper opens.
- .2 When bump switch is made, supply fan starts.
- .3 Return fan starts with one minute time delay.
- .4 The supply air temperature shall be varied by modulating the cooling coils and heating coil valves and outside air and return air dampers in sequence. In the summer mode three-way cooling coil valve remains open. The supply air temperature shall be varied in accordance with the following schedule:
- .1 Supply Air Setpoint: Winter Minimum 20.0°C, Space temperature Winter Minimum 15.0°C.
  - .2 Supply Air Setpoint: Winter Maximum 30.0°C, Space temperature Winter Maximum 25.0°C.
  - .3 Supply Air Setpoint: Summer Minimum 13.0°C, Space temperature Winter Minimum 12.0°C.
  - .4 Supply Air Setpoint: Summer Maximum 20.0°C, Space temperature Summer Maximum 30.0°C
- .5 The glycol pump shall start when heating coil valve has started to open and remain on when the outside air temperature in below 4.0°C.
- .6 The low limit thermostat shall stop the system if mixed air temperature drops below 3.0°C. Outside air dampers to close 100%, heating coil valve to remain open, and glycol pump to remain on.
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1.2 SEQUENCING  
(Cont'd)

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- .8 (Cont'd)
    - .7 The high limit thermostat shall stop the system if returned air temperature exceeds 57.0°C.
    - .8 Zone 3-way reheat coil valves shall be controlled through individual space sensors.
  - .9 Exhaust fans. For schematic and points list refer to 2/M31 and M45.
    - .1 Washroom exhaust fans:
      - .1 BAS shall start/stop exhaust fan according to schedule.
      - .2 When the fan starts the motorized damper opens.
      - .3 When the fan stops the motorized damper closes.
      - .4 BAS shall monitor the fan status.
    - .2 Smoke exhaust fans, kitchen fans, transformer room exhaust fan, and generator room exhaust fan:
      - .1 When the fan starts the motorized damper opens.
      - .2 When the fan stops the motorized damper closes.
      - .3 BAS shall only monitor the fan status.
  - .10 Ground floor cabinet unit heater. For schematic refer to 3/M31.
    - .1 The cabinet unit heater is activated via a thermostat located in the Ground floor main lobby vestibule.
    - .2 The cabinet unit heater shall not be controlled or monitored by the BAS.
  - .11 DEOC AHU-1 & MUA-1. For schematic and point list refer to M32 and M41.
    - .1 AHU-1
      - .1 The system is turned on according to occupancy schedule.
      - .2 When the fan is started, the status is monitored and alarm signal is sent to the BAS if a fault is detected.
      - .3 When the system is turned on, the humidifier is allowed to operate. The humidifier is modulated by the space humidity sensors.
      - .4 The discharge humidity sensor acts as a high limit and controls the humidifier in order to maintain the humidity level below 85%.
      - .5 Operation of the mechanical cooling shall be controlled in order to maintain the average room temperature at set point.
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1.2 SEQUENCING  
(Cont'd).11 (Cont'd).1 (Cont'd)

.6 The condenser status is sent to the BAS and an alarm is generated if a failure is detected.

.7 The supply air temperature sensor acts as a low limit and a high limit, sending an alarm signal to the BAS.

.8 A fire alarm contact sends an alarm signal to the BAS when smoke is detected. When this occurs, all components of the systems are deactivated.

.2 MUA-1

.1 The make-up air unit operates according to an occupancy schedule. The MUA-1 unit is allowed to operate only if the AHU-1 is in operation. When the fan SF-1 is started, its status is monitored and an alarm signal is sent to the BAS if a fault is detected.

.2 The outside air damper opens when system is energized.

.3 The electric heating coil is controlled in order to maintain the temperature of the air entering the AHU-1. The electric heating coil's status is sent to the BAS and an alarm is generated if failure is detected.

.4 The supply air temperature sensor acts as a low limit and a high limit, sending an alarm signal to the BAS.

.5 A fire alarm contact sends an alarm signal to the BAS when smoke is detected. When this occurs, all components of the systems are deactivated.

.12 Condenser and chilled water system. For schematic and point lists refer to M33, M42 and M43.

.1 Chiller

.1 During normal course a chiller control valve shall be open and the chiller shall be started along with associated pumps and cooling tower.

.2 When the operating chiller cannot meet demand either due to pump capacity or the maximum allowable evaporator flow rate or the chiller cannot meet the chilled water set point the second chiller shall start.

.3 The supply water temperature is monitored. When the temperature exceeds the set point by 1.0°C for 30 minutes the second chiller starts.

1.2 SEQUENCING  
(Cont'd)

## .12 (Cont'd)

## .1 (Cont'd)

.4 The chiller plant controller shall ensure that:

.1 the rate of change of chilled water flow is kept within the chiller limitation;

.2 the flow through a chiller is above its minimum acceptable limit;

.3 the running chiller is unloaded if necessary and the valve of the second chiller is opened slowly to avoid sudden flow change.

.5 The BTU meter shall determine the flow across the chiller.

.6 Maintain the chiller flow limits between the minimum and maximum limits recommended by the chiller manufacturer.

.7 Where possible two chillers shall be simultaneously operated at lower speed if overall energy consumed is less.

.8 The refrigeration monitoring and venting system shall be intergrated into the BAS system.

## .2 Condenser Water System

.1 The cooling tower is enabled whenever a chiller is operational. The cooling tower fans shall be modulated to maintain a minimum tower water discharge set point based on the minimum condenser water entering temperature.

.2 Whenever demand is low one of the cooling towers shall be shut down and isolating valve shall close. System shall operate on one tower only until demand increases sufficiently so that a single tower cannot adequately handle the load.

.3 If tower is ramped down and water discharge temperature is still low, the bypass between condenser supply and return shall be modulated to maintain water temperature downstream of bypass.

.4 One condenser water pump shall operate when one chiller is in operation; two pumps shall operate when both chillers are in operation. Pumps shall have a rotating starting sequence to equalize run times. Pump speed shall be modulated to maintain a proper temperature differential between the chiller condenser water inlet and outlet. A minimum pressure differential shall be maintained to ensure minimum flow. Pumps shall be allowed to modulate below this pressure set point.

1.2 SEQUENCING  
(Cont'd).12 (Cont'd).3 Chilled Water System

.1 Chiller shall modulate to satisfy cooling demand. The BAS communicates with the chiller using BACnet. In addition there are hardwired control points for chiller start/stop, chiller reset, and chiller alarm if communication fails.

.2 On low demand, one chiller shall be shut down and isolation valves closed. One chiller shall run alone until load cannot be adequately handled by a single chiller. Chillers will have a rotating sequence to equalize run times. A single chiller shall not run for a consecutive period longer than 200 hours, after 200 hours lead chiller switches.

.3 One chilled water pump shall operate when one chiller is in operation; two pumps shall operate when both chillers are in operation. Pumps shall have a rotating starting sequence to equalize run times. Pump speed shall be modulated to maintain optimum energy usage at the terminal locations.

.13 Secondary water system. For schematic and point list refer to M34 and M44.

.1 Summer:

.1 At minus 6.7°C a manual switchover command shall be issued.

.2 A heat exchanger steam valve shall close.

.3 The secondary water will circulate until the return water from induction units drops to 33.0°C.

.4 The bypass valve shall modulate to the chilled water and the chilled water to the induction units shall be maintained at 12.2°C.

.5 Pumps to run on time schedule.

.2 Winter:

.1 At 7.0°C a manual switchover command shall be issued.

.2 The bypass valve shall be opened to the heat exchanger circuit.

.3 The heating water to the induction units shall be varied by modulating the steam valve on the heat exchanger in accordance with outside air temperature as follows:

.1 at outdoor temperature at 4.4°C the secondary water temperature shall be maintained at 51.7°C;

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1.2 SEQUENCING  
(Cont'd)

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## .13 (Cont'd)

## .2 Winter:(Cont'd)

.2 at outdoor temperature of minus 28.9°C the secondary water temperature shall be maintained at 71.1°C.

## .4 Pumps to run lead-lag.

## .14 Ground floor perimeter heating. For schematic and point list refer to M35 and M44.

.1 Pumps P-1, P-2, and P-3 manually started through BAS.

.2 Maintain heat exchanger supply temperature at 82.2°C by modulating the steam valve.

.3 3-way valve shall maintain the radiation temperature as follows:

.1 at outside air temperature of minus 34.4°C the radiation water temperature shall be maintained at 82.2°C;

.2 at outside air temperature of 7.2°C the radiation water temperature shall be maintained at 37.8°C.

.4 Pressure Sensors to modulate control valve to maintain pressure setpoint.

## .15 High rise elevator shaft pressurization. For schematic and point list refer to M36 and M45

.1 Supply fans SF-1 & SF-2 and exhaust fan EF-1 shall be monitored by BAS.

.2 A reverse action room thermostat shall open outside air and exhaust air dampers and start exhaust fan EF-1 when temperature rises to 26°C and close dampers and stop fan when temperature drop below this set point.

.3 A fusible link in the air line and smoke detection system shall also open outside air and exhaust air dampers and start exhaust fan EF-1 in the event of high temperature or smoke detection conditions.

.4 Electro-pneumatic valves which are wired to the building fire alarm system shall open the outside air dampers and start pressurization fans SF-1 and SF-2 in the event of fire.

.5 On power failure, all dampers shall open.

## .16 Low rise elevator shaft pressurization and ventilation. For schematic and point list refer to M37 and M46.

.1 Supply fan and exhaust fan shall be monitored by BAS.

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1.2 SEQUENCING  
(Cont'd)

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- .16 (Cont'd)
- .2 In the event of fire or on duct smoke detection, pressurization system interlocked to the building fire alarm system shall start the supply fan SF-1 and open outside air damper A and close mixing damper B and penthouse intake damper C. The dampers E & F shall close and smoke evacuation return air shaft damper G shall open and exhaust damper D shall close and return air fan RF-1 shall be stopped.
- .3 On normal operation during day time, the supply air fan SF-1 and return air fan RF-1 shall be run by hard wire interlock, return air thermostat shall modulate penthouse intake, exhaust air, outside air, and mixing dampers to maintain 24°C. Outdoor air temperature controller shall select outside air damper or penthouse intake damper based on 25°C switchover temperature.
- .4 During night operation BAS shall stop supply air and return air fans SF-1 & RF-1 and smoke evacuation damper G shall remain closed. On fire alarm or smoke detection, the system shall be overridden and follow the sequence as described in paragraph 2.
- .17 Domestic Water Heater
- .1 Steam valve to modulate as required to maintain temperature setpoint within hot water tank.
- .18 Sanitary sump pumps
- .1 Every sanitary sump pump in the building shall be connected to BAS for the purpose of status monitoring.
- .19 Storm water sump pumps
- .1 Every storm water sump pump in the building shall be connected to BAS for the purpose of status monitoring.
- .20 Power Failure
- .1 Upon power failure all equipment will turn off.
- .2 Upon return of normal power signal, all equipment to follow morning start-up procedure. Equipment is not to revert back to previous operational status prior to power failure.
- .21 Fire Alarm
- .1 Upon fire alarm signal, all non-essential equipment shall turn off.
-

- 1.2 SEQUENCING      .21 (Cont'd)  
(Cont'd)
- .2 Equipment associated with Fire alarm  
(Stairwell pressurization fans SF-9 and SF-10)  
and Elevator pressurization fans (SF-1, SF-2,  
SF-3 and interlocked exhaust fans) to turn on.
- .3 When fire alarm signal is reset, all  
equipment to follow morning start-up  
procedure. Equipment is not to revert back to  
previous operational status prior to power  
failure.

PART 2 - PRODUCTS

- 2.1 NOT USED      .1 Not Used.

PART 3 - EXECUTION

- 3.1 NOT USED      .1 Not Used.



PART 1 - GENERAL

- |   |    |   |
|---|----|---|
| <u>1.1 General</u>                      | .1 | This Section covers items common to Sections of Division 26. This section supplements requirements of Division 1.   |
| <u>1.2 Codes and Standards</u>          | .1 | Do complete installation in accordance with CSA C22.1-09 except where specified otherwise.  |
|   | .2 | Abbreviations for electrical terms: to CSA Z85-1983.  |
|   | .3 | Comply with CSA Certification Standards and Electrical Bulletins in force at time of Tender submission.   |
|   | .4 | Where requirements of this specification exceed those of the above mentioned standards, this specification shall govern.  |
| <u>1.3 Care, Operation and Start-up</u> | .1 | Instruct Departmental Representative and operating personnel in the operation, care and maintenance of equipment.   |
|   | .2 | Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, and adjust.   |
|   | .3 | Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.   |
| <u>1.4 Voltage Ratings</u>              | .1 | Operating voltages: to CAN3-C235-83.  |
|   | .2 | Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment. |
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|--|----|--|
| <u>1.5 Permits, Fees and Inspection</u>            | .1 | Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.                                  |
|  | .2 | Pay associated fees.   |
|  | .3 | Departmental Representative will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost.   |
|  | .4 | Notify Departmental Representative of changes required by Electrical Inspection Department prior to making changes.  |
|  |    |  |
| <u>1.6 Materials and Equipment</u>                 | .1 | Provide materials and equipment in accordance with Section 01 00 10 - Material and Equipment.  |
|  | .2 | Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.                  |
|  | .3 | Factory assemble control panels and component assemblies.  |
|  |    |  |
| <u>1.7 Electric Motors, Equipment and Controls</u> | .1 | Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 23 and shown on mechanical drawings. |
|  | .2 | Coordinate the electrical work as required with the Division 23 for Supply installation and implementation of a new Building Automation system.  |
|  |    |  |
| <u>1.8 Finishes</u>                                | .1 | Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.  |
|  | .2 | Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.  |
-

- 1.8 Finishes  
(Cont'd)
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.
- 1.9 Equipment Identification
- .1 Identify electrical equipment with nameplates and labels as follows:
- .2 Nameplates:
- .1 Lamicoid 3 mm thick plastic engraving sheet, black face, white core, mechanically attached with self tapping screws.

#### NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .3 Labels:
- .1 Embossed plastic labels with 6 mm high letters unless specified otherwise.
- .4 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .5 Allow for average of twenty-five (25) letters per nameplate and label.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Transformers indicate capacity, primary and secondary voltages.

1.10 Wiring  
Identification

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1-09.
- .4 Use colour coded wires in communication cables, matched throughout system.

1.11 Conduit and  
Cable  
Identification

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	<u>Prime</u>	<u>Auxiliary</u>
up to 250 V	yellow	
up to 600 V	yellow	green
up to 500 V	yellow	blue
Telephone	green	
Other communication systems	green	blue
Fire alarm	red	
Emergency voice	red	blue
Other security systems	red	yellow

1.12 Wiring  
Terminations

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

1.13 Manufacturers  
and CSA Labels

- .1 Visible and legible after equipment is installed.

- 1.14 Warning Signs .1 As specified and to meet requirements of Electrical Inspection Department and Departmental Representative.
- 1.15 Conduit and Cable Installation .1 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .2 Holes for conduits passing through exterior wall and roof shall be properly flashed and made watertight.
- 1.16 Scope of Work .1 Provide a complete system for the following as shown on drawings and as described in these specifications:
- .1 Provide electrical power and control wiring to mechanical Building Automation System (BAS) as required for complete installation.
- 1.17 As Built Record .1 Departmental representative will provide two (2)sets of drawings at the start of construction to allow the contractor to keep and maintain accurate as built drawings. Co-ordinate requirements with Section 01 78 00.
- .2 One set shall be keep on site to record the information reflecting changes and installation on a daily basis during construction. At the end of the project all information from the construction set shall be transferred onto the clean set and sent to the departmental representative for the final review.

PART 2 - PRODUCTS Not used.

PART 3 - EXECUTION Not used.

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PART 1 - GENERAL

- 1.1 References .1 CSA C22.2-No.65-2003(R2008) Wire Connectors.

PART 2 - PRODUCTS

- 2.1 Materials .1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for flexible conduit as required.

PART 3 - EXECUTION

- 3.1 Installation .1 Remove insulation carefully from ends of conductors and:
- .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2-No.65-2003(R2008)
- .2 Install fixture type connectors and tighten. Replace insulating cap.
- .3 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
- .4 Install box connectors to CSA E222.2 No. 18.

PART 1 - GENERAL

1.1 References .1 CSA C22.2-No.0.3-2009, Test Methods for  
Electrical Wires and Cables.

1.2 Product Data .1 Submit product data in accordance with  
Section 01 33 00: Submittal Procedures.

PART 2 - PRODUCTS

2.1 Building Wires .1 Conductors: stranded for 10 AWG and larger.  
Minimum size: 12 AWG.  
.2 Phase neutral and ground conductors: Copper  
size as indicated, with 1000 V insulation of  
chemically cross-linked thermosetting  
polyethylene material rated RW90.

2.2 Control Wiring .1 600 V type: copper stranded annealed copper  
conductors, sizes as indicated with  
polyethylene insulation RW90 (x-link).

PART 3 -EXECUTION

3.1 Installation .1 Install wiring as follows:  
of Building Wires .1 In conduit systems in accordance with  
Section 26 05 34.

3.2 Installation .1 Install control wiring in conduit.  
of Control Wiring



PART 1 - GENERAL

- 1.1 References .1 ANSI/IEEE 837-2002, Qualifying Permanent Connections Used in Substation Grounding.

PART 2 - PRODUCTS

- 2.1 Equipment .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.
- .3 Rod electrodes: galvanized steel 19 mm dia by 3 m long.
- .4 Plate electrodes: copper, surface area 0.2 m<sup>2</sup>, 1.6 mm thick.
- .5 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .6 Insulated grounding conductors: green, type XLPE.
- .7 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .8 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
- .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.

PART 3 - EXECUTION3.1 Installation  
General

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837-2002.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install separate ground conductor to outdoor lighting standards.
- .9 Make grounding connections in radial configuration only, with connections terminating at street side of water pipe. Avoid loop connections.

3.2 Equipment  
Grounding

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, frames of motors, starters, control panels, elevators and escalators, distribution panels, outdoor lighting.

3.3 Communication  
Systems

- .1 Install grounding connections for voice/image/data, fire alarm, intercommunication systems as follows:
  - .1 BAS and Voice/image/data systems: make grounding system in accordance with the IT & Telecommunication standards and requirements.
  - .2 Fire alarm, intercommunication systems as indicated.

3.4 Field Quality  
Control

- .1 Perform tests in accordance with Section 26 05 00- Electrical General Requirements.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

PART 1 - GENERAL

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|-------------------------|----|--|
| <u>1.1 Related Work</u> | .1 | Fastenings and supports:Section 01 01 00   |
| <u>1.2 General</u>      | .1 | Fastenings and supports: No electrical equipment to be fastened directly to drywall only drywall supports. |

PART 2 - PRODUCT

- |                             |    |   |
|-----------------------------|----|---|
| <u>2.1 Support Channels</u> | .1 | U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted suspended and ceilings. |
| <u>2.2 Manufacturer</u>     | .1 | Acceptable manufacturers: Cantruss, Electrovert or equivalent.                  |

PART 3 - EXECUTION

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|-------------------------|----|--|
| <u>3.1 Installation</u> | .1 | Secure equipment to masonry, tile and plaster surfaces with lead anchors.  |
|                         | .2 | Secure equipment to poured concrete with expandable inserts.   |
|                         | .3 | Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation. |
|                         | .4 | Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.  |
-

3.1 Installation  
(Cont'd)

- .5 Fasten exposed conduit or cables to building construction or support system using straps.
    - .1 One-hole malleable iron straps to secure surface conduits and cables 50 mm and smaller.
    - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
    - .3 Beam clamps to secure conduit to exposed steel work.
  - .6 Suspended support systems.
    - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
    - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
  - .7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
  - .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
  - .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
  - .10 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
  - .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
  - .12 Electrical panels, switches or other electrical equipment shall be complete with suitable bases or mounting brackets. Install angle or channel iron supports to bear the equipment where it is shown in or on structural tile walls, or walls that are inadequate to bear the equipment.
  - .13 Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members required between beams for supporting conduits.
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PART 1 - GENERAL

<u>1.1 Shop Drawings and Product Data</u>	.1	Submit shop drawings and product data for cabinets in accordance with Section 01 33 00 - Submittal Procedures.
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<u>1.2 Reference</u>	.1	CAN/CSA C22.2 NO. 76-M92 (R2007) Splitters.
	.2	CSA C22.2 NO. 40-M1989 (R2004) Cutout, Junction and Pull Boxes.

PART 2 - PRODUCTS

<u>2.1 Junction and Pull Boxes</u>	.1	Welded steel construction with screw-on flat covers for surface mounting.
	.2	Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

<u>2.2 Cabinets</u>	.1	Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.
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<u>2.3 Splitters</u>	.1	Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
	.2	Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
	.3	At least three spare terminals on each set of lugs in splitters less than 400 A.

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PART 3 - EXECUTION

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|---|--------|---|
| <u>3.1 Junction, Pull Boxes and Cabinets Installation</u> | .1     | Install pull boxes in inconspicuous but accessible locations.   |
|   | .2     | Install terminal block as indicated in Type T cabinets.   |
|   | .3     | Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes. |
| <br><u>3.2 Splitter Installation</u>                      | <br>.1 | <br>Install splitters as indicated and mount plumb, true and square to the building lines.                                      |
|   | .2     | Extend splitters full length of equipment arrangement except where indicated otherwise.   |
| <br><u>3.3 Identification</u>                             | <br>.1 | <br>Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.                    |
|   | .2     | Install size 2 identification labels indicating system name, voltage and phase.   |



PART 1 - GENERAL

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|-----------------------|----|---|
| <u>1.1 References</u> | .1 | CSA C22.1-09 Canadian Electrical Code, Part 1.                              |
|                       | .2 | CAN/CSA C22.2 NO. 18.1-04 (R2009) Outlet boxes, Conduit boxes and Fittings. |

PART 2 - PRODUCTS

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|---|----|---|
| <u>2.1 Outlet and<br/>Conduit Boxes<br/>General</u> | .1 | Size boxes in accordance with CSA C22.1-09.   |
|   | .2 | 102 mm square or larger outlet boxes as required for special devices.               |
|   | .3 | Gang boxes where wiring devices are grouped.  |
|   | .4 | Blank cover plates for boxes without wiring devices.                                |
|   | .5 | Combination boxes with barriers where outlets for more than one system are grouped. |
|   | .6 | 347 V outlet boxes for 347 V switching devices.                                     |

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|---|----|---|
| <u>2.2 Sheet Steel<br/>Outlet Boxes</u> | .1 | Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required. |
|   | .2 | 102 mm square or octagonal outlet boxes for lighting fixture outlets.   |
|   | .3 | 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.   |

- |                          |    |  |
|--------------------------|----|--|
| <u>2.3 Masonry Boxes</u> | .1 | Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls. |
|--------------------------|----|--|
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|----------------------------------|----|---|
| <u>2.4 Concrete Boxes</u>        | .1 | Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required. |
| <br>                             |    |   |
| <u>2.5 Conduit Boxes</u>         | .1 | Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.                             |
| <br>                             |    |   |
| <u>2.6 Fittings-<br/>General</u> | .1 | Bushing and connectors with nylon insulated throats.  |
|                                  | .2 | Knock-out fillers to prevent entry of debris.   |
|                                  | .3 | Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.   |
|                                  | .4 | Double locknuts and insulated bushings on sheet metal boxes.  |

### PART 3 - EXECUTION

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|-------------------------|----|---|
| <u>3.1 Installation</u> | .1 | Support boxes independently of connecting conduits.   |
|                         | .2 | Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work. |
|                         | .3 | For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.            |
|                         | .4 | Provide correct size of openings in boxes for conduit. Reducing washers are not allowed.  |
|                         | .5 | Provide a suitable outlet box for each light switch, receptacle or other outlet, approved for the particular area in which it is to be installed.   |
|                         | .6 | Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.                  |
-

3.1 Installation  
(Cont'd)

- .7 Offset outlet boxes, shown back to back in partitions, horizontally to minimize noise transmission between adjacent rooms.
- .8 Use gang boxes at locations where more than one device is to be mounted. Use combination boxes with suitable barriers where outlets for more than one system are shown.

PART 1 - GENERAL

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|--------------------------------|--|
| <u>1.1 Location of Conduit</u> | .1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only. |
|--------------------------------|--|

PART 2 - PRODUCTS

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|---|---|
| <u>2.1 Conduits</u>                             | .1 Rigid galvanized steel threaded conduit.   |
|   | .2 Electrical metallic tubing (EMT): with couplings.  |
|   | .3 Flexible steel conduit and liquid-tight flexible metal conduit.  |
| <u>2.2 Conduit Fastenings</u>                   | .1 One hole malleable iron straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm. |
|   | .2 Beam clamps to secure conduits to exposed steel work.  |
|   | .3 Channel type supports for two or more conduits at 2 m oc.  |
|   | .4 Six mm dia threaded rods to support suspended channels.  |
| <u>2.3 Conduit Fittings</u>                     | .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.   |
|   | .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.   |
|   | .3 Raintight connectors and couplings for EMT. Set-screws are not acceptable.   |
| <u>2.4 Expansion Fittings for Rigid Conduit</u> | .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.                               |
|   | .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.   |
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2.4    Expansion Fittings for Rigid Conduit (Cont'd)	.3	Weatherproof expansion fittings for linear expansion at entry to panel.
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2.5    Fish Cord	.1	Polypropylene.
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PART 3 - EXECUTION

3.1    Installation	.1	Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
	.2	Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
	.3	Use electrical metallic tubing (EMT) for runs exposed, concealed in walls or suspended ceiling.
	.4	Use flexible metal conduit for connection to recessed incandescent fixtures without a prewired outlet box and connection to recessed fluorescent fixtures.
	.5	Use liquid tight flexible metal conduit for connection to motors or vibrating equipment.
	.6	Minimum conduit size for lighting and power circuits: 19 mm.
	.7	Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
	.8	Mechanically bend steel conduit over 19 mm dia.
	.9	Install fish cord in empty conduits.
	.10	Run 2- 25 mm spare conduits up to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space.

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3.1 Installation (Cont'd) .11 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.

.12 Dry conduits out before installing wire.

3.2 Surface Conduits .1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 Concealed Conduits .1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

PART 1 - GENERAL1.1 GENERAL  
REQUIREMENTS

- .1 Portable UPS units.
  - .1 This contractor shall furnish UPS units sustaining the Building Automation System(BAS) for 24/7/365.

PART 2 - PRODUCTS2.1 PERFORMANCE

- .1 Normal operation:
  - .1 System operates on mains power when mains voltage is within +/-10 % of nominal value and mains frequency is between 59.5 and 60.5 Hz.
  - .2 System performance and reliability:
    - .1 Consider any deviation from the required output power waveform as failure in UPS.

2.2 UNINTERRUPTIBLE  
POWER SYSTEM

- .1 Input power:
    - .1 Single phase, 120 V, 2 wire, grounded neutral, 60 Hz. Range to be 80-144Vac
    - .2 Frequency range to be 45-65 Hz.
    - .3 Emergency supply from standby automatic diesel-electric unit.
    - .4 Double-conversion online design constantly conditions and controls AC output to assure a zero delay transferring power in the event of a utility power failure.
    - .5 Unit to be tower.
  - .2 Output power:
    - .1 Single phase, 120 V, 2 wire, grounded neutral, 60 Hz.
    - .2 Full load output at 0.8 power factor lagging 3 kVA.
  - .3 Topology
    - .1 True online, double-conversion.
    - .2 UPS Bypass: Automatic on overload or UPS failure
    - .3 To be CSA approved.
    - .4 Surge Suppression: IEEE/ANSI C62.41 CategoryB
    - .5 Ambient operating temperature: 0 to 40°C, Relative humidity: 0 to 90% non-condensing
-

2.2 UNINTERRUPTIBLE .3 (Cont'd)  
POWER SYSTEM .5 Ambient operating temperature:(Cont'd)  
(Cont'd)

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PART 3 - EXECUTION

- 3.1 INSTALLATION .1 Locate UPS units for powering server, LAN equipment, essential control componets as required to sustain the BAS operation for 24/7/365.
- .2 Connect AC mains to main input terminal.
- .3 Connect UPS output to load.
- .4 Start-up UPS and make preliminary tests to ensure satisfactory performance.
- 3.2 PROTECTION .1 Protect installed products and components from damage during construction.